J. B. Tyrrell
Office Copy

GEOLOGICAL SURVEY

OF

CANADA.

REPORT OF PROGRESS

FOR THE YEAR 1857.

Printed by Order of the Legislative Assembly.

TORONTO:
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1858.

GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 31*st March*, 1858.

SIR,

I have the honor to request that you will do me the favor to present to His Excellency the Governor General the accompanying Report of the progress made in the Geological Survey of the Province during the year 1857.

I have the honor to be,

Sir,

Your most obedient servant,

W. E. LOGAN.

To the Hon. T. J. J. Loranger,

Provincial Secretary,

Toronto.

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For 1857.

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TO HIS EXCELLENCY

SIR EDMUND WALKER HEAD, BART

ONE OF HER MAJESTY'S MOST HONORABLE PRIVY COUNCIL,

Governor-General of British North America,

AND

CAPTAIN-GENERAL AND GOVERNOR-IN-CHIEF

IN AND OVER

THE PROVINCES OF CANADA, NOVA SCOTIA, NEW BRUNSWICK, AND THE ISLAND OF PRINCE EDWARD,

AND VICE-ADMIRAL OF THE SAME.

MONTREAL, 31*st* *March*, 1858.

MAY IT PLEASE YOUR EXCELLENCY:

I have the honor to present to Your Excellency a statement of the progress made in the Geological Survey of the Province during the past year; and in doing so, to place before you the Reports of those gentlemen who have aided me in the investigation committed to my charge. The Reports are those of Mr. Murray, Mr. Richardson, Mr. Bell, Mr. Billings, Professor James Hall of Albany, Mr. Hunt, and Lieut. E. D. Ashe of Quebec.

The labors of Mr. Murray comprised in the first place a topographical measurement and geological examination of the coast and the immediately adjacent islands at the mouths of the French River, the object of the work being to complete his surveys of the various branches of that river by shewing their relation to that part of Georgian Bay into which they fall. When the delineation of this portion of Mr. Murray's work was received in Montreal the plans of his various previous surveys of the river were in the hands of the lithographer to be engraved, as part of the Report last presented to the Legislature, and ordered to be printed under my direction. With the view of obviating the expense of an additional map to accompany the present Report, the delineation was introduced in its appropriate place on the plans then in progress, and it appears as part of the Report for 1856, while the geographical and geological descriptions constitute a portion of what is now submitted to Your Excellency.

Another duty assigned to Mr. Murray was the investigation of the physical structure of the copper-bearing rocks of Lake Huron. The economical importance of these rocks authorises a more detailed examination than there has yet been any opportunity of devoting to them. The discovery of the copper-lodes by which they are characterised is of course, the main object to be held in view; but to search for these by mere empirical examination, without any fixed rule, would be an endless work. The metalliferous lodes of any formation are found for the most part in cracks or dislocations which have disturbed the formation, and which have given an opportunity for the secretion of the ore. One set of positions in which such disturbances may be expected is the axes of anticlinal and synclinal folds; whence it becomes of importance to know where these folds exist. The best way of determining this is to ascertain the geographical distribution of the constituent parts of the formation, and the figure they exhibit when represented on a map. But in a stratified formation like the Huronian, the beds having a general conformity one to another, if the distribution of one bed be ascertained it will give an extensive knowledge of that of the remainder; it therefore becomes of great use to select one well-marked band of the formation and to follow it out. In about the middle of the Huronian series there is a conspicuous band of limestone from 150 to 250 feet thick, which is so completely contrasted with the rest of the formation in aspect and mineral character that it was considered the best to select for examination, as a test of physical structure, and Mr. Murray was instructed to trace it out.

The position selected by Mr. Murray from which to commence his examination was Echo Lake. The original map which accompanied this part of Mr. Murray's work is protracted by Mr. Johnson on the scale of one mile to one inch. But for the purposes of this Report it has been reduced to a smaller scale, and there has been added to it the position previously ascertained of the same band of limestone on the Thessalon River and on the coast immediately west of the Bruce mine, as well as its position on the Bruce mine location, in which last place it was pointed out to Mr. Murray by Mr. Borron, the superintendant of the mine. The relation of the different parts of the band, so far, will thus be understood in a general way, though it will still be necessary to ascertain the details of the intermediate parts, in order properly to connect the work around Echo Lake with that on the Thessalon River.

The want of conformity heretofore pointed out, between the Upper and Lower Silurian rocks of the Gaspé peninsula, prevents the out-crop of the one group from being any guide to the distribution of the other. At the same time both series of rocks are very much corrugated. From the neighborhood of the Chaudière to the Rivers Chatte and St. Ann, the axes of the folds appear to run nearly north-east, but they then change to east, and subsequently to south-east; and an irregularity occurs in the out-crop of the superior rocks, which, in attempting to construct a geological map of the peninsula, it was found impossible to represent with any approach to truth without a special examination of the interior between the St. Ann River and Gaspé Bay. Mr. Richardson was in consequence instructed to ascend the River Magdalen, and on reaching the out-crop of the Upper Silurian series, to follow it out to the right and the left. He has done so to the eastward, so as to join his work with what was done in Gaspé Bay by myself in 1843. But the season was so far spent by the time he returned to the Magdalen, that it would have been hazardous to attempt to join his work with that of Mr. Murray and myself to the westward. For this another opportunity must be chosen.

Mr. Richardson subsequently ascended the Saguenay for the purpose of making a *reconnaisance* of Lake St. John, preliminary to whatever future examination might be prosecuted in that neighborhood; and I have to draw Your Excellency's attention to the very favorable report he furnishes of the climate and agricultural capabilities of the valley of that lake, and the apparently great extent of land there capable of prosperous settlement.

Mr. Richardson's Report is accompanied with a plan of the Magdalen River on the scale of one mile to one inch, that which has usually been adopted for all our measured surveys, as well as one on a smaller scale, shewing the distribution of the rocks traced out in the Gaspé district, and another giving that of the Lower Silurian strata met with on Lake St. John. The plans are the work of Mr. Scott Barlow, who accompanied Mr. Richardson on his explorations.

Mr. Richardson was accompanied also by Mr. R. Bell, who in addition to aiding in the general work of the exploration, was instructed to make a collection of the recent marine, fresh-water and land shells he might meet with, as well as such other objects of natural history as could be obtained and transported without interfering with the main objects of the investigation. Mr. Bell has furnished a Report enumerating the species and localities of his collection, which will be of utility in aiding us to a knowledge of the geographical distribution of such organic forms. In transmitting this to Your Excellency I have to express my obligations to Mr. Lea of Philadelphia, one of the highest authorities in this department of natural history, for the aid he has kindly given in naming the land and fresh-water species of the collection, three of which he regards as new.

In addition to his labors in the arrangements of the Museum, the attention of Mr. Billings has been devoted to various points connected with the distribution of the Lower Silurian limestones on the Bonne-chère, the Upper Silurian limestone of Galt, and the Devonian rocks of the western peninsula of Upper Canada. His Report on these, together with his descriptions of various new species of organic remains, is now transmitted to Your Excellency.

Several new species of the genus *Graptolithus*, with others of *Dictyonema*, discovered by Mr. Richardson in the vicinity of Quebec in 1854 and 1855, were then placed for examination and description in the hands of Professor James Hall of Albany, whose works on the palæontology of North American rocks are too well known to require mention. These organic remains he kindly undertook to have figured and engraved, as a contribution to the palæontology of Canada; and his Report on the progress made in the work, with his descriptions of the fossils, constitutes one of the documents connected with the present communication.

The Report of Mr. Hunt comprises researches on the nature and mode of formation of magnesian limestones, farther investigations of some traps, serpentines and mineral waters, and some observations upon the value of the artificial guano manufactured from the fish-offal and bituminous shales of the Lower St. Lawrence.

My own time has been largely employed in the arrangements of the Museum. The cases designed to hold the collection of the Survey were not completed until after my return in 1856 from the Paris Exhibition; and my intention was that my assistants, when they should have completed the study and comparison of the facts and materials of each summer's exploration, should devote their remaining time to the classification and distribution of the specimens of the collection, until this task should be accomplished. But the American Association for the Advancement of Science having accepted a joint invitation from the Mayor and Corporation and the Natural History Society of Montreal, to hold their annual meeting for 1857 in this city, it became in some degree imperative upon the officers of the Survey at once to place the Provincial collection illustrative of Canadian Geology in a condition to be fully appreciated by such men of science, devoted to this branch of investigation, as might be present at the meeting. To do this required the whole of Mr. Billings' time, and very nearly the whole of my own, until the meeting of the Association which took place on the 15th of August.

Among the eminent men of science present at the meeting of the Association, I was glad to welcome my distinguished friend Mr. A. Ramsay, deputed to represent for the occasion the Geological Society of London. Under Sir Roderick Murchison as chief, he directs the Geological Survey of Great Britain, and is at the same time one of the Professors of the Government School of Mines; and I felt persuaded that it would greatly conduce to the benefit of Canadian geology, and serve to extend the interest already existing in it in the United Kingdom, if Professor Ramsay could be induced to accompany me, after the business of the Association should be concluded, on a geological tour through a part of the Province. An arrangement to this end was made, and Professor Hall volunteering to be our guide through the classic geological ground of New York, which I had never previously visited, I deemed it advisable to take advantage of so favorable an opportunity for increasing my own experience, and for making me acquainted with some of the Devonian rocks of that State which appear to be wanting in the Canadian series.

The requirements of the meeting of the American Association, and the few weeks spent in the tour to which I have alluded, brought round the month of October before I could enter upon any personal explorations. These were devoted to a farther investigation of the crystalline limestones of the Laurentian series of rocks, in which something has been added to our knowledge of their geographical distribution; but as no facts have been ascertained to illustrate their sequence beyond what were presented in the Report of 1856, and as a continued prosecution of the investigation is intended during the ensuing season, it appears to me desirable to reserve a farther description until I am furnished with a larger number of new facts.

While the arrangements effected in the Museum have so much trenched upon the time usually devoted to field work, they have placed the Survey in a position to more readily compare and understand the value of the materials from time to time collected, to decide at once upon what may be considered duplicates, and to commence a distribution of them among the educational institutions of the country. This was one of the objects originally contemplated in the institution of the Survey, and a first instalment of specimens has been sent to University College, Toronto, and Laval University, Quebec.

In the last Report it was stated that in carrying into effect that portion of the duties assigned to me which regarded the determination of the longitudes and latitudes of important places in the Province, I had had recourse to the use of the telegraphic wire for the longitudes, and had availed myself of the services of Lieut. E. D. Ashe of the Quebec Observatory. I have now the honor of transmitting to Your Excellency Lieut. Ashe's Report, with an abstract of the work done up to the present time. By this it will be observed that the longitudes determined are those of Quebec, Montreal, Ottawa, Kingston, Toronto, Collingwood, Windsor and Chicago. Quebec was made the point of departure in Canada, and the longitude of Quebec has through the kind assistance of Professor Bond, been compared with that of Cambridge Observatory near Boston, which is considered the position on the continent of America whose relation has been most accurately determined with Greenwich.

The determination of these various positions has enabled me to give a general truth to the topographical map of Canada, on which I am to delineate its geology. This map is now nearly completed, and would long ere this have been in the hands of the engraver, had not about half the time of the draughtsman who is compiling it been unavoidably occupied in preparing the tracings for the lithographer, and correcting the proofs of the twenty-two sheets of plans which have just been printed for the Legislature in connection with the last Report of Progress.

I have the honor to be

Your Excellency's most obedient servant,

W. E. LOGAN.

REPORT,

FOR THE YEAR 1857,

OF

ALEX. MURRAY, Esq., ASSISTANT PROVINCIAL GEOLOGIST

ADDRESSED TO

SIR WILLIAM E. LOGAN, F.R.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 1857.

SIR,

In the spring of the present year you were pleased to direct me to make a topographical measurement of the coast of Georgian Bay, where the several mouths of the French River discharge themselves, in order to connect the surveys previously made of the various branches of that river.

For this purpose, after having provided myself with two canoes, an assistant, and a party of Indians at She-bah-ah-nah-ning, I repaired to Pointe des Grondines, where our labors commenced about the middle of June. Being favored with very fine weather for carrying on our operations, little time was lost in accomplishing the work, and I had the honor of forwarding to you in July a plan of the same, with all particulars recorded on it. This work, I have understood from you, was received in time to be incorporated in the map of my previous explorations then in course of being lithographed, on the face of which it has already been published.

In accordance with your farther instructions, I then proceeded with my party to Bruce Mines, and subsequently to Echo Lake, near the western extremity of Lake Huron, where you suggested I should commence to work out the physical structure of the copper-bearing or Huronian rocks of the region, by following up the remarkable band of limestone which is there well developed about the middle of the formation. In connection with this work a survey was made of Echo Lake and River, the north part of Great Lake George, the connecting stream of St. Mary between Great and Little Lakes George, Little Lake George and a part of Garden River. From various points of this survey cross-bearings were constantly taken upon all the most conspicuous features in the interior. By these we were enabled to fix the position of such points with tolerable accuracy, and they afterwards rendered us good service as checks upon the perambulated measurements made during our inland excursions.

Through the aid of my assistant, Mr. John Johnston, who acted chiefly as draughtsman on the occasion, a plan of this portion of our work was completed on the usual scale of one inch to one mile. It represents all the main topographical features of the country examined, with its geology where it could be satisfactorily ascertained, and is accompanied by a vertical section. These have already been placed in your hands, and I would beg to call your attention to the very creditable manner in which Mr. Johnston's work is executed.

Finally, I made a short excursion from Bruce Mines for the purpose of ascertaining with accuracy the position of the out-crop of a band of limestone reported to me by Mr. Borron, the superintendant of the mine there, as having been observed a short distance from the works and within the location, and no doubt identical with that mentioned above. The connection of this work with the previous, cannot with certainty be shewn until some further intermediate examinations have been made, which I hope to accomplish in the course of the ensuing season's operations.

COAST AT THE MOUTHS OF THE FRENCH RIVER.

Geographical Characteristics.

The waters of the French River are discharged into Georgian Bay through several channels between Pointe des Grondines on the west and the inlet called by Bayfield the Key, which is situated at the north-east angle of Lake Huron. The distance between these two positions is a little under eighteen miles, and they are nearly due east and west of one another. The outlets of the river may be divided into three sets, the western, the middle and the eastern. Each set is composed of several discharging branches, every one of which before reaching the surface of Lake Huron is precipitated over a fall or rapid. The country is by this complicated reticulation cut up for many miles between the main body of the river and Lake Huron, into a great group of islands.

The western outlets have two main channels, the old travelled channel and the Mauvaise Rivière. The old travelled channel enters Lake Huron by three branches of discharge, which are situated about six miles from Pointe des Grondines in a bearing a little north of east. The middle of these branches has for many years been the principal ingress and egress for the Hudson Bay Company's canoes to and from their posts on the Ottawa, Lake Nipissing, and other parts of the interior. It is the one most easily approached from without, as well as most easily navigated.

The Mauvaise Rivière is situated about seven and a-half miles from Pointe des Grondines, and it also empties into Lake Huron by three branches, all within a short distance of one another, and each having a fall of about four feet, before joining the still water of Georgian Bay.

The middle outlets or Large River channel fall into the bay through three openings. The most western is about three and a-half miles east from the Mauvaise Rivière; the other two, which are small and within a-quarter of a mile of each other, are about a mile and a-half farther east, or about thirteen miles from the Pointe des Grondines.

The eastern outlets consist of two openings which empty into a long narrow bay lying directly north of the Hudson Bay Company's old post at the mouth of the Key inlet.

All these channels and outlets flow through a barren and desolate waste. The greater part of it is either perfectly bare rock, or a surface made little better than such by a scanty covering at intervals of small stunted trees and bushes, chiefly belonging to varieties of the fir tribe. The country is for the most part low, but extremely rugged, offering bold and precipitous but not very lofty cliffs on the coast, while the surface is arranged in sharp and broken ridges of rock, parallel to one another, for the most part in a north-east bearing, and conforming to the bays and outlets.

Inumerable islands, islets, knobs and reefs of rock lie off this part of the coast, rendering an approach to it dangerous and difficult at all points, but most especially off the entrance to the middle outlets or Large River channel. Between this and the cluster of islands called the Bustards, situated from two to three miles to the southward, nothing can be safely navigated larger than a canoe or a boat of the smallest draught of water. The old travelled channel or eastern set of outlets is undoubtedly the most accessible part for any craft, but there are many reefs and sunken rocks between it and the Pointe des Grondines, over which the swell of the lake may be distinctly heard to break for many miles around.

As an agricultural country a large portion of the region immediately south of the chief part of the French River appears to be valueless, and the pine-timber, where it attains a size worthy of notice at all, is too much scattered, and besides usually too small to be of any commercial importance. The principal if not the only recommendation which the coast at present possesses is as a fishing station. In this respect it is equal to any other part of the lake. It is amply supplied with white-fish and trout, as well as bass, pike and pickerel, all of which are now taken in large quantities by the Indians and half-breed fishermen from Weh-que-mi-kong and She-bah-ah-nah-ning; and were the trade skilfully and systematically pursued by an establishment possessed of capital, it would not fail to be a source of considerable profit.

Distribution of the Rocks.

The rocks of this part of the coast and of the islands adjacent to it are all of the Laurentian age. They consist of red and grey hornblendic and micaceous gneiss, becoming frequently very schistose, of quartzite, and intrusive masses of syenite and greenstone, intersected by veins of white quartz and cut by dykes of granite. The general strike of the stratification varies from a few degrees east of north to about north-east, the inclination being usually south-eastward at high angles. The strata are arranged in a series of parallel ridges, which alternate with low narrow valleys or with numerous channels or indentations of the coast. They are usually more or less contorted, and undulations of considerable magnitude may occasionally be observed in some parts. An example of such an undulation exists between the middle and eastward outlets, and it suggests the probability that there are frequent repetitions of the same strata.

A great mass of syenite, of coarse grain for the most part, sometimes reddish, but chiefly grey in color, spreads over the country between the western and middle outlets. The gneiss at the Mauvaise Rivière dips towards the syenite as if passing beneath it, while that near the middle outlets, where seen in contact with the syenite, dips from it about S. E. $<80^{\circ}$.* The surface of the syenite is very low and flat, and almost destitute of vegetation ; that of the gneiss presents abrupt broken ridges, more or less covered with a small growth of ever-greens and deciduous bushes. At the entrance to the bay receiving the discharge of the middle outlets, the gneiss is intersected by dykes of greenstone, and both are cut by granite veins.

Portions of the gneiss are garnetiferous, especially among the hornblendic schists and quartzose bands. These portions were observed chiefly near the extremes of the part surveyed, that is, near Pointe des Grondines on the one hand, and in the

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* The bearings given in this Report are magnetic, the variation being about 4° 15′ W. at the mouths of the French River, and about 0° 30′ W. in the neighborhood of Echo Lake.

bays that intervene between the middle and eastern outlets on the other.

Quartz veins are of frequent occurrence throughout the whole region; many of them are of large size, but in no case were they observed to contain any mineral indications worthy of especial notice, nor have any rumours through the Indians or others reached me of the presence of metalliferous lodes nearer than Lake Nipissing.

The character of the rocks here is not usually very well adapted for building purposes, except of the most ordinary description. The hard beds are usually thin, and they alternate with crumbling schistose layers, which are frequently contorted or broken. From such strata it would scarcely be possible to procure any available materials, but when the harder beds are of tolerable thickness and the strata somewhat regular, they might be made available, especially when they happen, as they sometimes do, to be cut by parallel joints in directions at right angles to one another. This is the case in the south part of the bay receiving the discharge of the middle outlets.

Portions of the syenite would no doubt dress into handsome rectangular blocks, and make a durable and elegant material, but the working of it would be attended with considerable difficulty, for the rock is tough and hard to cut or blast, and it does not appear to possess any regular joints either horizontal or vertical, though it would probably split in any direction required by the application of plugs and feathers.

It is probable that should stone be wanted for facing any public work in this region the nearest and best supply will be found among the Niagara limestones of the Grand Manitoulin Island. From them too would be obtained the lime required for the purpose of mortar.

ECHO LAKE AND THE SURROUNDING COUNTRY.

Geographical Characteristics.

Echo Lake is beautifully situated among lofty hills and bold precipitous rocks, a little over three miles north-east from the head of Great Lake George, with which it is connected by a sluggish stream flowing for the greater part through marsh or low flat land. The length of the lake is about four miles from head to foot, in a line running north-east and south-west. Its breadth is contracted by two opposite points of limestone near the middle, to a distance of somewhat under a mile, while it opens above and below into expanding bays. The widest part of the upper expansion is about two miles, and that of the lower rather less than a mile and a-half.

The main stream, supplying the lake with water, comes in at the north-east angle of the upper expansion through a marsh. Above the marsh the stream becomes rapid, and its upward course bears nearly due east for about three miles. It then bends round to the south-eastward. The valley continues in this direction for several miles, but finally turns to the westward and north-westward, and opens into a prairie with a small lake which constitutes the head of the stream.

The two Lakes George and the connecting stream between them are bounded by Sugar Island on the one side and the Canadian mainland on the other. The distance from the mouth of Echo River at the head of Great Lake George, to Root River at the head of Little Lake George, is seven miles and a-half in a straight line bearing west-north-west. The banks on either side of the stream on this line are low and flat, and frequently marshy; but at a short distance back, on the north side, the surface becomes broken and mountainous, rising in abrupt rocky precipices or bold rugged hills, and affording frequent scenes of great and picturesque beauty.

On the south in Sugar Island the land rises gradually to a considerable elevation, and presents a gently undulating surface, contrasting strongly with the wild and rugged character of the mountainous region on the north.

At the foot of Little Lake George, Garden River falls in on the left bank. Its course near the outlet is exceedingly tortuous, but the valley has a general upward bearing of about N. N. E. as far as we ascended it, which in a straight line, did not exceed three miles. I was informed by the Indians that the stream was accessible for canoes for many miles farther up, but that it became very rapid and difficult to navigate above the highest part we reached.

To the east of Echo Lake, and northward of the limestone point on the east side, there is a tract of fine land, heavily timbered with maple, elm and birch, interspersed at intervals with groves of hemlock and a few pines, with cedars in the hollows and swamps. The surface of this part rises gradually to the south-eastward for upwards of two miles, and is beautifully watered by numerous little brooks falling into the lake. This tract extends northward to the valley of Echo River, and is bounded to the eastward by a small brook which falls into the river where its upward bearing turns to the south-east, which is about two miles and a-half from Echo Lake.

To the east of this tract, and to the south of it and of the lower expansion of Echo Lake, the country is rugged and broken. It is marked by a succession of precipitous hills and narrow valleys, which run nearly due east in the south part, but take a south-easterly course as they advance. Among these ranges the waters of a considerable area flow westerly into the lower part of Echo River or Lake George. One of the streams flowing into the former has a nearly due east upward bearing for about three miles, where it is the outlet of a beautiful lake about four miles long, in a south-easterly bearing, divided into two nearly equal parts about a mile wide each where broadest, connected by a gut not exceeding a couple of chains in breadth.

On the north-east side of the upper part of Echo River bold precipitous cliffs rise up to heights of 500 feet; as they approach the north shore of Echo Lake they strike westward and run inland beyond the lake in the same direction, in conformity with the parallel ridges on the south already mentioned.

Westward of Echo Lake, and between it and the valley of Garden River, the country is very much broken by rocky ridges, but there are intervals of beautiful hard-wood land in the hollows and lower parts between them. Through each of these valleys there usually flows a pretty brook of clear water, taking its rise from one or other of the picturesque little lakes which lie on each side of the water-shed. Between Garden River and Root River, at a distance of from one to two miles from the north shore of St. Mary River and Little Lake George, a similarly rugged description of country prevails, with intervals of hard-wood land, lying at a high elevation, and at such parts the principal trees being hard maple, it is much frequented by the Indians for the manufacture of sugar.

The plains that skirt the main river and the shores of the Lakes George on the north side are possessed of a light sandy soil yielding red pine of good size, with a profuse growth of wild fruit trees and bushes; but there is also a great extent of marsh-land, where wild grass or reeds constitute the chief part of the vegetation.

Character and Distribution of the Rocks.

Huronian Series.—The rock formations examined in the region around Echo Lake are altogether of the Huronian age, with the exception of the flat parts skirting the shores of Great and Little Lakes George and St. Mary River. These, with Sugar Island, although nowhere exhibiting a good exposure of the rock in place, very probably belong to the lower members of the unconformable Silurian strata. To follow out the structure of the altered and contorted Huronian series, a band of limestone belonging to it was selected as the best developed feature, and the one most readily recognisable from its peculiarities of mineral character, as well as its association with a remarkable conglomerate both above and below.

The two points at the narrow part of Echo Lake are composed of this limestone, and the band was followed with little interruption to the westward, from the point on the west side of the lake, until it was found to sink below the plain in the valley of Root River. At the point on the west side of Echo Lake the dip is southerly, and freed from minor contortions it shews an average inclination of about twenty-five degrees; but the strike almost immediately inland turns off about north-west, and the limestone forms the face of the high cliffs west of the bay on the north side of the point. The band then trends about west by north for nearly three miles, after which it sweeps round and runs in a south-easterly direction for about two miles, giving evidence of a synclinal form in the stratification. It then folds over an anticlinal axis, making a sharp turn to the west, running in that direction with a southerly dip. Following the band on the south side of the anticlinal, it keeps a general course nearly parallel with the valley of the main river, and it is seen largely developed on the high land on each side of Garden River. Again it appears on the high land about a mile and a-half back from the head of Little Lake George, near the valley of Root River, beyond which in the same direction, we have the flat country underlaid by the Silurian strata.

This calcareous portion of the Huronian formation averages about 200 feet in thickness. It presents alternate layers of pale blue or whitish limestone, and greenish calcareous and silicious slate usually in thin strata. The calcareo-silicious slate weathers out in high relief, and gives a striped or ribbon-like aspect to the mass when exposed. About the middle of the band there is a calcareous breccia, generally in a massive bed, holding angular fragments of greenstone trap and dark blue or blackish impalpable grained slate.

Both above and below the limestone the rock is a slate conglomerate, the base of which is usually of a greenish color, frequently having the aspect of an igneous rock; but it contains numerous rounded pebbles of various kinds, the chief part of which are syenite, quartz, gneiss and jasper. In some cases the conglomerate is very coarse, the pebbles or boulders as they may be called, forming the greater part of the mass. In other cases the rock is a fine compact slate, enclosing rounded masses of various sizes and characters, which are scattered through the slate at wide distances from one another.

Following the limestone band east from Echo Lake, it strikes about E. S. E., and is lost beneath the heavily timbered land in a little more than half-a-mile from the point. It forms in this distance two rather sharp-ridged hills, with a northerly escarpment to each, and they are flanked to the east by a cedar swamp. Beyond this the band was nowhere found in place for five miles; but it appears by the distribution of the upper and lower conglomerates, which were traceable for the greater part of six miles, and by occasional loose limestone blocks between them, that it runs in prairies and marshy valleys where the rock is altogether concealed. The general strike of the conglomerates is south-easterly, parallel with the ridges which have been already described; and in the position to which this would carry the calcareous band, blocks of limestone were met with a little over half-a-mile south-west from the exit of the small lake at the head of Echo River, from which position it is probable that it holds the same course until it strikes Thessalon and Otter-tail Lakes on the Thessalon River, where it is already known to be exposed.

The rocks beneath the lower slate conglomerate are greenish silicious slate and pale greenish quartzite, which on Echo Lake are displayed in high precipitous cliffs on the north side. These are underlaid by greenstone, and below the greenstone is a highly altered green chloritic slate, which is exposed in nearly vertical strata forming high precipices at the extreme head of the lake.

Above the upper slate conglomerate there was observed at several places a thinly laminated dark blue or blackish slate of very fine texture, interstratified with thin beds of dark grey quartzite. These were overlaid by whitish or pale grey quartzite, in some parts immediately succeeded by a mass of greenstone, and in others gradually passing upwards into a quartzose conglomerate with blood-red jasper pebbles.

Great masses of trap appear to be irregularly interposed among the strata. They are of nearly uniform character, being for the greater part coarse grained greenstone of a dark green color. Numerous greenstone dykes intersect the formation, which seem almost invariably to be fine grained or compact. About two miles north of Root River a deep flesh-red granite dyke of a porphyritic character occurs. It is interposed between the lower chloritic slates and an overlying mass of greenstone, which runs nearly parallel with the strike of the stratification.

A line drawn in a north-east and south-west direction near the centre of the area examined, as represented on the map, would cross the measures at about a right angle, and they would probably be found to be as follows in ascending order :

	Feet.
1. Green altered slates of a chloritic character, ...	1000
2. Greenstone, ...	400
3. Greenish silicious slates, interstratified with pale greenish quartzite,	1200
4. Slate conglomerate, ...	1000
5. Limestone, ...	250
6. Slate conglomerate, ...	800
7. Dark blue or blackish fine grained slates, with dark grey quartzite,.	500
8. Whitish or whitish-grey quartzite, passing into quartzose conglomerate with blood-red jasper pebbles, ...	1000
9. Greenstone, ...	700
	6850

Copper pyrites is very generally disseminated through the masses of greenstone wherever they were examined, and it occasionally appears in quartz veins in sufficient abundance to constitute metalliferous lodes. The most favorable indications known of this description in the area are on the south side of Echo Lake, and in the hills north of the mouth of Root River, both of which localities have been taken up for the purposes of mining, but have not hitherto been worked to advantage.

Specular iron ore was also frequently observed both in the trap and in the sedimentary portion of the formation, occasionally arranged in thin continuous layers between the strata for considerable distances, and at other times in small isolated masses irregularly distributed through the rock. The latter condition was especially observed in the quartzose conglomerates with blood-red jaspers, where indeed the iron ore appeared to constitute a characteristic mineral.

Portions of the band of limestone are available in an economic point of view for burning into quick-lime, but it is not in general well adapted for building stones. Mr. Palmer of Sugar Island informed me that he had procured a few loads of the stone for the purpose of testing its capabilities, and found it to produce an excellent material for mortar, although rather difficult to burn, and mostly of a dark color.

Lower Silurian Rocks.—On the north end of Sugar Island, and the flat land contiguous to it north of Little and Great Lakes George, no exposures of rock were found, with the exception of certain strata in the valley of Garden River. Here a shale or indurated clay occasionally crops out at the lower part of the bank of that tributary, and is of a reddish color, sometimes mottled with green spots or marked with green stripes. A red color similar to that of the shale is pretty generally imparted to the clay and soil of all the flat land in the country around, and slabs and fragments of red or variegated red and green sandstone are imbedded in the clay and distributed largely over the surface.

A rock similar to the fragments of sandstone is found extensively displayed in place at Sault St. Mary, and there cannot be much doubt that the red shale of Garden River belongs to the same set of strata, and that these strata run under the Lower Silurian limestones which occur farther south on St. Joseph Island. In so far as the Canadian portion of these limestones is concerned, I am not aware that any of the fossils which have been brought from them are characteristic of deposits older than the Chazy limestone; and the total absence of fossils from the red sandstones makes it difficult to determine exactly their equivalent in that part of the Lower Silurian series which is inferior to the Chazy.

Drift.—The whole of Sugar Island and the flat land at the foot of the Huronian hills, including the lower part of the valleys which run up among them, is covered with deposits of clay, sand and gravel, with numerous boulders derived chiefly from the copper-bearing rocks to the north.

The banks of Garden River, which are from forty to sixty feet high, are composed of red and drab clays holding calcareous concretionary nodules, and surmounted by a stratum averaging about six feet in thickness of coarse sand of a reddish-yellow color. The flat land on the north side of River St. Mary and its two lakes, as well as the margin of Sugar Island, is largely composed of sand and gravel presenting the ruins of the red

A, Level of Sea. B, Level of Lake Huron.

a, Green chloritic slates.
b, Greenstone.
c, Greenish silicious slates, with bands of quartzite.
d, Lower slate conglomerate.
e, Limestone.
f, Upper slate conglomerate.
g, Fine-grained black or dark grey slates.
h, Whitish and grey quartzite.
i, Lower Silurian red and green sandstones.

sandstone formation, mixed up with those of greenstone, quartzite, and various shales of the Huronian series. The boulders are in general derived from the latter formation, and among them are conspicuously displayed, particularly to the south of the point more especially examined, immense blocks of red jasper conglomerate; but at one part near the out-crop of the Huronian limestone at Root River there are numerous large rounded masses of gneiss and mica slate, resembling in all respects such as are derived from the Laurentian rocks. A large mass indeed was observed, which had the appearance of being in place. This is situated in a ravine, north of the limestone, between the lower slate conglomerate and a band of greenstone trap overlying the green silico-chloritic slates; it forms a low escarpment, much covered and concealed with bushes, and consists of red and grey micaceous gneiss, in alternating bands, with a dip N. E. $<35^{\circ}$.

The rocks in the neighborhood of Echo Lake present many smooth rounded surfaces, shewing ice grooves and scratches. The direction of those that come under my observation varied from S. 55° W. to S. 70° W.

The accompanying wood-cut represents a vertical section of the rocks on the line drawn on the map a little to the west of Echo Lake.

The scale of the section is one mile to one inch, both horizontally and vertically.


GEOLOGICAL SURVEY OF CANADA.
Sir W.E. Logan F.R.S. Director
PLAN
SHOWING THE DISTRIBUTION OF THE
HURONIAN LIMESTONE
BETWEEN
ROOT RIVER AND BRUCE MINES
Scale of Statute Miles
Gros Cap
SAULT STE MARIE
ST MARY RIVER
Sugar Island
Little Lake George
GREAT LAKE GEORGE
Echo Lake
Echo R.
Marsh
Limestone
Supposed outcrop of Limestone
Thessalon Lake
Otter-tail Lake
Thessalon River
MINING LOCATIONS
Bruce Mines
Neebish Island
St Joseph Island
N.B. The Coast line reduced from Bayfield's Charts.

Huronian Limestone near the Bruce Mine.

The information derived from Mr. Borron regarding the out-crop of the band of Huronian limestone on the Bruce mine location, was found to be essentially correct. The limestone occurs in small broken ridges about half-a-mile or a little more north from the lake shore, and a short distance east from the boundary between that location and the next to the westward, in the occupation of the Wellington Mining Company. Its general aspect and mineral character are identical in most respects with those displayed by it elsewhere. It is much disturbed and intersected by dykes of greenstone trap, the general bearing of the principal of which is about N. 72° W. and S. 72° E.

The position of the limestone here and at the most southern point of the next location westward, where its presence is stated in your Report on the North Shore of Lake Huron in 1848, indicates the structure you then appear to have suspected as the true one for this part of the coast. These exposures of the calcareous band are on the opposite sides of an anticlinal axis, and between the newly discovered out-crop and the developments of the band on Thessalon and Otter-tail Lakes, north of the location, there is a synclinal form, on the axis of which the band will turn somewhere southward of the lowest exposures which we observed together on the Thessalon River.

I have the honor to be,

Sir,

Your most obedient servant,

ALEX. MURRAY.

REPORT,

FOR THE YEAR 1857,

OF

MR. JAMES RICHARDSON, EXPLORER,

ADDRESSED TO

SIR WILLIAM E. LOGAN, F.R.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 31*st December*, 1857.

SIR,

In the month of May last you were pleased to direct me to make a geological examination of a part of the Peninsula of Gaspé. I was instructed to commence with a survey of the Magdalen River, and from it to trace the out-crops of such important groups of rock as might be met with to the eastward as far as Gaspé Bay.

Leaving Montreal on the 26th of May, I arrived at Quebec the next day with my party. Here a week elapsed before a proper conveyance could be procured, and two more weeks were occupied by our passage down the St. Lawrence.

Having arrived at the mouth of the Magdalen, a few days were spent in making arrangements for the survey of the river. We commenced by measuring a part of the coast below its mouth, and in determining our distances both here and subsequently on the river, we made use of the micrometer telescope, while our bearings were ascertained by prismatic compass.

In these operations I was aided by Mr. Scott Barlow, who being at one end of the sights while I was at the other, was enabled to check the bearings; and having with us a repeating circle and reflecting horizon, I was farther indebted to Mr. Barlow for a general check on the measurements, by his frequently ascertaining the latitude by observations of the sun. Mr. Robert Bell, another of our party, in addition to a persevering attention to the general objects of the survey, devoted a part of his time to the collection of recent objects of natural history, his observations on which will be communicated to you by himself.

Our ascent of the river commenced on the 20th of June, and the highest point on it to which our micrometer measurements reached, being the farthest navigable for our canoes, was attained on the 20th of July, the distance being over sixty-two miles. A farther distance of a few miles was examined on foot, but running short of provisions, we were obliged to return to the mouth of the river. For several days previous to our return we subsisted principally on porcupines, which we found in some abundance along the river.

After allowing the men a few days rest we again ascended the river twenty miles, and then leaving our canoes, made a traverse southward, nearly at right angles to the stratification, to York River, which empties into the south-west arm of Gaspé Bay. From this we proceeded eastward, nearly with the stratification, until we struck the Dartmouth River, intersecting it near its discharge into the north-west arm of the bay. When about half-way, Mr. Barlow separated from us to run a line of section oblique to the measures, striking the Magdalen where we had left it, and to take our canoes back to the mouth.

Another traverse was made from Griffon Cove on the St. Lawrence to Peninsula Cove in Gaspé Bay; and proceeding thence up the Dartmouth River to the west line of South Sydenham township, an additional transverse line was measured from this position to Grand Etang on the St. Lawrence.

The whole distance, with the exception of the sixty-two miles on the Magdalen, was travelled on foot, and all our perambulations, comprehending over a hundred miles, were measured by counting our paces, positions being checked as occasion occurred by bearings on previously determined prominent objects.

On leaving the Magdalen my intention was to return by the York River to the point where we struck it on our first traverse, and then to cross over to our starting point; but the want of sufficient water in this stream for its navigation in canoes, forced me reluctantly to abandon the attempt, and purchasing a boat at Grand Etang we ascended the St. Lawrence to the mouth of the Magdalen.

There being scarcely sufficient time again to ascend the Magdalen with a view of tracing the out-crops by a pedestrian excursion to the westward, and so join our work with that of Mr. Murray on the St. Ann in 1845, and your own on the Chatte in 1844, I was tempted by the facility of navigation to make an excursion up the Saguenay to Chicoutimi, and thence to Lake St. John. The examination here made can only be considered preliminary to such future explorations as you may institute upon the various important streams that flow into this lake, and the distribution of the rock masses on its borders will require the exploration of some of these rivers to be made intelligible.

Leaving Lake St. John, Mr. Bell and our canoe-men returned by steamboat from Chicoutimi down the Saguenay to Tadousac, and thence to Quebec, while Mr. Barlow and myself made our way on foot by the road to Bay St. Paul; thence we proceeded to Quebec, and there joining the remainder of the party, two days after they had arrived, we reached Montreal in the beginning of November.

Description of the Magdalen River.

The Magdalen River falls into the St. Lawrence on the south side, in latitude 49° 15′ 32″ N. and longitude 65° 18′ 36″ W. nearly. Its mouth is about sixty miles above Cape Rosier, and about seventy below Cape Chatte. The entrance to it from the sea is on the west side of a not very deep bay, from which the right or east bank of the river is separated for about a mile by a narrow strip of fine gravel, but little elevated above the highest tides, while the left bank consists of an escarpment of stratified clay, about ninety feet in height, containing marine shells of the drift period. This escarpment continues out about a-quarter of a mile beyond the mouth of the river, and, resting on black bituminous shale, forms Cape Magdalen. It extends up the coast for between two and three miles, and the clay of which it is composed spreading for about a mile or a mile and a-half inland, presents a gently undulating surface, well fitted for cultivation. Some patches of grain upon it, consisting of wheat, rye and barley, appeared to promise a fair average yield, and others of potatoes and turnips seemed to be in a thriving condition, though the style of husbandry was but indifferent.

From the mouth of the river to the highest part reached by us, the distance in a straight line about S. W. is but thirty-one miles and a-half, while following the sinuosities of the stream it is sixty miles, and the distance actually measured by micrometer is 62 miles 2 chains 65 links.

The first stretch of the valley from the mouth of the river to Porcupine Bluff, (so called from our having killed the first porcupine upon its top,) is about eleven miles, but the channel of the stream measures very nearly fourteen, the general upward bearing being S. 25° E.* In this a serious impediment is met with in the ascent of the river about five miles from its mouth. It consists of two vertical cascades of twelve and sixty-two feet respectively, with a torrent above and between, occurring in a narrow precipitous gorge, with banks so steep as to be impassable, and rising to the height of 800 or 900 feet on each side of the stream. Over the summit of this height, on the eastern side, it became necessary for us to effect a portage, and the difficulties in transporting our canoes across were so great that seven days were consumed in the task, though the

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* The bearings given in this Report are in relation to true north. The variation in the area of the Gaspé exploration is about 2[illegible]° 0′ W., and in the valley of Lake St. John about 18° 30′ W.

distance was not much over a mile. Not only had we to cut a clear road through very thickly growing though not large spruce trees, but after the road was opened we were obliged to use ropes, and to hold on by the trees in ascending and descending the hill, as well as to excavate foot-holes with a shovel to avoid slipping.

In flowing through this gorge the stream makes a turn out of the general bearing of about half-a-mile to the westward, its course presenting rudely three sides of a parallelogram, below which the valley continues narrow to the flat land at the mouth, while the hills rise irregularly on either bank to heights not much inferior to that of the portage. Above the portage the valley is less deep and somewhat wider, the land presenting a more gradual fall from the hills, the sides of which appear to be but thinly covered with soil, while coarse gravel composes such flats as are met with at the foot. The timber on the flats consists of balsam-fir, white birch and cedar, with now and then ash and elm, but the last two are by no means abundant, while the mountain sides, all the way up from the sea, present balsam-fir, spruce, white birch and pine, the last being in some abundance about the portage.

For the next four and a-half miles above Porcupine Bluff the general upward bearing of the valley is a little west of south, in which the stream measures rather over six miles and a-quarter, to the junction of a tributary falling in on the right bank; to this from its temperature, in the absence of any known name, we gave that of Cold Water Brook. This tributary was the first of any importance met with; it comes from the south through a valley which is a continuation of that of the Magdalen up to this point, and just before joining the Magdalen, it flows between two prominent mountains, for which their shape suggested the appellation of East and West Terrace Mountains. On their north sides, particularly that of the west mountain, and towards the top, several perpendicular escarpments of from fifty to a hundred feet each, rise at irregular distances behind one another, and sweeping round into the valley of the Cold Water branch they slope to the south and converge, gradually becoming less marked, until they disappear altogether. By a rough measurement the summit of the eastern mountain was computed to be 1375 feet above the river, or 1957 feet above the sea. The summit of the other, about a mile to the westward, was not ascertained by measurement, but it is probably about 200 feet higher.

The soil and timber above Porcupine Bluff differ but little from those below, with the exception of an increasing abundance of white pine. It appears to me probable that between the portage and the Terrace Mountains about one-sixth of the wood seen on the slopes was of this species; most of it is large enough for saw-logs, and some may be of a size fit for squared timber. How far back from the river it may extend I am not prepared to say; but even what was in view would in my opinion, be worthy the attention of lumberers. The only difficulty in getting it out would be the falls and rapids near the portage, but these might probably be improved, while they would afford unlimited water-power for mills. From the foot of the falls sawn timber might be sent with safety to the mouth, where there is a good harbour, and deep water for two vessels, while over the bar at the entrance, there is a depth of seventeen feet at the ebb of tide.

From the Terrace Mountains the upward course turns nearly west and continues so for very nearly five miles, presenting a succession of rapids, with a swift current the whole way. On the south side, West Terrace Mountain is continued for half the distance, but after the first mile it loses in elevation. On the north, for the same distance, the hills come close upon the river, presenting a height of about 500 feet. In the remainder of the distance the hills on both sides are more detached and less elevated.

The next stretch of the valley runs N. 25° W., and in this bearing, which continues for six miles, it presents a parallelism with that part between Porcupine Bluff and the mouth. The hills on each side are farther apart than those lower down, and not so bold, the highest summits not exceeding 500 feet over the river. Just at the turn at the upper end of this part of the valley a tributary falls in on the left side; at its immediate junction it is twelve feet wide, and its downward course south; but as it appears probable that it issues from a small lake, the position of which was described to me by one of the inhabitants at the mouth of the Magdalen, the general downward course of the depression in which it runs, may be about south-west. In this case it would be a continuation of the next and longest stretch of the valley of the main stream, and would apparently correspond with the depression on the south side of the portage mountain.

The next and longest stretch of the Magdalen valley has an upward bearing of about S. 55° W., and in this bearing a straight line of nearly twenty-four miles brings us to the end of our micrometer measurements. In this part of the valley the only marked divergence from the bearing given is about six miles up, where the general course is nearly west for about two miles. The lower end of this divergence is marked by a tributary fifteen feet wide, which flows in on the right, and another half-a-mile above it, and twenty-four feet wide, falls in on the left, while the right side two miles still farther up presents an additional branch. This is twenty-eight feet wide, and its transparency suggested the name of Clear Water Brook. The only other branch of any importance in the twenty-four miles also falls in on the right, about three miles below the termination of our micrometer measurements; at its mouth it was thirty feet wide.

The hills along each side of this stretch of the valley, although not so high over the bed of the river as those lower down, are more regular in their outline. They run in ridges parallel to one another. Those nearest the river, which are at no great distance, appear to be between 200 and 300 feet high, and those visible farther back gain upon them but slightly in elevation. These ridges appear to agree in their direction with the general course of the river, with the exception of one on the right side, the escarpment of which is seen three miles east of the Clear Water, and just south of the bend mentioned, at the junction of the lowest tributary. Facing the north, this escarpment rises rapidly to a height of probably 700 feet, and the surface then sloping more gently in a contrary direction, gives the aspect of an isolated hill.

The escarpment resembles the north side of East Terrace Mountain, and bearing exactly for the position of that mountain, it is probably of the same formation.

From the Terrace Mountains upwards the timber of the valley is smaller than lower down. It consists of spruce, balsam-fir, white birch and cedar. Only a few trees of white pine were observed. The soil is thin both on the hills and on the flats. On the latter it is supported generally on coarse gravel, in which pebbles of reddish syenite abound. These pebbles were small at the lowest point at which they were observed, but appeared gradually to increase in size as we ascended, and towards the end of our measurements the river found its way with a rapid current among large rounded masses of this rock. The masses much resemble some of the syenites of the Laurentian formation, and may have been transported from the north side of the St. Lawrence.

About a mile and a-quarter above the termination of our measurements a large tributary joins the main stream on the left. The valley in which it flows is not deep, and can be traced by the eye in its upward course, which is N. 25° W., for between nine and ten miles. For a mile above its junction, with an average breadth of forty feet, it presents a rapid and broken stream, and probably runs with a swift current the whole distance. Beyond this, according to the description given me by a hunter well acquainted with this part of the country, its upward course turns west of south, and in about four miles reaches the base of a mountain which rises considerably above the table-land through which it flows; it is in several small lakes or ponds on the summit of this mountain, about two miles farther, that the tributary has its source.

About a hundred paces farther up the main stream than the mouth of the north branch a tributary enters on the opposite side, shewing a breadth of about ten feet. It runs in a depression which appears to be a continuation of the previous one, its upward bearing being S. 10° E. The main stream from the end of our measurement to the junction has a breadth of from sixty to eighty feet, and its upward bearing is S. 70° W. or nearly at right angles to the two branches. This upward bearing it maintains until it reaches the base of the same mountain that gives origin to the north branch, the distance being about five miles. From this, as described to me by the hunter already mentioned, it bends round the southern base of this mountain, making an arc to which the last mentioned bearing of the main stream, if produced, would form a chord of five miles more, with a distance of about a mile and a-half from the curve about half-way. From the western extremity of the chord the upward course is about north for three miles, when by a sharp bend it becomes east for about four more, the main valley splitting up into several subordinate depressions, each of which sends a contribution from one or more small lakes at its source. These lakes are scattered among the tops of the same mountain in which originates the north branch, and the more southern of them are not far from its source, while the more eastern are not over one or two miles from the east end of the curve made by the main stream round the mountain's base.

This mountain rises boldly above the general level of the country around, its summits attaining a higher elevation by probably 1000 or 1500 feet. Approaching it, the size of the forest trees appear to diminish considerably, and occasional open spaces produce only short wiry grass. The sides of the mountain seem almost devoid of trees, and the top destitute of all vegetation whatever. Large areas below the summit appeared to be covered with huge detached masses of grey-colored rock, and some parts were marked with stripes of red, while on the 20th of July along the whole length of the upper surface, as seen from the mouths of the north and south branches of the river, patches of snow were abundant. In a bearing parallel with the depression or valley of these branches the measure of the mountain is about ten miles. According to Mr. Murray, the St. Ann River flows in a wide valley between Mount Albert of his exploration of 1845 and this mountain, which would therefore from a favorable point of view, appear to be a great isolated hill, and it evidently constitutes the abrupt eastern termination of the Shick-Shock range of mountains, which from the Matan, where Mr. Murray places its western limit, would thus have a length of about sixty-five miles.

While we ascended the Magdalen an endeavor was made to determine the rise of the valley. The river is so rapid in the whole of its length that we met with scarcely any reaches of smooth water to aid us in carrying forward ascertained levels from one part to another; and as we had no mountain barometer, it would have been necessary, in order to attain any reliable result, to use a spirit-level the whole of the way. We did not consider it prudent to expend upon the task the time this would have required. I contented myself therefore with measuring by means of the spirit-level of my clinometer the rise of only the more precipitous parts, and estimated others by the comparative aspect of the current, and the greater or less resistance offered to the progress of our canoes. With the exception of two short intervals, in which the canoemen could use their paddles, they were compelled to resort to their poles the whole distance, or jumping out into the water to drag or push the canoes along with their hands. On such occasions we were often obliged to land and scramble along the bank for considerable distances, and it was then I could sometimes ascertain the rise of parts by the clinometer. The result is given for what it is worth, without any great confidence in its accuracy, except as a very rude approximation to the truth.

Levels of the Magdalen River.

	Distance.	*Rise.*	*Total Distance.*	*Height above the Sea.*
	M. Ch. L.	Feet.	M. Ch. L.	Feet.
Rise from the mouth up the river to high-water mark,................	1·59·48		1·59·48	
—— from high-water mark to the foot of the first rapid, estimated at 9 feet per mile,....................	1·57·55	15·4		
—— from the foot of the first rapid to the foot of the Mountain Portage, including a measured rise of 14·5 feet in 28 chains, estimated at 20 feet per mile,....................	1·20·74	25·0	4·57·77	40·4
—— from the foot to the head of the Mountain Portage, viz. :—				
Rapids, including two vertical falls of 3 feet each,..(measured) 19·5	0·25·12			

	Distance. M. Ch. L.	*Rise.* Feet.	*Total Distance.* M. Ch. L.	*Height above the Sea.* Feet.
Cascade, ...(measured) 12·0				
Torrent between the Cascades, (measured) 131·6	1·02·81			
Cascade, ... " 62·0				
Torrent to the head of Mountain Portage,...(measured) 82·5				
——	0·21·76	307·6	6·27·46	348·0
Rise in continuous rapids above the head of the Mountain Portage (measured)	0·55·93	43·5		
—— from the head of the previous rapids to a cascade, broken water all the way, estimated at 20 feet per mile, ...	0·51·14	12·7		
—— in a cascade, ...(measured)		4·0		
—— from the head of the cascade to Porcupine Bluff, swift current all the way, estimated at 12 feet per mile, ...	6·22·30	75·3	13·76·83	483·5
—— from Porcupine Bluff to Terrace Mountain Rapids at Cold Water Brook, a swift current all the way, the last half being broken water, estimated at 15 feet per mile, ...	6·49·22	99·2	20·46·05	582·7
—— in part of Terrace Mountain Rapids, (measured)	3·21·41	283·5		
—— in continuation of Terrace Mountain Rapids, terminating 20 chains above a small brook joining on the right, estimated at 45 feet per mile,.....	2·36·48	110·5	26·23·94	976·7
—— from the head of Terrace Mountain Rapids to the foot of Flat Rapids, a strong current with comparatively smooth water the whole way, estimated at 5 feet per mile,.........	0·46·05	2·9		
—— in part of Flat Rapids, (measured)	0·74·87	65·0		
—— in continuation of Flat Rapids to a tributary joining on the left side, at the Great Elbow, estimated at 30 feet per mile, ...	3·20·67	97·7	31·05·53	1142·3
—— from the head of Flat Rapids to the foot of Red Rapids, a violent current all the way, often breaking into rapids, estimated at 15 feet per mile, ...	5·33·69	81·3		
—— in Red Rapids, estimated at 25 feet per mile, ...	0·73·64	23·0		

	Distance. M. Ch. L.	Rise. Feet.	Total Distance. M. Ch. L.	Height above the Sea. Feet.
Rise from the head of Red Rapids to a tributary joining on the right, a violent current all the way, often breaking into rapids, estimated at 15 feet per mile,................	3·59·50	56·1	41·12·36	1302·7
—— in rapids to a tributary joining on the left, ... (measured)	0·66·95	28·0	41·79·31	1330·7
—— from the head of the last rapids to the foot of Clear Water Rapids, a violent current with much broken water prevailing all the way, estimated at 15 feet per mile,........	3·68·07	57·7		
—— in Clear Water Rapids to Clear Water Brook, estimated at 70 feet per mile,.......................	0·36·02	31·5	46·23·40	1419·9
—— from the head of Clear Water Rapids to the foot of Long Rapids, a violent current all the way, with much occasionally broken water, estimated at 15 feet per mile,......	10·02·10	150·3		
—— in Long Rapids to the end of micrometer measurements, estimated at 70 feet per mile,..............	5·37·84	383·0		
—— from the end of micrometer measurements to the junction of North and South Branches, rapids similar to the last prevailing all the way, estimated at 70 feet per mile, ...	1·20·00	87·5	63·03·34	2040·7

This would give for the valley a rise of about thirty-two feet in a mile; but if from the result be deducted the Mountain Portage cascades and rapids, and the measured part of the Terrace Mountain Rapids, both of which are perfect torrents, the rate of rise would be reduced to about twenty-five feet in a mile. On the St. Ann, though Mr. Murray met with no vertical falls, he ascertained by barometrical measurement that the rise in the part which he measured, was about twenty feet in a mile, and from the description he gives me of its navigation I am induced to suppose that his difficulties of ascent were by no means equal to ours, even when those of the Mountain Portage and Terrace Mountain Rapids are excluded. The rise given to the Magdalen therefore does not appear extravagant.

Taking the height of the valley at the north and south branches to be 2000 feet, and that of the mountain between the Magdalen and the St. Ann to be 1500 more, its summit would be 3500 feet above the level of the sea. Mr. Murray's barometrical measurement of Mount Albert made its summit 3778 feet above the sea; and as he states that when standing on Mount Albert, the mountain to the east of St. Ann River bounded his view in that direction, it would follow that its height must have been at least equal to his own elevation, which would correspond nearly with the conclusion arrived at by myself.

District between Magdalen River and Gaspé Bay.

The distance from the mouth of Cold Water Brook to York River where we struck it on our traverse, is nearly eleven miles in a straight line, bearing S. 25° E. We followed the valley of the Cold Water, which bends more to the west, but our greatest distance from the straight line was not over a mile and a-half. It occurred when we had proceeded up the brook about three miles and a-half, where a tributary ten feet wide joins it on the right, with an upward bearing south of east. From this the bearing of the Cold Water valley again gradually approaches the straight line, and about a mile and a-quarter farther up another tributary joins on the same side as the former, and runs nearly parallel with it. A third falls in about three-quarters of a mile farther, on the opposite side; and the source of the main brook is met with about three miles and a-half above it. The source consists of a great multitude of copious springs which issue over an area of from thirty to forty acres, and collecting together form at once a considerable stream.

These springs were on the highest ground of our traverse, and were estimated to be about 800 feet above the Magdalen at the junction, which would be nearly 1400 feet above the sea. Immediately beyond them the descent to the York River commenced, the distance to the river being about two miles and a-half, to which there was a fall of probably 800 feet.

In the valley of the Cold Water as in that of the Magdalen there is evidence of a thin soil. The timber up to the first brook is spruce, balsam-fir and cedar, and there are large areas both on the mountain sides and in the lower parts of the valley, where the trees appear from the slightness of their hold in the ground, to have fallen over into a confused net-work of prostrate timber, through which a subsequent dense growth has sprung, producing a tangled mass very difficult to penetrate. The trees above the first brook are of the same kind as those below, but they are small, generally from two to three inches in diameter. The woods are open however, and afford good walking, and there is evidence of a previous growth having been destroyed by fire. Although pine was rarely met with standing, the charred and prostrate remains of good-sized trees, were by no means scarce.

From the position where we struck the York River to the settlements on the north-west arm of Gaspé Bay, the distance in a straight line about east, is thirty miles, but the line we travelled was about five miles more. The position at which Mr. Barlow separated from us, which we called the Ponds, was about eleven miles forward on this line, and his traverse to the Magdalen, in which he kept a straight line N. 63° W., was seventeen miles and a-half.

In the first part of our eastern traverse we kept along the left bank of the York River for about three miles. The width of the stream was from a chain and a-half to two chains; its current was rather swift, and its surface shewed broken water in several places. Its banks were often abrupt, presenting bare precipices of calcareous rock varying in height from fifty to 200 feet. In the three miles that we walked along its left bank we crossed three considerable tributaries with a general north-westerly upward bearing; they joined the main stream through rocky precipitous gorges of from 200 to 300 feet deep. Below the last one, the river gains rapidly to the southward, in its downward course, being turned in that direction by an elevation of from 300 to 500 feet, in which considerable vertical breaks of rock are brought to view.

This elevation forms a ridge which divides the York River from one we met with at the distance of four miles from the last of the tributaries mentioned. We supposed it to be the upper part of the Dartmouth River. It was twenty-four feet wide where we crossed it, and it flowed north. In its upward bearing it appeared soon to turn eastward, and farther in that direction it probably occupies the next valley north from the York River, and runs parallel with that river for some distance, but in a contrary direction. About two miles and a-half exactly north from our point of intersection, Mr. Barlow crossed it on his return traverse. It was there still flowing north, but it probably turns to the east not far below, to gain the position where I subsequently left it at the north-west corner of South Sydenham township, and the point where our eastward traverse previously came out upon it, two miles farther down.

Proceeding on our eastern traverse, only two other streams of any importance were met with, and they were both tributaries of the Dartmouth. One of them occurred about nine miles from our first intersection of the main stream. It had a breadth of twenty-four feet, and flowing northward, it must join the Dartmouth some short distance above the west line of South Sydenham. The other was met with three and a-half miles farther east. It goes among the settlers on Gaspé Bay by the name of Lady-steps Brook. Where we crossed it its breadth was twenty feet, and its flow was from the south-west, in which direction its source is probably near that of the main stream. On our course it occupied a deep gorge, with a considerable mountain on the west and a still more important one on the east. The latter may have a height over the bed of the stream of probably 1200 or 1300 feet, and we gave it the name of Mount Serpentine, from the fact of our having discovered on it a band of serpentine, which we traced for a distance of nearly a mile and a-half. The stream turns eastward along the northern base of this hill, and joins the main river about three miles below our crossing.

Between York River and this brook the inequalities of the surface did not appear to be many. One occurred three miles east of our first intersection of the Dartmouth. Here an escarpment of from fifty to a hundred feet of shaly limestone, facing the south-west, capped an elevation of from 300 to 400 feet, passing over which we descended as much in about a mile and a-half to the Ponds already mentioned as the position where Mr. Barlow commenced his return traverse. The rills on each side of this ridge flowed southward to the Dartmouth. The next four and a-half miles, to the north-flowing brook already mentioned, are indented with no more than a gorge or two of from eighty to a hundred feet deep, but in a mile beyond the brook we ascended 700 feet and kept at that height for a mile and three-quarters, and then descended from 800 to 900 feet in a-quarter of a mile farther. This descent is within three-quarters of a mile of Lady-steps Brook, and thus constitutes the flank of the mountain already mentioned as existing west of it.

East of Mount Serpentine our way to the settlements of Gaspé Bay was marked to the right by a bold range of heights rising 1500 feet or more above the sea, cut by occasional transverse gorges, while on the left we had the valley of the Dartmouth at no great distance.

On our eastern traverse the timber met with consisted chiefly of balsam-fir, tamarack and cedar. On the first part of the line it appeared to be small, but it increased in size when we came to within fifteen miles of Gaspé Bay. In damp bottoms cedars were occasionally met with measuring ten feet in circumference. Pine was not observed until we were within eight miles of the settled part. The most marketable portion of it seemed to have been cut down by the lumberers several years ago, and what now remains appears to be of but little importance.

Ascending the Dartmouth River from its mouth, the first nine miles, up to Lady-steps Brook, run nearly on the strike of the rocks, and though the stream is rapid and broken, it is navigable for canoes. For two miles above this it runs across the measures coming from the north, and the lowest half-mile of the distance is characterised by several vertical falls, varying from two to ten feet in height. Beyond these two miles a zig-zag upward course for four miles more is sometimes with and sometimes across the stratification, and reaches to the west line of South Sydenham township. This was as far as we continuously ascended the stream, but its course beyond has already been indicated.

A little above the South Sydenham line the river is joined by a tributary coming from the north across the stratification. It is eighteen feet wide at its mouth, which constituted the starting point for our traverse to Grand Etang. Several tributary brooks and rills, running in deep dells oblique to the stratification, flow into this one on each side, and crossing these in succession, the inequalities of the surface appear more marked on this traverse than on the east one further south, but there did not appear any important difference in the soil or timber.

The traverse from Griffon Cove to Peninsula Cove was made on the new road in the course of construction by the Government. In this part there is generally a better soil and larger timber than I met with in any other locality visited. Considerable areas support a heavy growth of yellow birch and maple, with varieties of ash and elm, promising in this instance at least, fertility to the agriculturist.

DISTRIBUTION OF THE ROCK FORMATIONS.

The rocks met with in the district of which the geographical features have just been given, are similar to those which in previous Reports have been described by yourself and Mr. Murray, as prevailing both to the east and the west of the area subjected to my examination. I shall give their characteristics as they appeared to me, in the order of their supposed ascending sequence, as established by yourself, not only from the results of those explorations, but in regard to part of the series, as modified by your subsequent examination of the vicinity of Quebec, and the facts ascertained last year on the Island of Anticosti. The Gaspé district is so disturbed that without reference to previous investigations, it would have been impossible for me to have arrived at correct conclusions in respect to superposition, more particularly with regard to the members of those subordinate groups which constitute the two lower divisions of its rocks.

By the arrangement in the museum of the Survey, of the specimens previously obtained on the north side of the Gaspé peninsula, I am made aware that the great groups to which the rocks of my last season's exploration on the south side of the St. Lawrence belong are—

1. Lower Silurian.
2. Middle Silurian.
3. Upper Silurian.
4. Devonian.

In previous Reports the fourth division was termed the Gaspé sandstones, the third the Gaspé limestones and shales. The second and first were separated into a series entitled conglomerate limestones, pillar sandstones and graptolitic shales, and was described under seven subordinate groups, some of which it was supposed might be repetitions of one another, the true sequence not having been determined. The Quebec and Anticosti examinations lead to the conclusion that the ascending sequence of the Lower and Middle Silurian rocks of Gaspé under the titles above mentioned is—

A, Graptolitic shales. B, Conglomerate limestones.	} Lower Silurian.
C, Pillar sandstones.	Middle Silurian.

In the geology of New York A and B are members of the Hudson River group, A having been occasionally called the Lorraine shales, and B, Eaton's sparry limestone; C is supposed to be equivalent to the Oneida conglomerate. In the geology of Canada A has been locally termed the Richelieu shales, B the Quebec or Point Lévy conglomerate limestones, and C the Sillery sandstones. With this explanation I shall proceed to describe the distribution of the rock formations in the area between the Magdalen River and Gaspé Bay.

Section between Griffon Cove and Peninsula Cove.

Commencing with the most eastern traverse, that between Griffon Cove and Peninsula Cove, you have yourself already stated that the coast exhibits a great exposure of hard black brittle shale holding graptolites, the thickness of which may be about 1000 feet. These shales belong to the group A, in the first or lowest great division.

Two miles south-westward of the cove, about an-eighth of a mile is covered with large angular fragments of a greenish sandstone, some of which presented the aspect of a fine conglomerate with quartz pebbles as large as peas. All the fragments tried were more or less slightly calcareous. None of the rock was seen in place, but the abundance and angularity of the fragments convinced me that it could not be far removed, and the position of the fragments may be assumed as that of the rock. These sandstones resemble those of Sillery and would thus belong to group C, or the second great division. Between their position and that of the coast exposure there would be ample room for group B.

Half-a-mile or more beyond this, loose fragments of black slate and a grey slightly calcareous sandstone covered the bed of a brook in great abundance, and occurred not far from a post marked "Lots 3 and 4," being no doubt the corner post common to those lots in the township of Gaspé, but in what range I was not able to ascertain. These fragments resembled some of the strata of Point Lévy, and are therefore supposed to belong to group B.

Beyond this brook a mile and a-quarter, the position being about five miles from Griffon Cove, large masses of a conglomerate rock cover the surface for a short distance. They were traced in undiminished abundance for 200 paces to the westward, and not quite so far to the east, leaving no doubt they were close upon the position of the rock *in situ*, and indicated its strike, which would be about S. 40° E. and N. 40° W. The loose masses shewed the rock to be an aggregate of quartz pebbles of about an inch in diameter, most of which are white, with others of grey compact limestone, of yellowish-white feldspar and of green shale. The matrix was greenish and strongly calcareous, and the color of the weathered surfaces reddish-white. This conglomerate is coarser than any part I have seen of group C, but the pebbles and color of the fragments appear to me to be more closely allied to the strata of this group than to those of B.

A-quarter of a mile still further on, we come to the base of the third great division, or the Gaspé limestones and shales. The first exposure on the Griffon Cove road occurs in a brook called by the inhabitants Ruisseau de la Grande Carrière, where about forty-five feet of grey limestone are seen. The greater part of the beds is composed of very pure limestone, which would be an excellent material for burning into lime; but these pure beds are interstratified with others of an arenaceous character, which on exposure to the weather decompose into a porous earth to the depth of half-an-inch. These strata are overlaid by beds which by the action of atmospheric waters, lose their lime on the exterior, and give a light porous chalk-white residue. Nodules and patches of chert occur in these beds, which also weather white with a slight tinge of yellow. These forty-five feet of strata contain moderately well preserved fossils, among which were *Atrypa reticularis*, *Strophomena depressa*, *Favosites Gothlandica*, and encrinal stems. The dip of the beds in the Ruisseau de la Grande Carrière is S. 54° W. <20°, and a mile and a-quarter forward across the measures, in another brook a few beds of iron-grey limestone shew a dip of S. 4° W. <22°. It is probable that these exposures with the interval between them comprehend the whole thickness of the Gaspé limestones, for the more southern one strikes the foot of a hill presenting a flank which runs to Little Gaspé Cove, where as you have stated, the junction of this and the succeeding formation can be seen. An average of the dips mentioned would give a thickness to this calcareous group of 2100 feet, which very well corresponds with that stated in your Report, as the thickness farther east.

From the foot of the limestone hill to the margin of Gaspé Bay below Peninsula Cove the distance is about a mile and a-half. In this the only exposure of rock seen occurred at ninety-six chains forward. It consisted of greenish-grey sandstones, without fossils, shewing a dip S. 29° W. <39°, and judging from the rocks which strike out upon the coast farther down the bay, there is little doubt the whole distance from the hill is underlaid by strata of the same character. This would give a thickness of about 4000 feet, which is the thickness you assign to this portion of the Gaspé sandstones in your Report, stating that it constitutes one side of a synclinal form, and is repeated with a contrary dip on the other side of the bay.

Section from Grand Etang to the Valley of the Dartmouth.

Between high and low water-mark on the coast and up the stream issuing from the lake or great pond which gives name to the place, a wide exposure exists, as you have yourself stated, of black bitumino-argillaceous shales interstratified with grey calcareous sandstones, and thin grey yellow-weathering limestones, marked with graptolites in the shales, on some of the limestones, and the surfaces of the more arenaceous layers. The breadth displayed by these strata approaches half-a-mile, and their dip is very uniform in a direction S. 20° W.; but the slope varies from thirty degrees on the south side to seventy degrees on the north, and between the two there is supposed to exist an anticlinal axis, similar to several examples displayed in the neighbouring cliffs. On the north side of the axis the thickness of the strata is computed to be about 1400 feet, and they are supposed to belong to the group A of the first or lowest division. These beds are not so black nor so bituminous as those at Griffon Cove, and though they are supposed to belong to the same group, and may in fact represent them, they are presumed to be partially beneath them.

Upwards of two miles southward from these beds the next exposure met with occurs. It consists of greenish-grey slightly calcareous sandstone, weathering brownish. In parts it approaches the character of a fine conglomerate, with translucent quartz grains in some abundance, and small flat pieces of black shale, with occasional flakes of silvery mica. The beds are from twelve to fifteen inches thick, and are divided by cleavage joints into natural rectangular prisms of various lengths. The stone would dress easily, and is of sufficient toughness to retain its edges and corners; it would constitute a good material for building purposes. The width of the exposure was thirty paces, and the strata were vertical, with a strike S. 89° W. The aspect of the rock somewhat resembles the sandstones of the group C; but evidence derived from exposures farther south, to be mentioned presently, induced me to suppose that its place was in the group B.

Beyond these sandstones no exposures were met with for a mile and a-quarter. There then occurred black and iron-grey shales, alternating irregularly with black and green shales, both interstratified with greenish-grey yellowish-weathering limestone beds from an inch to an inch and a-half thick. Beds of this character crop out at intervals for another mile and a-quarter, the dip of the most southern exposure being S. 10° W. <51°. Comparing these beds with your description of some of the shales associated with the conglomerate limestones between the St. Ann and Chatte Rivers, they also are supposed to belong to group B.

Immediately succeeding these, and prevailing for a mile and a-half, are greenish-grey sandstones interstratified with red shales, of which shales there appears to be an important band at the base on the north side. There were exposures of these rocks both in the brook which ran near the line of traverse and in the neighbouring heights, and their resemblance to the Sillery sandstones leaves no doubt in my mind that they belong to group C. The dip of the northern portion was S. 10° W. <51°, and of the southern S. 6° W. <64°. The latter is probably an overturn, for from the evidence farther on, the form of the deposit must be that of a trough. The distance from the most southern exposure of these strata to the Dartmouth, near the western line of South Sydenham township, is about a mile, and it is not improbable that the formation may extend to the vicinity of the river.

Farther south than the south-west corner of South Sydenham, but somewhat to the east, there occurs an exposure of rock in the bed of the Dartmouth. It consists of a somewhat coarse grained sandstone, one bed of which was twelve feet thick, and composed of an aggregation of laminæ of not more than one-eighth of an inch each; these when separated, shew on the surfaces a thin film of a nacreous aspect, which might be taken for talc. These beds are associated with greyish nacreo-silicious slates, and thin calcareous layers, and with them present nearly throughout a set of minute wrinkles. They are also traversed in various directions by strings and small veins, some consisting of white quartz and others of calc-spar. Similar rocks occur two miles farther down the river, and are so contorted that it is difficult to follow the relation of one part to another.

About half-a-mile further down the stream, the channel of it is strewed in abundance with great fragments of conglomerate, the pebbles of which consist of light grey compact limestone, varying in diameter from one to three inches, aggregated so closely as to afford but little room for the matrix, which is itself sufficiently calcareous to be called a limestone, though of an arenaceous character. On the exterior the fragments weather to a yellowish-brown, and in their whole aspect they very much resemble the conglomerate limestones of Point Lévy. The abundance of the fragments leaves little doubt that though the rock from which they were derived was not seen in place, it could not be far removed. A little lower on the river there is an exposure of greenish-grey calcareous sandstone so strongly resembling in every particular that mentioned as occurring nearer the coast, that specimens from the two localities cannot be distinguished from one another, and the near proximity of the conglomerate limestones in the present instance induces the supposition that these sandstones in both cases belong to group B.

The position of the last mentioned exposure is about a mile and a-half above the junction of Lady-steps Brook with the Dartmouth, and it is immediately followed by a considerable developement of the Gaspé limestones. The two formations are not seen in contact, and it appears probable that a fault of some importance may run between them, as the beds in the lowest display of the limestones are much disturbed, while the whole volume of the formation appears to be suddenly thrown forward to the south more than two miles by an upthrow on the west side. A mile and three-quarters of the distance, (being the breadth of the space between the eastward traverse and the upward examination of the Dartmouth,) were not travelled over, and I cannot therefore state with certainty the character of the rocks that may be exposed in them. It is probable however, that they continue to belong to group B; for on the north side of Lady-steps Brook rises Mount Serpentine, the rock giving the name to which is supposed here as in the Eastern Townships to appertain to this group. This serpentine is situated about half-a-mile on the south side of the brook, and about 800 feet above its channel. It occurs in a band which was traced for upwards of a mile running S. 82° E.; but from the precipitous fall of the cliff in which it was exposed it was difficult to ascertain its exact breadth. As near as it could be made out at three places it was estimated at between thirty and forty paces. The rock is a blackish-green interiorly, weathering brownish-red on the exterior, and like the Silurian serpentines of the Eastern Townships it has been found by the analysis of Mr. Hunt to contain both chromium and nickel. In contact with the serpentine on the south side dark green chlorite slate occurs, and appears to occupy the breadth of perhaps half-a-mile, rising to the summit of the hill, which may be 500 feet over the serpentine. The strike is given above, but it was not possible to determine on which side the slope occurred. The opposite side of the hill was not examined, but it is probable another half-mile would intervene before reaching the Gaspé limestones.

The following is an ascending section of the Gaspé limestones as they are seen on the Dartmouth on the east side of the fault:—

	Feet.
Grey limestone of a uniform compact texture in beds of from one to six inches thick, which are much disturbed, the beds for short distances standing in various attitudes, both as regards strike and inclination; an allowance of one-half the apparent volume is made for the irregularities,	83
Measures concealed,	465
Grey limestone of compact and uniform texture, in regular beds of from one to six inches thick; dip S. 9° W. $<20^{\circ}$,	81
Measures concealed,	223
Grey arenaceous limestone with a few obscure fossils; nodules and small patches of chert prevail in the lower part, while the upper beds are of a uniform grey compact limestone as before,	429

	Feet.
Grey compact limestone in beds of from one to six inches thick, in thin close laminæ. The rock weathers to a chalk-white porous mass without lime, for an inch on the surface, ...	137
Measures not well examined in consequence of the steep and difficult character of the side of the gorge through which the river passes,.	503
Grey hard calcareous beds with very fine lines of lamination; the rock weathers white and yellow, ...	121
	2042

The following is a section in ascending series of the Gaspé sandstones, seen in contact with the limestones:—

	Feet.
Iron-grey fine grained argillo-calcareous sandstones with small scales of silvery mica in the planes of bedding, and carbonized comminuted remains of plants in abundance. Interstratified with the sandstones are occasional beds of grey limestone from a-quarter of an inch to an inch thick, weathering yellowish-brown, and containing encrinal columns, obscure corals and bivalve shells,......	95
Greenish-grey sandstones, in beds of from one to six inches thick, with ripple-mark on some of the surfaces, as well as comminuted remains of plants in abundance. A few thin beds of grey limestone are interstratified, but no fossils were observed in them,.........	552
Greenish-grey sandstone, with comminuted remains of plants, interstratified with iron-grey and greenish shale, and a few hard grey calcareous beds. The dip is S. 4° W. < 41°. The position of this exposure is on the left bank of Lady-steps Brook, at its entrance into the Dartmouth,..	357
	1004

Section of the Magdalen River.

As already stated, Cape Magdalen about a-quarter of a mile north of the mouth of the river on the west side, is composed of drift clay with marine shells such as at present inhabit the gulf, resting on black shales. This clay occupies the left bank for about a mile and a-quarter above the mouth. The black shales beneath are interstratified with grey calcareous sandstones, and they are visible from the cape to the mouth of the river, dipping S. 3° E. < from 32° to 60°, the high angle which is at the cape being probably an overturn dip. On the river, for a mile and a-quarter up, no strata are visible, but on the coast about a mile to the eastward there are great exposures, the strike of which would bring the strata into the upper three-quarters of a mile. These are composed of black shales interstratified with thin hard grey calcareous sandstones, and grey limestones more or less arenaceous, sometimes the shales and sometimes the harder beds predominating. They present towards the base two coarse grained calcareous sandstone beds about ninety feet apart and about fifty feet thick each, holding fossils. Among these could be recognised *Leptæna sericea* and *Orthis testudinaria*, both of them however slightly distorted by molecular movements in the rock; an *Orthoceras* accompanied them. The general dip of these measures is about S. 3° E. < from 25° to 30°, and the thickness upwards of 1000 feet. These beds are probably in part a repetition of those at the cape, though it is not easy to point out the exact position of any fold connecting the two.

Measures more or less of the same general character, with the exception of the strong coarse grained fossiliferous sandstones, prevail for the distance of five miles more up the valley, comprehending the rocks of the Mountain Portage and of the rapids for a mile and a-quarter above, and it is supposed probable that they are carried forward thus far by repetitions resulting from undulations, the evidences of which however it is not easy to detect. The first exposure occurs immediately beyond the position assigned to the shales already described. The dip is S. 4° E. <52°, and this inclination is so much steeper than that of the previous dip, that it may be taken for an overturn. The next exposure is three-quarters of a mile farther up, and the succeeding one another three-quarters of a mile beyond, where the dip is S. 4° W. <54°. Three-quarters of a mile still farther a small synclinal and anticlinal are visible, keeping the strata at the surface for some distance. Within half-a-mile farther, at the foot of the portage and at the foot of the twelve-feet cascade a short distance above, the average dip is S. 6° E. <63°, and there are displayed grey argillaceo-calcareous slates with thin beds of a compact yellow-weathering black dolomite, which shews itself also in nodules or patches of from three to four feet in thickness, with an obscure separation from the enclosing rock. Some of the nodules measuring from six to fifteen inches in diameter are of a grey color. Thin beds of this yellow-weathering black dolomite mark the strata to the head of the portage, and the measures seem to be arranged in the form of a trough. The strike varies a few degrees now and then, but the dip with a southerly direction first shews an inclination of $<59^{\circ}$, then $<36^{\circ}$. It then becomes northerly, with an inclination of $<85^{\circ}$, which it maintains to the sixty-two-feet fall, but at the head of the portage it is reduced to $<5^{\circ}$. Here there is a distinct difference between the bedding and the cleavage, and the layers of dolomite are included in grey strongly calcareous slates, weathering white, striped with black bands which give a dark brown streak, though they emit no bituminous odour when rubbed or freshly fractured.

In the additional mile above the portage the strata in the lower exposures are very much corrugated, and in those at the upper end the dip is S. 1° E. $<43^{\circ}$. These beds are black and dark grey shales, interstratified with hard grey calcareous sandstones, and bear so strong a resemblance to those near the mouth of the river as to justify the supposition that they are a repetition of them.

It would thus appear probable that the strata in the lowest five or six miles of the river stand in the form of a number of troughs, with in general overturn dips on the south side, and a depth gradually increasing to the Mountain Portage, which presents the main synclinal axis, and shews the highest set of strata at the surface. The compact yellow-weathering black dolomites are a very marked feature of these strata, and they appear in every respect to have so exact a resemblance to dolomites brought by yourself from the Grande Coupe, six miles below Grand Etang, as to leave no doubt of the equivalence of the strata. At the Grande Coupe graptolites occur in the shales associated with the dolomites, and it is not to be doubted that they belong to the group A.

In a stretch of over five miles up the valley of the Magdalen, above the rocks described, there are no exposures on the river. It is supposed however that in this part the strata of the Mountain Portage must be repeated at the surface, and finally sink beneath it, as the first display of strata beyond appears to belong to group B. This display occurs in Porcupine Bluff, which is a prominent object about 300 paces removed from the right bank of the river, and about 300 feet high. The escarpment which forms the north side of this bluff is a hard and fine-grained sandstone or quartzite, for the most part slightly calcareous, and varying in color from yellowish-white to dull reddish-white and light reddish-brown. It is generally studded with abundance of thin small scales of black shale, and partially spotted with iron-stains probably from the decomposition of grains of iron pyrites; some parts of it weather to a brownish hue. Small veins traverse the rock in various directions, filled with vitreous quartz, and sometimes a film of calcareous matter invests the sides of the veins. Some of the veins and cracks are filled with iron ochre. The whole thickness exposed is between sixty and seventy feet, with few observed divisions into beds. Those divisions which did occur, as well as the indications derived from differences of color and of fineness in the grain of the rock, give the dip S. 8° E. <from 12° to 15°.

North of the escarpment red shale covers the surface in abundance for 150 yards, while 200 paces to the south of it the sides and bed of a brook running with the stratification support great angular masses of conglomerate limestone. Some of these masses are equal to cubes of from ten to fifteen feet, and under a thin covering of moss and vegetable soil they are closely packed together with an occasional mass of amygdaloidal trap.

On the opposite side of the river, about a mile from Porcupine Bluff in the bearing S. 82° W., which is the exact strike, there occurs another sharp pointed ridge about 200 or 250 feet in height, on which the same description of sandstones occurs.

The next exposure met with occurs in a similarly shaped hill, which we called Thunder Bluff. It is about two miles farther up the valley than Porcupine Bluff, or about a mile and a-half across the measures from the run of the last sandstones. It stands about a-quarter of a mile from the left bank of the river, opposite to a deep bend into which it points, as if there were some relation between the base of the hill and the sweep of the stream. The hill quickly rises 300 feet over the river, but gains additional height in the run of the ridge to the westward. The rock of which it is composed is as far as observed, a light grey white-weathering arenaceous limestone, in beds varying in thickness from a-quarter of an inch to ten inches, interstratified with two beds of conglomerate limestone of one foot each and about three feet apart. The grit of the arenaceous limestone consists of grains of dark translucent quartz as large as pins' heads, very regularly disseminated through it. Some of the beds are very finely laminated, and divisional planes are sometimes marked by a film of yellowish-black matter, probably argillaceous, of an unctuous character. The conglomerate consists of flattened pebbles of compact grey or black limestone, most of which appear to be coated with the same unctuous black argillaceous matter as before, in rather thicker films. The matrix is a calcareous sandstone of a yellowish or reddish-white, approaching in appearance to some of the sandstones of Porcupine Bluff. The breadth of rock exposed is sixty paces, and the dip S. 16° E. <from 80° to 90°, giving a total thickness of about 150 feet. Some fragments of encrinal columns were observed on the rock but too obscure to be identified. This rock is probably a modified or proximate repetition of that of Porcupine Bluff, on the south side of a trough with a precipitous dip, and both of them belong to group B.

Between Thunder Bluff and the Terrace Mountains, a distance of about two miles and a-quarter, no rock in place was observed, and in the Terrace Mountains we come to the Gaspé limestones. But before proceeding farther in the direct line of section, it may be as well to describe some of the rocks exposed on the higher parts of the Magdalen, which for a considerable part of its course displays strata belonging to group B, with the strike of which it there appears nearly to coincide.

That part of the river which runs between Cold Water Brook and the head of Terrace Mountain Rapids shews nothing but Gaspé limestones, in the strike of which it runs; but about a mile and a-half northward of these rocks in the lower part of the Flat Rapids, large masses of grey arenaceous limestone and limestone conglomerate are met with in abundance. They strongly resemble the rocks of Thunder Bluff, and being precisely in the westward strike of the Thunder Bluff beds, there cannot be much doubt that they mark the position of its continuation. In less than a mile across the measures above this there are two exposures of rock, both consisting of blackish-blue unctuous shale, interstratified with light grey calcareous sandstones of one or two inches thick, in which are abundantly disseminated dark translucent grains of quartz. These exposures are but half-a-mile from one another, the lower one though somewhat irregular dips northward <from 50° to 90°, and the upper S. 1° E. <from 80° to 90°. The beds of these exposures may be equivalent to one another on the opposite sides of a trough overlying the conglomerate limestones, which should therefore re-emerge from beneath the unctuous shales to the north. If the strata of Porcupine Bluff were continued westward in the strike they present, they would intersect the Flat Rapids in the position where the conglomerates might be expected, but unfortunately no exposures occur to enable us to confirm the supposition.

Above the last exposure there are none for upwards of three miles northward to the Great Elbow, and for about an equal distance south-westward above that bend to the Red Rapids. The Red Rapids afford the following beds in ascending order:

	Ft.	*in.*
Measures concealed, but supposed to be red and green shale,.........	12	0
Red shale, ...	39	0
Red and green shale, the red predominating towards the base, but the green towards the top. There is a cleavage independent of the bedding, the strike of the cleavage being N. 69° E. and S. 69° W.,	25	0
Red and green shale,...	4	0
Grey calcareous shale finely laminated; some of the divisional planes have a fine unctuous coating of mottled blackish-grey and greenish-grey, and the shales are interstratified with reddish-grey strongly calcareous sandstones of one or two inches thick, subdivided into laminæ separated by glossy blackish unctuous pellicles of clay. These calcareous sandstones weather reddish-brown, and all the beds are traversed by numerous small veins of calc-spar,	8	0
Grey calcareous shale as before interstratified with slight reddish-grey calcareous sandstones and arenaceous limestones of from three to four inches thick, divided by unctuous pellicles,.................	5	0

	Ft.	in.
Light reddish-grey arenaceous limestone, weathering reddish-brown, subdivided as before by thin pellicles of glossy black unctuous clay,	1	8
	94	8

The exposure is on the left bank of the river, and shews the lower part of the beds dipping S. 25° E. <36° ; and as the strata accumulate on one another ascending the stream, the strike gradually bends round the western end of a trough about 100 yards up, until the upper layers dip N. 25° W. <36. The stratigraphical place of the beds is supposed to be beneath the conglomerate limestones as indicated by the occurrence of the red shale on the north side of Porcupine Bluff.

An exposure which occurs a mile and a-half above this is either in immediate relation to it or may possibly be some modification of it. The dip at the place is S. 31° E. <from 73° to 90°, and the beds in ascending order are as follows:—

	Ft.	in.
Red shales interstratified with beds of greenish hard compact calcareous sandstone of from one to two inches thick, constituting half the amount,	63	0
Measures concealed,	112	0
Red shales interstratified with greenish hard compact calcareous sandstones of one or two inches, constituting one-third of the mass,	22	0
Greenish hard and compact calcareous sandstones, interstratified with sandstones of the same color and hardness but without lime ; the beds being from one to two inches thick,	34	0
	231	0

Two miles farther up, and about two and a-half miles below Cold Water Brook there is an exposure in which greenish hard compact calcareous sandstones similar to those mentioned above, but weathering somewhat brown, are inclosed in greenish instead of red shale. The beds are vertical, but the strike, which is N. 59° E., would bring them very near to the red shales farther down. Similar rocks however, about a mile farther up shew a change in the strike, which becomes N. 61° W., the dip being N. 29° E. <66°. The course of the valley changes with the strike, and the return of the valley to the previous bearing a little below Cold Water Brook, may probably be taken to indicate a restoration of the previous strike. Accordingly three miles and a-half above Cold Water Brook, where the next exposure of rock occurs, we find the strike to be S. 64° W., very nearly what it was before. Here the strata are vertical, and consist of yellowish-drab calcareo-argillaceous shale, unctuous to the touch, interstratified with yellowish-grey shaly limestones of from one to two inches thick. Small nodules of a similar limestone are thinly disseminated in the shale. About fifty yards down the stream from these beds, and on the north-west side of their strike, probably below them in stratigraphical place, there occurs a bed of conglomerate limestone. It is twenty-four feet wide, and its pebbles consist of compact limestone with a smooth conchoidal fracture, shewing various shades of grey, and in some of the pebbles two or more shades run in narrow alternating bands. The matrix is also calcareous, with only a small amount of sand; so that the whole rock would burn to very good lime.

These rocks running directly up the valley are exposed in two additional places in the distance of a mile and a-half; they are vertical in one of the localities, and in the other inclined south-easterly at an angle of 61°.

A mile and a-half further on occur grey shales interstratified with greenish hard calcareous sandstones of from one to two inches thick, similar to beds lower down, and beyond them about half-a-mile there is a recurrence of red and green shale dipping S. 56° E. $<32°$, with another exposure of conglomerate three-quarters of a mile beyond. This conglomerate is identical in appearance and character with that last mentioned, but over half a-mile forward another bed of conglomerate is met with, whose thickness does not exceed a foot and a-half. The pebbles and matrix however, are similar to those of the previous bed, of which it may be a modification. It is associated with grey calcareous sandstones of from three to twelve inches thick. They are studded with abundance of dark translucent grains of quartz of the size of pins' heads, and form bands in a blackish-grey unctuous shale, in which also are interstratified beds of grey limestone of about an inch thick, that have the peculiarity of a fibrous structure, the fibres being at right angles to the plane of the beds, like those of satin-spar. With the exception of the fibrous limestones the strata much resemble those towards the foot of Flat Rapids.

Between the last conglomerate band and the previous one there may be an anticlinal axis; for while the attitude of the beds at the previous one is vertical, with a strike S. 31° W. and N. 31° E., the dip of the last is S. 26° E. <from 20° to 30°, and there may be a synclinal between these beds and those of the next exposure three-quarters of a mile higher, where the rocks are exactly the same as the last, but with a dip (probably overturned) S. 66° E. <from 60° to 90°.

Red and green shales again make their appearance a mile and a-half farther up, dipping S. 26° E. <48°, and half-a-mile beyond conglomerate limestone is seen associated with black unctuous shales dipping N. 49° W. <from 50° to 90°. Not far above this exposure the course of the valley turns rather more to the westward, apparently diverging a little from the strike; but following the strike for about two miles to the south-west we again come upon an exposure of conglomerate limestone, associated with which on the north-west side, there occurs a reddish-grey quartzite, strongly resembling that of Porcupine Bluff. This exposure is about a mile across the measures to the south-east of the Magdalen at the termination of our micrometer measurements. Near the end of these measurements another band of conglomerate accompanied by dark-grey shales presents itself on the river dipping N. 41° W. <85°, and it is repeated about half-a-mile lower down, and about 250 paces north-west of the strike of the last, with a dip S. 31° E. <85°, shewing the existence of a synclinal axis between the two. Shales of a character similar to that of the beds associated with these conglomerates, continued to present themselves in the remaining mile and a-half to the junction of the north and south branches, but the conglomerates themselves were not observed, though it was indicated by the strike that they could not be far removed.

It is plain from these details that as stated before, the upper part of the Magdalen runs upon group B, and if the direction of the group were maintained in its south-westerly bearing it would apparently attain a position on the south of the Shick-Shock range of mountains. In your Report and that of Mr. Murray we ascertain that the same group exists on the north side of the range, and if as has been supposed, the range is composed of group C, it would follow that it presents a synclinal form.

Returning to the direct line of section at the mouth of Cold Water Brook, the whole volume of the Gaspé limestones is presented to us in the Terrace Mountains. The dip of the strata in these mountains appears to be very regular and uniform all the way across the measures, being from S. 5° E. to S. 14° E. < from 38° to 35°. The formation occupies a breadth of twenty-four chains, and the surface where the uppermost beds crop out is 1375 feet in geographical height above the base. In going over the mountain the exposures met with were at considerable intervals. In the section obtained therefore, there are many portions concealed, but the sequence of such beds as presented themselves for examination is here given in ascending order :—

	Feet.
Measures concealed,	30
Brownish-grey shaly limestone interstratified at intervals of from six inches to two feet, with harder limestone of the same color in beds of from two to three inches, in some of which nodules and patches of brownish-grey chert occur, with thicknesses varying from a-quarter of an inch to an inch and a-half. The chief part of the mass weathers yellowish-white, but some of the beds reddish-brown. No fossils were observed,	100
Measures concealed,	125
Brownish-grey shaly limestone, interstratified with more compact beds as before ; no fossils were seen,	6
Measures concealed,	375
Brownish-grey shaly limestone with harder beds as before ; no fossils were seen,	20
Measures concealed,	355
Brownish-grey shaly limestone with harder beds as before ; no fossils were observed,	24
Measures concealed,	597
Brownish-grey calcareous shale interstratified with brownish-grey limestone, in beds of from one to three inches, weathering brown and yellowish-brown ; no fossils were observed,	15
Measures concealed,	593

	Feet.
Brownish-grey calcareous shale weathering brown in beds, of from two to three inches, interstratified with occasional harder layers of silicious limestone of the same color, and like the shale weathering brown; no fossils were observed, ...	45
	2255

No fossils were observed in any of the exposed beds, though they were most carefully sought for. Only one loose fragment of limestone was met with holding organic remains. It occurred at the foot of the mountain, near the base of the formation, but the remains in it resemble those which have been brought from the top of the Gaspé limestones, near Ship-head in Gaspé Bay. Among the species were *Strophomena depressa, Chonetes* ——— ? and *Platyostoma* ——— ?

The crest of the hill and the summit of the formation as given above coincide, and the Gaspé sandstones are supposed to come in on the line of section some short distance forward on the gradual descent which occurs in the geographical surface. The junction of the two formations however was not seen, and the first exposure indicating a change was met with in a spot, whose place on the line would be a mile and a-half from the limestones. It occurs to the west of the line on the right bank of Cold Water Brook, nearly a mile and three-quarters from its mouth. The rock is a greenish-gray sandstone having very generally disseminated through it small scales of silvery mica. The beds are from two to six inches thick, and much studded with comminuted and carbonized remains of plants, as well as with brachiopodous shells. These shells were generally filled with iron ochre, and it was difficult to procure them sufficiently well preserved to be properly identified. The number of species did not however appear to exceed two or three, and the most abundant is identical with a small *Meganteris* (*M. elongata ?*) from the sandstones of Gaspé Bay, as well as those of Brehaut Bay, on the coast between Douglastown and Percé. The dip of these fossiliferous beds was S. 14° W. <55°.

About a mile and three-quarters southward of this, similar greenish-gray sandstones, but without fossils, occur on the lowest tributary of Cold Water Brook, but here the dip is N. 1° W. <14°. Between this tributary and the next one about a mile and a-half farther south, a hill is interposed, rising to the height of about 800 feet over the main brook. On it the sandstones are very generally seen up to the summit, which occurs about a-quarter of a mile from the second tributary. At the summit the dip is N. 18° E. <39°, and the descent over the escarpment down to the tributary is very abrupt. No rock in place was observed either in the escarpment or in the tributary, but numerous large flat fragments of calcareo-arenaceous shale, abundantly marked with the carbonized remains of plants, were mingled with fragments of a harder and more compact material, sufficiently calcareous to be entitled to the appellation of a very arenaceous limestone, and these were accompanied with some fragments of chert. I am in consequence inclined to give the tributary as the southward limit of the sandstones, which between the tributary and the Terrace Mountains would thus lie in the form of a trough, measuring on the line of section about four miles and a-half across. This, agreeably to the dips observed on the opposite sides of the synclinal axis, would give for the sandstones a thickness of about 6000 feet.

Crossing the measures southward towards York River, the first exposure of the limestones met with on the south side of the trough was a little over a mile and a-half forward. It occurred about half-a-mile down an escarpment descending from the summit of a gradual rise which attains a height of 700 feet, and it consisted of about thirty feet of dark brownish-grey limestone, weathering partly white and partly brown, with patches and nodules of chert. The dip was N. 9° E. < from 15° to 20°. No fossils were observed in the beds.

The distance from this position to York River is rather over four miles. Until reaching the river no exposures of rock were met with. Such as were seen on the river were calcareous. At the end of the traverse the strata consisted of dark grey compact calcareous shale, showing fine lines of stratification, but breaking up into flat fragments of from one to six inches thick, which like some of the rocks of East Terrace Mountain, weather white. The dip of the strata was S. 1° E. $<43^{\circ}$. Here no fossils were observed, but a few were met with two miles down the stream, not much out of the strike of these beds, where a height of 400 feet above the river was capped by 100 feet of calcareous shales of a somewhat softer character, weathering brown and white. Half a day's search produced a few fragments of *Brachiopoda* and two small species of *Orthoceras*, one of which strongly resembles an unnamed species from the limestone cliffs of Ship Head or Cape Gaspé. The dip here is S. 16° E. $<45^{\circ}$.

The dip of these calcareous rocks and that of the last exposures in the valley of Cold Water Brook being in opposite directions, it is plain that an anticlinal runs between them. It is not possible for me however to point out the precise position of its axis. Perhaps it may occur at the springs at the source of the brook, which may issue from some crack or dislocation on the crown of the arch. But taking the thickness of the limestone formation as ascertained in the Terrace Mountains, and the dips observed on the York River and the upper part of the Cold Water valley, it appears extremely probable that between the Gaspé limestones on each side of the anticlinal there would be ample room for some part of the Lower Silurian division.

The strata constituting the base of East and West Terrace Mountains visibly coincide with the general course of the Magdalen River for two miles above the mouth of Cold Water Brook, and there is no doubt from the fragments in the bed of the stream and the form of the south bank, that they do so as far as the head of Terrace Mountain Rapids. These fragments were absent from the river until they were once more met with in the east and west reach below Clear Water Brook. Here however they reposed on the rocks of group B, but the hill which rose boldly up to the height of 700 feet not far from the south side, and so strongly resembled East Terrace Mountain in form, pretty well indicated their source. In it we have no doubt a continuation of the Gaspé limestones, which have thus a nearly east and west bearing for about eleven miles. Above Clear Water Brook the hills on the south side did not show any of the terraced character, and it is probable that the valley of that brook may limit the extension of the Cold Water Brook trough in so far as the continuous westward run of the Gaspé limestones is concerned.

On our eastward traverse the first rocks met with after leaving the valley of York River, were observed when we crossed the Dartmouth. They consisted of twelve or fourteen feet of gray calcareous shale, interstratified with hard and somewhat arenaceous beds weathering brown and holding chert in patches and nodules. The shales resembled those capping the 400 feet hill on the York River, but they contained no observed fossils. The dip of the strata was N. 15° E. <38°, and they therefore belong to the limestones of the south side of the Cold Water Brook trough, and are probably not far from their base.

The next exhibition occurred about a mile and a-half before reaching the Ponds. Here an escarpment of sixty feet, surmounting a precipitous rise of 450 feet, presents itself, composed of brownish-gray calcareous shale in beds varying in thickness from a-quarter of an inch to two inches, in which nodules and patches of chert occur. The rock crumbles in the atmosphere into small fragments weathering white and brown, and much of it becomes exteriorly a porous earthy mass from the loss of its carbonate of lime, particularly in the upper part of the exposure. No fossils were observed in the strata. Their dip was N. 64° E. <43°.

Descending more gradually from this to the Ponds, the surface in the neighborhood both around and in the bottom of the ponds, which are not deep, is strewed with huge angular blocks of limestone, a great many of them measuring as much as six feet square and two feet thick, and some of them exhibiting obscure indications of fossils.

To the eastward of the Ponds a long distance intervened without any exposures of rock *in situ*, and we were obliged to place some dependence, in judging of the distribution, on the fragments observed on the surface, in water-courses and among the roots of overturned trees. For nearly a mile from the Ponds fragments of limestone predominated over all others;

then for three miles and a-half fragments of greenish-gray sandstone with carbonized comminuted plants excluded all others until reaching the twenty-four-feet brook flowing north to the Dartmouth. Crossing this brook, the fragments of sandstone became mingled with others of limestone, and beyond it for two miles and three-quarters the fragments consisted of limestones and calcareous shale.

This brought us to a great exposure on a small tributary of Lady-steps brook, where 300 feet of limestone are seen dipping N. 35° W. $<$54°. Having as indicated by the distribution of the fragments above given, crossed the sandstone, this exposure most probably belongs to the limestones of the east end of the Cold Water Brook trough. The north-west dip appears to indicate a turn in the calcareous belt carrying it round the flank of Mount Serpentine to the southern side, there to be interrupted by the fault described in following up the section from Grand Etang.

In his traverse from the Ponds Mr. Barlow in the first mile observed fragments of limestone only, while for three-quarters of a mile beyond fragments of sandstone prevailed; but in a farther distance of four miles and a-quarter, about the middle of which he crossed the Dartmouth, the loose masses were of limestone and calcareous shale. Beyond this they again changed to sandstone, and continued so for about three miles. The ground then became rather wet and the wood tangled, and but few upturned trees occurred to expose the rocks; but in five miles he reached a crest corresponding to that of the East Terrace Mountain, beyond which limestone was common for the rest of the distance.

It appears pretty certain from what has been said that the Cold Water Brook trough is a continuation of the synclinal of Gaspé Bay, the axis of which, from a point opposite to Ship Head or Cape Gaspé, would run about northwest for six miles, then N. 60° W. for about twenty-five miles to Lady-steps Brook, and N. 80° W. for about thirty-seven miles to the valley of Clear Water Brook.

The axis of the anticlinal to the south of this has been described by yourself as striking in upon the coast of Gaspé

Bay, near Cape Haldimand, and thence running across the entrance of Gaspé Basin and passing near the English church. Thence it would run nearly parallel with the bearing already given to the synclinal axis and probably strike near the source of the Dartmouth River, passing thence to the springs at the source of Cold Water Brook, and from them westward for upwards of twelve miles.

From what has been said it will be evident from combining the facts of the present exploration with those of your Report of 1845, that the Gaspé limestone, commencing at Ship Head or Cape Gaspé, will run along the north side of the Gaspé trough as far as Clear Water Brook, and then return along the south side of it to some point on the anticlinal axis about south of the Ponds, whence it will again run westward on the York River, beyond which its course would require farther investigation.

The sandstone within the trough east of the dislocation near Mount Serpentine, would probably be separated from that westward of it; and this, with Mr. Barlow's traverse, appears to prove that it would thus be divided into two outlying areas by the valley of the Dartmouth River.

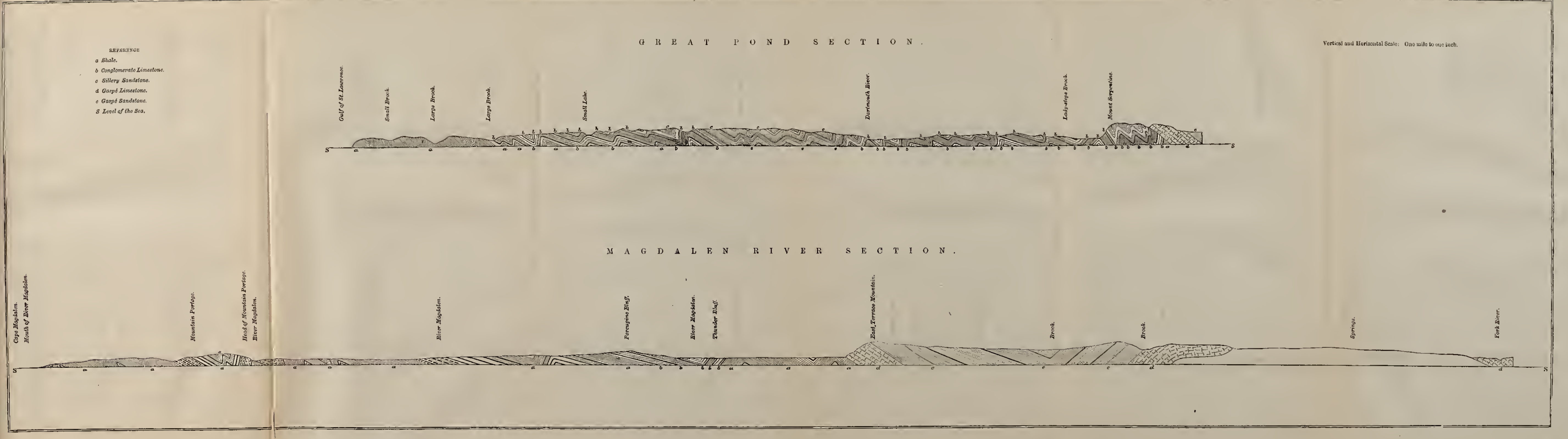
The accompanying wood-cuts represent the supposed arrangement of the strata in the Grand Etang and Magdalen sections, the horizontal and vertical scale being one mile to one inch.

ECONOMIC MATERIALS.

The materials fit for economic application met with on the present exploration were but few. They consisted of clay fit for brick-making, serpentine, limestone, and hydraulic cement.

Common-brick Clay.—Clay fit for the manufacture of red bricks exists in abundance in the Post-tertiary deposit which has been mentioned as occupying a considerable area at the mouth of the Magdalen, as well as in several of the bays in the St. Lawrence, both above and below the Magdalen, but such clays were nowhere seen in the interior.

Serpentine.—It is probable that some of the rock of Mount


REFERENCE
a Shale.
b Conglomerate Limestone.
c Sillery Sandstone.
d Gaspé Limestone.
e Gaspé Sandstone.
S Level of the Sea.
GREAT POND SECTION.
Vertical and Horizontal Scale: One mile to one inch.
Gulf of St. Lawrence.
Small Brook.
Large Brook.
Large Brook.
Small Lake.
Dartmouth River.
Lady-steps Brook.
Mount Serpentine.
MAGDALEN RIVER SECTION.
Cape Magdalen.
Mouth of River Magdalen.
Mountain Portage.
Head of Mountain Portage.
River Magdalen.
River Magdalen.
Porcupine Bluff.
River Magdalen.
Thunder Bluff.
East Terrace Mountain.
Brook.
Brook.
Springs.
York River.

Serpentine would answer for the purposes of ornamental architecture. All of the rock however that came under my observation was too much cracked and flawed to yield any large sized blocks. It is therefore rather from the analogy which this rock bears to the serpentines of the Eastern Townships, where very beautiful blocks have been obtained, that the Gaspé locality may be expected to yield, upon farther examination, an available material.

Limestone.—The Gaspé limestones will no doubt yield abundance of material fit for burning into lime. They seem however to afford a greater number of beds capable of such an application on the coast in the vicinity of Cape Gaspé than in the area that came under my observation. This may be owing to the greater number of fossils that appear to mark the limestones of Cape Gaspé, of which those more westward seem to be almost destitute. Some of the conglomerate limestones of group B would yield good material for the purpose, as well as many of the beds interstratified in the shales of group A.

Hydraulic Cement.—The black yellow-weathering dolomites of the Mountain Portage on the Magdalen, similar to those obtained by yourself from the Grande Coupe six miles below the Grand Etang River, afford a material which gives a very strong hydraulic cement, setting in a few minutes under water to a very hard and tenaceous mass of a yellowish color. The range of the formation containing these bands being from Gaspé to Quebec and beyond, makes it probable that a considerable quantity of this stone may be obtained from various localities along the south shore of the St. Lawrence. The stone differs from that at Quebec, from which Captain now Major-General Baddeley, R.E., first prepared a cement, now manufactured by Mr. P. Gauvreau; this contains no magnesia, while the Gaspé stone is a dolomite.

Fish Offal.—Although not coming under the category of mineral substances, any one who visits any part of the Gaspé coast where a fishing establishment exists, cannot fail to notice the great quantity of offal that remains after dressing the fish, and to understand the advantage to which it might be turned as a manure.

The only fishing establishment that came under my observation was that of Messrs. F. & M. Lesperance at Grand Etang. These gentlemen employ about twenty-two boats and sixty men during the fishing season, and obtain annually 3,300 quintals of dried codfish, which is all sent to Europe. Salmon, mackerel and herring, in addition to codfish, form important items in their trade, and cod-liver oil is manufactured by them to a considerable extent.

In connection with the fishing, about 100 acres of land are under cultivation, being worked by the men when not engaged in fishing. The greatest cleanliness prevails throughout the establishment, and all the refuse around the fishing stages is each day carted away to the fields as manure. The ammonia and phosphate of lime which it contains render it a powerful fertiliser.

Although the country along the south shore looks somewhat mountainous, and the breadth of flat land capable of cultivation appears to be but small, there are not wanting instances of considerable success in the combined operations of farming and fishing. As one instance, I may mention Mr. Isaac Green who settled in May 1856 at the mouth of the River Martin, some distance below Cape St. Ann. In that year he made from 400 trees 300 lbs. of maple sugar, and cleared land for the following quantities of grain sown :—

3½ bushels barley sown June 16, returned 70 bushels, cut Sept. 8.
16 " potatoes planted, returned 300 bushels.
1 gallon onions sown, returned 1 barrel.

In addition to this his two sons, lads of fourteen and sixteen years of age, caught codfish between July and the autumn to the value of £45. In the year 1857 he sowed and planted—

8½	bushels	barley,	returning	150	bushels.
1	"	oats,	"	20	"
1	"	wheat,	"	20	"
1	"	pease,	"	15	"
20½	"	potatoes,	"	300	"
2	gallons	onions,	"	6	"

His sons, from the 15th June to the 1st August, caught and cured 45 cwt. of codfish, and other fish to the value of £15.


GEOLOGICAL SURVEY of CANADA.
Sir Wm E. Logan F.R.S. Director.
PLAN
SHOWING THE
DISTRIBUTION of the DEVONIAN
AND
SILURIAN FORMATIONS
in a part of
GASPÉ
To Illustrate the Exploration of
J. Richardson.
1857.
Scale 6 Miles to an Inch.
N B The Coast line reduced from Bayfield's Charts.
Longitude West from 65° Greenwich.
Cape Magdalen
Mountain Portage
Great Elbow
Porcupine Bluff
Thunder Bluff
Flat Rapids
W. Terrace Mountain
Supposed Base of Gaspé Limestones
Supposed Base of Gaspé Sandstones
Sillery Sandstones
Darmouth River
SYDENHAM.N
SYDENHAM.S
FOX
Fox Pt
GASPÉ BAY NORTH
GASPÉ BAY SOUTH
CAPE ROSIER
Cape Rosier
Cape Bon Ami
Cape Gaspé
GASPÉ BAY
York River
Douglastown or St Johns River
YORK
DOUGLAS
Haldimand
Middle Branch
South Branch
Great Cloridon
Grande Greve
Alexander Fork
The Ponds

EXPLORATION OF LAKE ST. JOHN.

We arrived at the mouth of the Saguenay on the 23rd of September, and sailed up the river to the village of Chicoutimi, which we reached on the 28th, having been somewhat delayed by head winds; here we had some difficulty in obtaining canoes. Of the two we had taken with us to Gaspé one had been abandoned on the south side of the St. Lawrence, being too much worn to be of any farther use, and the other we lost in ascending the river, having been obliged to cut it adrift in a gale of wind.

To Mr. W. E. Price of Chicoutimi I was indebted for the use of one for which he would accept no recompense, and I was farther obliged to him for much information, and for the interest he evinced in the objects of our exploration. I was likewise indebted to Mr. G. Duberger, Crown Land Agent, for his kindly supplying Mr. Scott Barlow with materials for the construction of a map of the country around Lake St. John, and to his son Mr. E. Duberger, P. L. S., for much useful information; as well as to the Rev. J. B. Gagnon, who pointed out to us the routes by which we could travel most expeditiously.

Leaving Chicoutimi on the 30th September, our equipment was sent by land to the foot of Lake Kenogami, a distance of fifteen miles. Here a second canoe was hired, by which I was enabled to visit several points on the lake, while the provisions and other materials proceeded forward in a barge. Crossing by the Bon Portage from the head of Lake Kenogami to Lake Kenogamishish, we proceeded to the foot of it and then down the River Aulnais, and from its mouth down the Belle River to Lake St. John. Lake St. John was examined along the coast and around its islands, and we ascended three of its tributary rivers for different distances, the Belle River as already mentioned, the Ouiatchouan for one mile and the Peribonka for twelve miles.

We regained the mouth of the Belle River on the 20th of October, and returning to Chicoutimi, after sending the chief portion of our party by Tadonsac as already stated, Mr. Barlow and myself proceeded on foot to Bay St. Paul, and reached Quebec two days after the others.

Geographical Description of the Country.

From the mouth of the Saguenay to Cap à l'Ouest on the right bank, a distance of fifty miles, we passed up so rapidly that I had only time to remark that on each side precipitous cliffs rise to heights of from 300 to 1100 feet, shewing a succession of almost bare rocks of the Laurentian age, apparently gneiss. It is only at the mouth of some of the tributary streams that a foot-hold can be obtained for agricultural purposes. Such was observed at the junction of the River Marguerite on the left bank, about thirteen miles from the St. Lawrence, at that of the Little Saguenay eighteen miles up on the right bank, and at the St. John on the same side, a little over twenty-four miles up. In all other parts where the surface was not actually denuded of vegetation, it sometimes gave support to an abundant growth of blue-berry bushes, or some few small spruce and pine trees of different kinds.

Above Cap à l'Ouest farm-houses begin to appear, at considerable intervals at first, but approaching Chicoutimi on the one hand and the head of Ha-Ha or Grand Bay on the other, they become numerous. Advancing from Cap à l'Ouest the country becomes deeply covered with Post-tertiary clays, through the horizontal surface of which the Laurentian rocks protrude like islands, with occasional cliffs of the same facing the bays and the rivers. These clays form an excellent soil, but in some parts, more particularly in the neighbourhood of Lake St. John, to which the clays extend, they are covered over with from one to three feet of sand and gravel. The area thus covered is considerable, and it is but little resorted to for farming. Over a large part of this however, the defects of the light sandy soil might be easily obviated. With a small amount of labor the clay might be brought up from beneath the sand and gravel and spread over the surface, where mixing with the lighter material it would form an easier worked soil, equally fertile with that composed entirely of clay. The beneficial effects of such a mixture are shewn by natural examples in some parts of the area on gentle slopes which have been formed by denudation, where the sand gradually thinning becomes well mingled with the clay for some breadth near the junction, or on flat surfaces where the denudation has left the sand so thinly spread over the clay as to permit the action of the plough to effect the mixture. At the same time that such a soil possesses a great and durable fertility, it requires less labor and care in its management than the stiff clay.

The clay deposit between Chicoutimi and the head of Grand Bay has in some places a thickness of 600 feet, and where this exists land-slips are of common occurrence. They give to the surface a broken and rugged aspect, yet it is not uncommon to find whole farms situated on the remains of such *éboulements*, while others standing on the still unmoved ground might from analogy be supposed to be in positions somewhat insecure. The greatest display of these land-slips is to be seen up the Ha-Ha River and the River St. Alphonse, both of which empty into Grand Bay, and on the road between Chicoutimi and the bay. But the conditions which produce these slips extend to Lake St. John, and may be expected beyond, as the clays were observed on the banks of Lake Kenogami, at Bon Portage and on Belle River, where in many places they have a thickness of a hundred feet. It is here that large areas, as already mentioned, are overlaid with sand. On Lake St. John the clays were seen to the east of the Metabetchouan, at the Hudson Bay Company's post, and to the north-west of the River Ouiatchouan, as far as Blue Point, where a very thriving settlement is established on them. To the west and north of Blue Point and around by the north margin of the lake to the outlet, the shores are low and sandy. The sand is greyish-white, and appears to be derived from the destruction of Laurentian rocks.

The greatest length of Lake St. John is about twenty-six miles, extending in a bearing N. 20° W. from about the mouth of the Metabetchouan River to that of the Peribonka, and its greatest breadth about twenty miles from the mouth of the Ouiatchouanish to the Great Discharge. The principal rivers that flow into the lake are as follows. First the Belle River, which joins it on the south side about six miles above the Little Discharge. Its average breadth just above the position where it is influenced by the waters of the lake is about one chain. Next is the River Metabetchouan, which is probably as large again as the Belle, and is about eight miles above it. A little more than the same distance farther is the Ouiatchouan, equal in size to the last, and six miles beyond it a somewhat smaller stream, the Ouiatchouanish. About the same distance farther we come to the most eastern part of the lake, and here enters the River Chamouchouan, and a couple of miles to the north the Mistassini. These two rivers are each of them over half-a-mile wide at their mouths, and when the waters of the lake are at their highest, which is fourteen or fifteen feet over their lowest level, the two rivers join for some way inland. At low water the shore between them, as well as above and below them presents a margin of dry sand of from one to two miles wide, forming a delta through which the rivers cut various channels. This description of coast extends all the way to the mouth of the Peribonka, which is the next stream, a distance of twelve miles, where the breadth of sand is upward of two miles, gradually tapering to nothing along the north-east shore. Inside of this extensive margin of dry naked sand there is a considerable breadth of low sandy country supplying a growth of meadow hay, with strips of small trees and brush-wood, giving farther evidence of the great amount of arenaceous material that is brought down by the rivers from the Laurentian rocks of the interior, the accumulation of which has so far filled up the whole lake as to give origin to its Indian name of *Pia-koua-kanny*, said to signify the broad shallow lake.

For the first twelve miles of its upward course the Peribonka is from a-quarter to a-half mile wide, and it presents several low sandy islands, as well as low sandy banks. But at this distance from its mouth it at once contracts to a breadth of not much over one chain, and maintains it for a-mile up. Through this sluice, bounded on each side by dark violet-blue labradorite rock, the whole volume of the river rushes with immense violence, producing a rapid current for some way down in the middle of the wider water below. Above this the river again widens out and still water prevails for a farther distance up. It then once more contracts and again rushes between its rocky margins with the same violence as before. This alternation of still and rapid water holds for some distance up the river, and the country on each side is said to correspond with the changes, giving a swampy surface opposite the still water, while a ridge of rock runs across the rapid part, very probably indicating the strike of the Laurentian rocks through the vicinity.

On these ridges large quantities of pine timber are said to exist, and they have I believe, already furnished a large proportion of its supply to the lumbering establishment of Messrs. W. Price and Son. The timber over the country described consists generally of spruce, balsam-fir, yellow and white birch and maple on the clay, with elm and ash in low places. On the higher and more sandy parts white pine prevails.

The valley of St. John Lake may very properly be considered as commencing at the mouth of Ha-Ha Bay. This constitutes the eastern extremity of the general depression or comparatively level surface of which the area occupied by the lake is probably the lowest flat; and from this point the boundaries of the depression separate from one another, that on the north side of the Saguenay running about N. 20° W. for about thirty miles, and then changing its bearing to about N. 75° W., and in that direction running for about sixty miles. The boundary on the south side of the Saguenay separates a little from the south side of Ha-Ha Bay, in its progress running nearly S. W. It then gradually turns to about west of north, and gaining the south side of Lake Kenogami, runs along its whole length as well as Lake Vert beyond. It continues nearly in the same direction, and crosses the Metabetchouan about a mile from its mouth, coming very near the lake in a bay west of it. It crosses the Ouiatchouan at the fall about a mile from the lake and then turns about N. 55° W. Running in this direction it crosses the Ouiatchouanish about six miles up, and from Blue Point it is traceable by the eye running in the same course for twenty miles more, in which it keeps to the south of the Chamouchouan. Between the north and south boundaries where they can be no farther traced by the eye, there is a separation of about fifty miles for the breadth of the valley, the length of which up to a line running across at the upper end of the lake is about seventy-five miles, the general bearing of the valley being N. 70° W. How much farther it may extend in the same direction I am unable to say. Thirty miles added to the distance above mentioned would give an area of 5000 square miles. But as viewed from Lake St. John the northern boundary appears to terminate, and the valley may perhaps spread out to the eastward. Indeed one of the Indians who was with me asserted that it did so, stretching along in that direction to the Seven Islands on the St. Lawrence, while in the opposite one it extended to Lake Temiscamang. But it is uncertain what dependence can be placed on his information. I may state however, that his account is in some degree corroborated by what I was given to understand last year when at the Mingan Islands. Mr. Henderson of the Hudson Bay Company's post informed me that large loose masses of limestone, which from his description I inferred were Silurian, are met with far in the interior from the Seven Islands, in a direction that appears to bend towards Lake St. John, and I am inclined to think that where these blocks were seen, some of the Silurian strata will be found *in situ*, as is the case on Lake St. John. Where flat deposits of these rocks extend the country is almost certain to be capable of cultivation.

The northern ridge is much more elevated than the southern, and it is apparently destitute of soil on the summits, which are probably not under 2000 feet above the lake. The hills on the south were not supposed to be much over 700 or 800 feet above the lake. Their tops were generally rounded, and the growth of timber upon them, which was all composed of evergreens, seemed to confirm the report of the inhabitants, that these hills were pretty well covered with soil. The range however, gains in height towards Ha-Ha Bay, and all the wood is there of a stunted growth.

The cultivateable land of the valley of St. John most probably occupies a very large proportion of its area, and as in the settled parts of it good crops seem to be the general result, it appears to me very probable that the valley will hereafter support a very considerable population. There appears to be no doubt in the minds of the settlers that they are able to grow all the kinds of grain produced in the neighbourhood of Montreal, and in equal abundance; and the unexplained superiority of climate in the valley over places more to the south renders the investigation of this part of the province a subject of considerable interest.

Mr. Blair, who superintends the works of Messrs. W. Price & Son, at Grand Bay, has kindly furnished me with the returns from the farm of the firm for the past eleven years. He informed me that the results for ten of these years had already been published in the *Toronto Globe.* I shall therefore only give the return for the season which had just past when I left Chicoutimi.

Statement of Produce raised on the Farm of Messrs. W. Price & Son, Grand Bay, under the management of Mr. Blair.

Produce.	Bushels Sown.	Yield per Bushel.	Bushels per Arpent.	Sown or Planted.	Cut.
Wheat	33	15	20	5 May to 20 May.	15 Aug. to 20 Aug.
Wheat & Rye	44	16	24	9 " to 18 "	15 " to 20 "
Barley	11	20	30	25 April to 18 "	30 July to 13 "
Oats and Rye	154	12	25	9 May to 18 "	19 Aug. to 3 Sept.
Oats	238	12	30	25 April to 8 "	20 " to 9 "
Pease	40	10	18	1 May to 8 "	31 " to 22 "
Potatoes	100	20	275–300	7 " to 27 "	6 " to 15 Oct.

Hay, total yield, 25,200 bundles; average yield per arpent, 200 bundles; cut 27th July to 19th August.

Indian Corn, a small quantity in the garden, good sized; picked green for use 15th August, and thoroughly ripe 15th September.

REMARKS.

Wheat.—A part sown on new ground was stinted by dry weather in the end of June and beginning of July.

Oats and Rye.—Being sown on new ground, they suffered from dry weather in the end of June and beginning of July.

Oats.—Being sown on new ground, they suffered from dry weather in the end of June and beginning of July.

Pease.—Other grain pressing to be cut, a scarcity of hands caused a late harvest and consequent loss by shelling.

Potatoes.—Dry and free from disease.

Hay.—Early rain and then frost in the spring destroyed the roots in some places, which produced nothing.

The cattle that are kept on the farm are a cross between the Canadian and short-horn. The principal object held in view is the raising of stock for beef and for hauling timber. In the winter straw is used liberally among the horses to induce the cattle to feed upon it more fully. Sawdust from the mill of the establishment, is used in the stable in summer to soak up the liquid manure.

DISTRIBUTION OF THE ROCK FORMATIONS.

The formations which present themselves in the area above described are in ascending order,

1. Laurentian.
2. Lower Silurian.
3. Post-tertiary or Drift.

Laurentian Series.

Between the St. Lawrence and the mouth of Ha-Ha Bay all the rocks examined consisted of gneiss. About three miles farther down the St. Lawrence than Tadousac, at a point just below Rivière à Baude, the rock is distinctly banded, and in great part composed of deep flesh-red orthoclase feldspar, which runs in layers of greater or less thickness, separated from one another by small but continuous patches of greenish hornblende, grains of quartz being sparingly disseminated. The strata dip S. 35° E. $<51°$, and they are cut by a perpendicular vein of calc-spar, which is twelve feet wide and runs N. 20° E. The calc-spar occurs in large cleavable masses and is nearly pure, there being disseminated through it only a few small crystals of copper pyrites.

On the north or left side of the Saguenay, about seven miles below the mouth of the River Marguerite, a mottled rock is met with composed of reddish-white orthoclase feldspar and small quantities of white quartz, with spots and streaks of greenish granular hornblende in some abundance, and a little brown mica. Lines indicating stratification are visible, but they are indistinct and irregular, and it was not easy to determine the general dip. At Cape Diamond, which is the highest cliff on the same side of the river, about seven miles farther up, the gneiss consists of pale yellowish or flesh-red orthoclase striped with black hornblende in dotted lines, and mixed with a sparing amount of white quartz, the whole showing a dip about S. 20° W. $<45°$.

Not far from the extremity of the point which separates Ha-Ha Bay from the higher part of the river, the rock consists of alternations of red and grey gneiss, the former exactly resembling the beds seen near Rivière à Baude, and the latter only differing from it in color from the paler tinge of the feldspar, and the greater abundance of black hornblende. Some of the thin bands are composed almost entirely of black hornblende, with fine grains of feldspar and quartz and brown mica weathering yellowish-white; others consist largely of white translucent quartz and reddish-white orthoclase, and the whole are interstratified with occasional layers of fine grained lime-feldspar, with cleavable pyroxene. The beds are vertical and run nearly north and south. At the head of Ha-Ha Bay, at the commencement of the road to Chicoutimi, a considerable exposure occurs consisting of several varieties of rock, which run parallel with one another. At the south side of the exposure there are about 300 yards in breadth of a coarsely granular orthoclase rock, composed of pale flesh-red feldspar, with small quantities of quartz, considerable quantities of black granular hornblende and a little brown mica. The mass does not show any very distinct marks of stratification, except that it runs parallel with about twenty or thirty yards of a porphyroid feldspathic rock, the base consisting of greyish-yellow lime-feldspar with violet-colored feldspar (labradorite) imbedded in it. The individuals of the latter are large, and the rock holds crystalline masses of dark olive-green cleavable pyroxene with small portions of magnetic iron ore, and occasional patches of black mica. This mass is followed by an equal thickness of rock composed of black granular hornblende, with small quantities of striated triclinic white feldspar, the hornblende greatly predominating. Beyond this dark band succeed about 400 yards of fine grained flesh-red orthoclase rock in which are unequally mixed white translucent quartz and a sparing quantity of brown mica. In these successive masses taken separately it is not easy to discover any arrangement of lines indicating stratification, but their parallelism to one another, and the fact that they conform to the stratification which is seen elsewhere in the vicinity, induces me to suppose that they constitute a part of it, and are not intrusive. The masses appear to be vertical, and their bearing is about S. 30° W. and N. 30° E.

About a mile east of Chicoutimi the rock which presents itself is a dull pale brownish-yellow lime-feldspar with a waxy lustre, sometimes fine grained and slightly calcareous, and sometimes made up of moderately sized cleavable masses, with occasionally a little brown mica, and in one part a small quantity of white quartz. The rock generally contains cleavable green pyroxene in considerable masses, with magnetic iron ore, and occasionally small crystals of a black mineral as yet undetermined, but supposed to be orthite. At Chicoutimi, above the mouth of the Kenogami, the rock is a reddish gneiss resembling that at the mouth of Ha-Ha Bay.

The fall which occurs at the Rocky Portage, near the foot of Kenogami Lake, descends over a porphyroid mass composed of flesh-red orthoclase feldspar, holding a small amount of white quartz with black granular hornblende and brown mica. It resembles the most southern mass at the commencement of the road from Ha-Ha Bay to Chicoutimi, with the exception of its porphyroid aspect, and it has some indistinct indications of stratification, across which there was a breadth exposed of about 400 yards.

Proceeding along Lake Kenogami, which is a narrow strip of water with a length of fifteen miles, it seems the whole way to separate the orthoclase rocks which compose the range of gneiss rising on the south, from the lime-feldspar rocks on the north. Between three and four miles up the lake, on the north side near the Au-Sable exit, the rock is a fine grained mixture of black hornblende and triclinic feldspar, exactly resembling the black band on the road from Ha-Ha Bay. Upwards of four miles farther on we have a greenish-white granular lime-feldspar, holding patches of granular pyroxene, and the rock is porphyroid from the presence of masses of a light blue feldspar. Two miles beyond this the rock is a bluish-grey coarsely crystalline lime-feldspar, with small quantities of golden-yellow and brown mica, while about a mile from the head of the lake it consists of a pale dull yellowish-brown lime-feldspar with a waxy lustre, holding cleavable masses of dark green pyroxene, altogether resembling the rock a mile east of Chicoutimi.

On the Bon Portage, which leads from the head of Lake Kenogami to Lake Kenogamishish, a rock which is a variety of the last described, is seen in juxtaposition with one composed of orthoclase feldspar, a small quantity of quartz and brown mica, while a little farther on the road a fine grained light violet lime-feldspar occurs with patches of fine grained pyroxene.

At the Crooked Falls on the Aulnais, just below Lake Kenogamishish, the rock appears to be composed of fine grained flesh-red orthoclase and brown mica, without perceptible quartz or any indications of stratification. It is a material resorted to for mill-stones in the vicinity.

Continuing to skirt along the south range of hills bounding the valley of Lake St. John, we find as we proceed westward from Lake Kenogami, that they still give the south limit of the lime-feldspar rocks. One mile west of the Metabetchouan River the hill presents a fine grained micaceous gneiss, composed of deep flesh-red orthoclase with quartz and brown mica, the dip being southward at a high angle. Between this rock and the lime-feldspar there runs a band of sometimes fine and sometimes coarse grained flesh-red orthoclase and quartz, forming a pegmatite, of which the feldspar has the aspect of that which so often in the Laurentian series presents the arrangements peculiar to graphic granite. This is about two feet wide, and north of it the rock is of a porphyroid character, composed of greyish-white lime-feldspar, with tinges of red and green, the latter due to granular pyroxene, which forms patches with scales of mica, and it holds imbedded cleavable masses of lavender-blue feldspar (labradorite), shewing very beautiful striæ. In some narrow bands the pyroxene predominates, and is then accompanied with magnetic iron ore.

At the falls of the Ouiatchouan a similar succession occurs.

The hill is composed of micaceous gneiss, to the north of which runs a band of coarse grained pegmatite, with lime-feldspar rock beyond; but in this case the last rock consists of white lime-feldspar, brown mica, and black hornblende, the latter greatly predominating. In this direction the examination of the older rocks was not continued farther. The lake shore here began to recede from them, and there was not time for their investigation; but little doubt is entertained that the same relation between the orthoclase gneiss and the lime-feldspar rocks will follow the south range as far as the eye was able to trace it from Lake St. John.

Several exposures of rock belonging to the Laurentian series were examined between the junction of the River Aulnais and the lowest rapid of the Peribonka. They lie in a line nearly straight, the bearing of which is about N. 18° W., and they are all of lime-feldspar. The first of these exposures is at a fall on the Belle River, about four miles up from its mouth, where the rock consists of a light violet-red fine grained lime-feldspar, with patches of fine grained pyroxene, and becomes porphyroid in parts from the presence of magnificent cleavable masses of violet-blue lime-feldspar (labradorite), which are strongly striated. The breadth of this exposure is about fifty yards, and its strike appears to conform to the gneiss in the south range of hills. A mile below this the rock consists of black granular hornblende with a sparing quantity of white lime-feldspar, very similar to some bands already described, and half-way between it and the mouth there protrudes from the clay a mass of about a yard wide, composed altogether of dark-green cleavable pyroxene with curved surfaces, associated with small quantities of magnetic iron ore.

At the mouth of the river a surface of rock seen under the water of Lake St. John appeared to be dark violet lime-feldspar, identical with an exposure to be mentioned at the lowest rapid of the Peribonka. A similar rock was observed about two miles below the mouth of the Belle River, again on the outside of the island above the Little Discharge, a fourth time on the largest island between the Little and the Great Discharge, and a fifth time on the shore about two miles above the Great Discharge, where it was accompanied with rensselaerite. All these exposures from the mouth of Belle River are so like one another that it is probable they belong to one band, which is continued to the Peribonka Rapid already mentioned. At this rapid the rock is exposed for a mile in a direction slightly oblique to the supposed strike and for 200 yards at right angles to the strike on the right or west side of the stream, while it rises in a precipice thirty feet in height on the opposite side. It presents a uniform black exterior, and in fresh fractures its color is a deep violet-blue, which characterizes large cleavable forms having strongly striated surfaces. Though no part of it that came under my observation displayed opalescence, the rock is a splendid instance of nearly pure labradorite, the only mineral disseminated through it being a pyroxene in very small quantity. On the right bank of the stream it is cut by a vertical band of a pale green mineral with a waxy lustre, unctuous to the touch, which appears to be rensselaerite. It was traced for about fifty yards, and was taken to indicate the strike of the stratification, which would very nearly correspond with the bearing of all the exposures of the rock from the mouth of Belle River.

The impression produced upon me by the geographical and geological facts ascertained is that both the north and south ranges of hills bounding the valley of St. John Lake are composed of the same orthoclase gneiss which occurs between the St. Lawrence and Ha-Ha Bay, and that the lower ground is in general underlaid by the lime-feldspars, with the exception of those parts covered by the Lower Silurian series ; but to prove this satisfactorily will require a much greater amount of investigation.

On our walk from the head of Ha-Ha Bay to Bay St. Paul our opportunities of examination were not very good, as we found on entering among the hills that the ground for the chief part of the way was covered with about eight inches of snow. For the first forty-five miles of the road all the exposures of rock observed were orthoclase gneiss, resembling those on the lower part of the Saguenay. The highest and boldest hills appeared to be those about the head of Ha-Ha Lake, where the outlines and the rocks resembled those of Cape Diamond on the Saguenay. The first indication of change was met with about six miles north of the church of St. Urbain, not very far from the road which branches off to Murray Bay. We here met with lime-feldspar rock weathering opaque white, consisting of white lime-feldspar spotted with pale pink, and holding in sparing quantity very minute grains of pyroxene. We ascertained also that the rock which stands in the apparent south-west strike of the great mass of ilmenite you have described as existing some distance below the church, on the land of Mr. Fortin, is composed of lime-feldspar of a pale yellowish-brown passing into greenish, and that a similar lime-feldspar occurs in patches imbedded in the ilmenite. It is probable that a large part of the rocks of this vicinity may have lime-feldspar as their chief constituent, and be as you have supposed in your Report of 1856, a continuation of the lime-feldspar rock of Chateau Richer.

Before leaving the subject of the Laurentian series I may state that several bands of garnet-rock, composed almost entirely of raspberry-red garnets with white reticulating quartz, the bands separated from one another by micaceous schists, were met with on the north-east side of Bay St. Paul, close upon the margin of the St. Lawrence. The whole occupied a breadth of about sixty feet, of which the garnet-rock constituted about one-third. The strike of the stratification was about east and west.

Lower Silurian Series.

The first and most eastern exposure of this series seen on Lake St. John, occurs on a flat island about half-a-mile to the west of the Little Discharge. The beds shew but little dip, and that not always in the same direction. They consist of yellowish-grey granular limestone, and have thicknesses of from two to eight inches. They are well stored with fossils, among which occur *Stromatocerium rugosum*, abundant and large, *Streptoplasma corniculum*, *S. profunda*, *Palæophyllum rugosum*, *Stictopora acuta*, *Orthis testudinaria* *O. lynx*, *O. elliptica*, *Leptæna sericea*, *Strophomena* *alternata*, *Rhynconella (Atrypa) increbescens*, *R. recurvirost* *Murchisonia gracilis*, *M. bellicincta*, *Pleurotomaria umbilicata*, *P. supracingulata*, *Ormoceras tenuifilum?* *Orthoceras ottawaense?*

The next observed locality of fossiliferous rocks on the coast is above fourteen miles south-westward from the previous one, its position being about two miles west of the mouth of the Metabetchouan River. Here the Silurian limestone was seen resting on the Laurentian rocks, both the orthoclase gneiss and the lime-feldspar running under it. The following is the ascending section of the limestone:—

	Ft.	*in.*
Brown compact bituminous limestone, in beds of from three to nine inches thick; the rock presents fossils which are replaced by silica, and except when they are weathered out, but few good specimens could be procured. Among them were met with *Stromatocerium rugosum*, *Streptoplasma corniculum*, *S. profunda*, *Receptaculites Neptuni*, *Leptæna sericea*, *Strophomena alternata*, *Rhynconella recurvirostra*, *Murchisonia gracilis*, *M. ventricosa*, *Pleurotomaria bellicincta*, *Ormoceras tenuifilum?* *Calymene senaria*, ...	8	0
Blackish-brown bitumino-calcareous shale, becoming occasionally a limestone; the only fossil observed in it was a species of *Tellinomya?*........................	1	0
Brown bituminous somewhat granular limestone, in beds of from six inches to three feet. The fossils in it were much the same as those at the base,........................	13	
	22	

About a-quarter of a mile farther west, beds of the same racter as the preceding were observed, filling up hollow the surface of the Laurentian series, and the beds slightly conforming to these hollows produced irregularities in the dip, which however upon the whole pointed towards the lake or N. E. and E.

A little over a mile farther along the shore the following section occurs in ascending order. The dip at the spot is N. 1° E. $<40^{\circ}$, but it moderates in a very short distance:—

	Ft.	*in.*
Grey limestone in beds of from one to two inches thick interstratified with greenish-grey shale; fossils are present in the limestone, but they are very obscure,........................	17	0
Grey limestone in beds of from one to two inches thick interstratified with greenish-grey shale, the latter less abundant than before,....	14	0

	Ft.	in.
Yellowish-grey nodular limestone, in beds of from two to three inches thick, holding fossils, among which are *Streptoplasma profunda*, *Stictopora acuta*, *Orthis testudinaria*, *O. pectinella*, *Leptæna sericea*, *Strophomena alternata*, *Encrinurus vigilans*, ...	19	0
Yellowish-grey granular limestone with beds thicker and more even than the previous, with similar fossils but obscure, ...	10	0
Yellowish-grey granular limestone, similar to the last; the fossils are obscure; at the top fragments of encrinal columns are abundant,.	22	0
	82	0

In three places, this being one, these beds are followed by black bituminous shales resembling those of the Utica slate formation, and as the fossils of the limestones beneath them are such as characterize the Trenton group down to the base of the Bird's Eye and Black River limestones, there can be no doubt that the same members of the Lower Silurian series exist on Lake St. John.

A-quarter of a mile farther on, forty-two feet of the limestone are exposed on the margin of the lake where the dip is S. 85° E. <50°, and still farther on a thickness of seventy feet is seen. In both these instances the limestones are followed by the black shales. From the last mentioned exposure the limestones run inland, and strike round to the mouth of the Ouiatchouan, leaving the whole of Point Traverse, composed of the black shales.

On the Ouiatchouan the base of the limestone is found about three-quarters of a mile up from the mouth, resting on the Laurentian rocks, and the formation occupies the breadth of half-a-mile, leaving the remaining quarter of a mile for the black shales. Three feet at the base of the limestones are composed of yellowish-grey beds with tolerably well defined fossils replaced by silica, and weathered out on the surface; among them are *Monticulipora dendrosa (Chætetes lycoperdon)*, *Streptoplasma profunda*, *Halysites catenulatus*, (never before found so low on this continent), *Orthis lynx*, *Murchisonia gracilis*, *M. bellicincta*, *Pleurotomaria umbilicata*, *Scalites minor*. The remaining thickness up to the contact with the black shales is probably about fifty feet. The dip of the strata is from N. 25° E. to N. 70° E. <from 8° to 10°; but the descent of the

geographical surface is such that the accumulation of strata is not beyond the volume stated. The general character of these strata is that of a grey sometimes nodular limestone, in beds of from two inches to one foot in thickness, with partings of bituminous shale. The beds are moderately well supplied with fossils, among which are *Monticulipora dendrosa*, *Streptoplasma profunda*, *Leptœna sericea*, *Strophomena alternata*, *Rhynconella increbescens*, *Orthis tricenaria*, *Pleurotomaria umbilicata*, *Murchisonia bellicincta*, *Bellerophon bilobatus*, *Oncoceras constrictum*, *Isotelus gigas*, *Acidaspis Horani*. Between the limestones and the black shales on the Ouiatchouan there appears to be a fault running S. 45° E., which brings down the shales against the limestones, but the down-throw is not supposed to be a great one.

Beyond the Ouiatchouan no rocks are seen on the lake shore until we reach Flat Point, a distance of about five miles; but from this point to Blue Point, nearly six miles farther, exposures of the limestone occur very frequently the whole way, and in the latter part of the distance, from a point about half-a-mile north of the Ouiatchouanish, their contact with the black shales is occasionally well displayed. In the whole of this distance the dip is towards the lake, and the strike conforms in some degree to the turns of the coast, the general bearing being about N. But at Blue Point it turns at a right angle to the westward, and the line of contact gradually departs from the shore.

The following section of the limestones occurs at Blue Point in ascending order.

Ft.

Yellowish-grey bituminous compact limestone in beds of from two to three inches thick; the rock holds many fossils which are replaced by silica; few of them can be obtained by fracturing the rock, but they are dissolved out on the surfaces of the beds into high relief by the action of the water, and very good specimens are thus obtained. Among them are *Phytopsis cellulosum*, *Stromatocerium rugosum*, *Streptoplasma profunda*, *Receptaculites Neptuni*, *Columnaria alveolata*, and *Halysites catenulatus;* the last coral occurred loose, but having been found in place in the section on the Ouiatchouan, I do not doubt that the species belongs to the Blue Point section also. In addition to these corals there occurred *Atrypa hemiplicata*, *Rhynconella increbescens*,

	Ft.
Orthis testudinaria, O. tricenaria, Tellinomya ——— ? *Murchisonia gracilis, M. bellicincta, Pleurotomaria umbilicata, P. lenticularis, Subulites elongatus, Bellerophon undatus, Ormoceras tenuifilum*	42
Grey bituminous limestone in beds of from three to nine inches, with obscure fossils	26
Yellowish-grey bituminous and somewhat granular limestone in beds of from three inches to one foot; among the fossils were *Orthis lynx, O. testudinaria, O. tricenaria, Strophomena deltoidea, S. alternata, Leptæna sericea, Atrypa hemiplicata, Murchisonia bellicincta, Pleurotomaria umbilicata, Ambonychia* —— ? *Phacops callicephalus, Encrinurus vigilans, Isotelus gigas*..	32
	100

The country being flat to the westward in the strike of the limestone from Blue Point, it is probable the formation may extend much farther in that direction. I was informed of its existence about six miles up the Ouiatchouanish, but the locality was not visited.

Large loose fragments of similar limestone were met with at the head of Ha-Ha Bay, near the village of Bagotville, but none of it was seen in place there.

The distribution of the black bituminous shales has been given in describing that of the limestones beneath them. On the east side of the Ouiatchouan a visible thickness of about thirty feet skirts the coast for a-quarter of a mile with a dip N. 36° E. <from 3° to 4°. The dip at Point Traverse with the same slope becomes rather more easterly, being there N. E., and the formation is continued out to Large Island about a mile north of the point, where Mr. Barlow ascertained that the strata were flat. The greatest thickness was observed at Blue Point. The lowest beds as they strike inland here dip N. 3° W. <26°, but before reaching the extremity of the point the dip becomes twenty degrees more westward, and between the two spots an accumulation of strata equal to a hundred feet is displayed.

In every observed exposure these shales are black and strongly bituminous, and they lie in beds of from a-sixteenth to an-eighth of an inch thick. The change from the limestones below them is sudden, there being no interstratification of calcareous layers at the base. From a-quarter to half-an-inch at the bottom was filled with fragments of encrinal columns, which being white gave to the layer a dotted grey aspect and supplied it with calcareous matter. Graptolites abound in the beds. Among them is *Graptolithus mucronatus*, and there are probably some new species. *Dictyonema* occurs, and among the fossils are *Orbicula filosa*, *O. lamellosa*, *Lingula* ——? several new species of *Orthoceras* and *Triarthus Beckii*.

On Snake Island, about a mile and a-half westward of Large Island, there occurs an argillaceous yellow-weathering limestone, of which a small exposure was seen in place. The island, which is about a mile long and a furlong wide, is covered with fragments of the same kind, and Mr. Bell and Mr. Barlow obtained from those around the island a considerable collection of good fossils, some of the forms among which appear to indicate that the island must be underlaid with rocks of the Hudson River group. Among the fossils are *Streptoplasma corniculum*, *Stictopora acuta*, *Halysites catenulatus*, *Beatricea undulata*, so common in Anticosti, *Orthis occidentalis*, *O. lynx*, as large as in Anticosti, *O. testudinaria*, *Atrypa Headi*, *Rhynconella increbescens*, *Ambonychia radiata*.

Drift.

Along the whole distance from the entrance of Ha-Ha Bay to the farthest westerly point attained on Lake St. John on the south and west shores, clays, sand and gravel are met with in many parts; but in so far as my own knowledge of them extends their distribution and thickness have already been given in the geographical description.

Marine testacea were found in clay on Belle River about half-a-mile below the lower falls, where a few individuals of *Saxicava rugosa* were brought to view by a land-slip in the bank of the river. The exact height of the position above the sea I am not able to give, but it is probably somewhere between 200 and 300 feet. Another locality presenting them was on the River Ouabouchbagama or St. Alphonse about four miles above its entrance into the upper part of Ha-Ha Bay. Here fragments of *Saxicava rugosa* were observed, and the computed height of the spot above the sea was about 150 feet. The same species in abundance, with *Natica clausa*, *Littorina palliata*, and *Balanus crenatus*, was observed by Mr. Bell in a bed of sand of six inches thick overlaid with clay. The position is about a-quarter of a mile below the Catholic church at Chicoutimi village, and the height of it above high water-mark is only a few feet.

No ice grooves were observed on the surface of any of the exposures of rock examined, most of which were too much injured by the effects of weather to have retained them if they ever existed; many of the rocks however have that general rounded form which is supposed to result from the wearing action of ice.

ECONOMIC MATERIALS.

As on the south side of the St. Lawrence, the substances met with around Lake St. John capable of economic application were but few. They consisted of bog iron ore, mill-stones, garnet-rock, rensselaerite, labradorite, building stones, limestone, common-brick clay, and mineral waters.

Bog Iron Ore.—This ore was observed in small quantities on the east side of the Ha-Ha River, about one mile from Ha-Ha Bay on the road leading from it to Bay St. Paul. It occurred in small masses of a-quarter or half-an-inch in diameter lying somewhat detached from one another. Though they were not sufficiently numerous to be of any value, they may indicate deposits of more importance in the vicinity.

I was informed by Mr. J. Kane, Crown Land Agent at Ha-Ha Bay, that a small quantity of the ore was found in digging a ditch on a lot belonging to Mr. Joseph Tremblay in the second range of Bagot, beyond River St. Alphonse.

Mill-stones.—The feldspathic rock at the fall on the River Aulnais yields a material which has been applied to the manufacture of mill-stones. The rock is destitute of any indication of stratification, but it appears to split readily into rectangular blocks, by the application of wedges. It is made up of feldspar with mica equally distributed through it and without any observed quartz. It must therefore be the unequal hardness of the two minerals, rather than the great resisting power of the feldspar, which renders the stone effective. I was informed by Mr. Felix Langlois that he had used the stone in his mill at the fall for grinding wheat, and that it answered the purpose remarkably well.

Garnet-rock.—In your report of progress for the year 1852, you have noticed the application of garnet rock as a polishing material when reduced to a powder, the garnet, in consequence of its hardness, which is superior to that of quartz, being sometimes used in that form as a substitute for emery. In some parts of the bands of garnet-rock met with in Bay St. Paul the garnets are so closely aggregated that much of the mass might be made available for the purpose indicated.

Rensselaerite.—The refractory nature of this mineral, which often occurs in considerable rock masses, and its applicability to various ornamental purposes, renders the occurrence of it worthy of notice. The thickness of the band observed at the rapids of the Peribonka is not sufficient to be made available; but the presence of the mineral in association with the labradorite rocks gives a reasonable expectation that it may be found in larger abundance in some parts of the district in which these rocks appear so largely to prevail.

Labradorite.—Athough none of the exquisitely beautiful opalescent varieties of the rock were observed, there is yet every probability that they will hereafter be discovered in the valley of St. John Lake; but the porphyroid and violet-blue descriptions met with would give materials capable of application to purposes of decoration. The uniform color of the mass exposed at the Peribonka rapids, and the great solid blocks that could be obtained there induced me to think that at some future time it might be turned to good account.

Building Stones.—Most of the lime-feldspar rocks met with would split into fine solid rectangular blocks for building purposes, and though of course harder than limestone, they would not be very difficult to dress. The exposure which has been mentioned near Chicoutimi would be available for building stones. It occurs behind the house of Mr. G. Duberger, where natural rectangular blocks shew the tendency of the rock to yield useful forms of any required size from one to five feet cube. The color as has been stated is here of a yellowish-grey or brown passing into greenish.

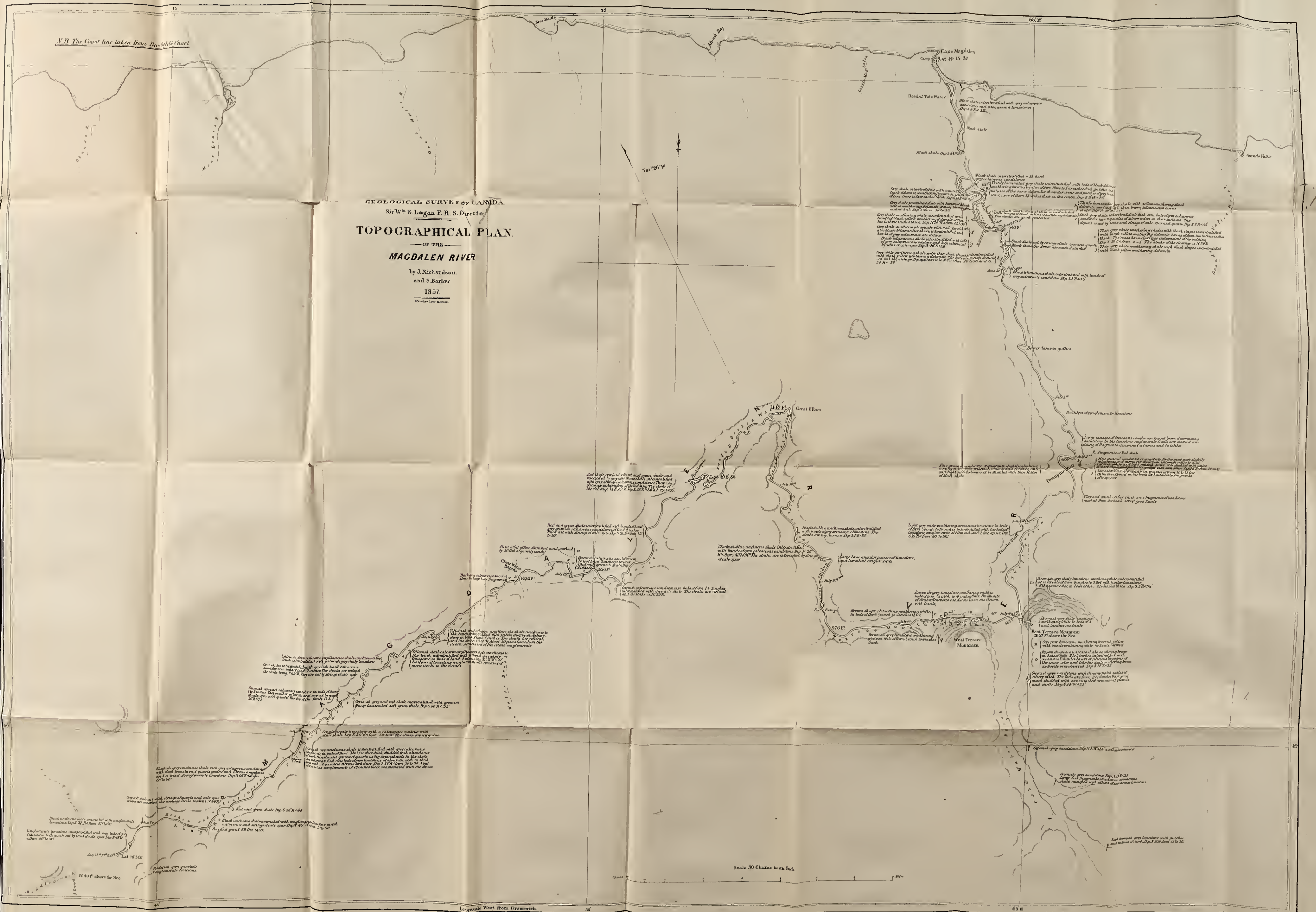
About a mile west of the mouth of the Metabetchouan the Silurian limestone would give a good easily worked stone in blocks of almost any required size, and this will probably be resorted to for architectural purposes long before the lime-feldspars, in consequence of its greater cheapness, particularly as the same locality would afford lime for mortar.

Limestone.—Not only near the mouth of the Metabetchouan, but at almost every spot where the fossiliferous limestones were met with on Lake St. John, stone fit for burning into lime could be obtained. At the head of Ha-Ha Bay near Bagotville, the inhabitants have for several years resorted for their lime to the large loose blocks of the same fossiliferous rocks, which have been mentioned as existing there. But when these are exhausted, unless the rock should be discovered in place in the vicinity they will probably have recourse to the strata of Lake St. John.

The twelve-feet vein of calc-spar which occurs below Tadousac would afford a present supply of lime to the inhabitants of the neighbourhood, who not suspecting the properties of this rock, have hitherto been under the necessity of sending to a great distance for their supply of lime or of doing without it altogether. The latter alternative appears to have been the one generally adopted, as the buildings shewed no signs of the use of mortar in their construction. I took the opportunity of informing several of the inhabitants of the position and the economic value of the calc-spar, and although all of those to whom I gave the information appeared to be aware of the existence of the vein, none of them seemed to have entertained any idea that it would yield them a material of which they stood so much in need. Some of them I have no doubt will speedily make the information available.

Common-brick Clay.—It will be unnecessary to point out any particular spot as containing clays fit for brick-making, as the whole district from Ha-Ha Bay to the most westerly


GEOLOGICAL SURVEY OF CANADA.
Sir Wm. E. Logan F.R.S. Director.
PLAN
SHOWING THE DISTRIBUTION OF THE
LAURENTIAN AND LOWER SILURIAN ROCKS
in the vicinity of
LAKE St. JOHN
To Illustrate the Exploration of
J. Richardson.
1857.
LAKE St. JOHN
River Peribonka
Low and Sandy
Sand
Great Discharge
Little Discharge
River Saguenay
R. Mistook
R. Shipsha
R. Valin
R. au Caribou
R. Marguerite
SIMARD
TREMBLAY
HARVEY
SIGNAY
LABARRE
KENOGAMI
JANQUIERE
CHICOUTIMI
Chicoutimi
HA-HA BAY
BAGOT
ROBERVAL
OUIATCHOUAN
CARON
MESY
PLESSIS
LATERRIERE
SIMON
METABETCHOUAN
CHARLEVOIX
R. Chamouchouan
Trenton Limestone
Utica Slate
Lime Feldspar
Belle River
Falls 80 to 100 Ft.
Kenogami Road
Lake Kenogami
Lake Kenogamishish
Sydenham Road
Bagotville
Cap a l'Ouest
Cap a l'Est
Blue Pt.
Traverse Pt.
H. B. Co. Post
Saw Mill
Road to St. Urbain
Road to St. Agnes
Ha-Ha River
Scale of Miles.



GEOLOGICAL SURVEY OF CANADA.
Sir Wm. E. Logan F. R. S. Director
TOPOGRAPHICAL PLAN.
OF THE
MAGDALEN RIVER.
by J. Richardson.
and S. Barlow
1857.
N.B. The Coast line taken from Bayfield's Chart
Cape Magdalen
Lat. 49 15 32
Head of Tide Water
Var. 26° W
Great Elbow
Beaver dams in gullies
East Terrace Mountain
1057 Ft. above the Sea
West Terrace Mountain
Scale 80 Chains to an Inch
Longitude West from Greenwich

point of Lake St. John on the east and south sides abounds with it, and scarcely any place, excluding the sandy deltas of the large rivers, could be named, within a short distance of which the clay could not be rendered available for all the bricks that will ever be required.

Mineral Springs.—I am not able from personal observation to point out the exact locality of any mineral spring, but I was informed that there is one not far from Chicoutimi, and another near the head of Ha-Ha Bay. If these springs, when they are examined, should prove to be possessed of any medicinal virtues, they would be of some importance to positions which are annually becoming more and more resorted to by the tourist for his pleasure and the invalid for his health.

I have the honor to be,

Sir,

Your most obedient servant,

J. RICHARDSON.

ERRATA IN MR. BELL'S REPORT.

Page 95, 4th line from bottom for *North-east* read *North-west.*

" 97, 5th line from bottom for *Urea grylli* read *Uria grylle.*

" 100, 12th line from bottom for *Vetrina* read *Vitrina.*

" 102, 9th line from bottom for *Temasias* read *Tamias.*

" 106, 10th line from bottom for *Plathycarcrinus irrogaturs* read *Platycarcinus irroratus.*

" 107, 1st line from top for *Alasmadonta* read *Alasmodonta.*

" 107, 15th line from bottom for *Carduim* read, *Cardium.*

REPORT

FOR THE YEAR 1857,

OF

MR. ROBERT BELL,

ASSISTANT ATTACHED TO THE EXPLORING PARTY OF MR. RICHARDSON,

ADDRESSED TO

SIR W. E. LOGAN, F.R.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 1*st March*, 1858.

SIR,

During last summer and autumn, while accompanying the exploring party under Mr. J. Richardson, with which you were pleased to send me, I collected agreeably to your instructions, specimens of all the recent shells I could obtain. Not having had an opportunity to make the necessary preparations for collecting specimens in other branches of natural history, my attention was confined almost exclusively to the mollusca as being the most easily preserved.

On the 3rd of June we embarked on board of a schooner at Quebec, intending to proceed without delay to the Magdalen River; but those in charge of the schooner finding it necessary to stop and take in ballast at Bay St. Paul on the north-east bank of the St. Lawrence, between fifty and sixty miles below Quebec, an opportunity was afforded me of collecting what shells were to be found there.

On the shoals at the mouth of the River Gouffre there occurred a number of *Sanguinolaria fusca* (Conrad). Most of the shells are thinner and less eroded, but many of them larger than any of this species afterwards found lower down the St. Lawrence. The bay is a pretty deep indentation on the left bank of the St. Lawrence, and it is well sheltered by Isle aux Coudres which lies in front of it, as well as by the high land in the interior. The shells were obtained with the animal in them in shallow ponds when the tide was out, at the end of long tracks they had made on the bottom, consisting of a soft arenaceous mud in which I sank over the ankle in walking through it. The shells varied in size from 5½ lines in length, 1¾ lines in width, and 4¼ lines deep, to 1 inch 2½ lines long, 3½ lines wide, and 11⅛ lines deep. One individual larger than others was obtained empty, but the valves united by the ligament; it measures 1 inch 6½ lines in length by 4 lines in width, and 1 inch 2⅛ lines in depth; the posterior side of it appears to be more produced than usual. The water of Bay St. Paul, although much too salt to be potable, must be largely diluted with the fresh water coming down the St. Lawrence, and down the Gouffre. On the bank of the Gouffre one specimen of *Unio complanatus* was procured, which although wanting the animal had the valves still firmly united by the ligament.

After leaving this place we were detained some days by head winds at the Brandy Pots, an island so called I was informed from the occurrence on its surface of many small pools of the color of brandy. The island is situated near the lower extremity of Hare Island, on the south side. It is about forty acres in extent, and is well clothed with grass and a few stunted trees. Hare Island is well wooded with spruce, balsam-fir and white birch, and much ground hemlock grows among the trees. Several opportunities were offered me of going ashore to collect shells. The banded and yellow varieties of *Helix hortensis* (Lam.) were found in great abundance, both on the Brandy Pots and on Hare Island. In one instance eighteen individuals, partly of the yellow and partly of the banded variety, were met with adhering to a single isolated tuft of tall grass causing the leaves to hang down as if laden with fruit. On Hare Island a number of dead specimens of *Succinca obliqua* (Say) were obtained.

The salt-water shells found alive consist of *Mytilus edulis* (Linn.), occurring rather abundantly on the Brandy Pots; *Sanguinolaria fusca* (Conrad) thrown up on some parts of the shore in heaps composed partly of living and partly of dead shells; *Mya arenaria*, of which only a few specimens were observed; *Littorina tenebrosa* (Gould), *L. palliata* (Gould), *L. rudis* (Mont.), were very abundant on the banks of both islands. Besides these a number of dead shells were obtained consisting of *Buccinum undatum* (Linn.), *Lottia testudinalis* (Muller sp.), and one each of *Fusus tornatus* (Gould), *Astarte sulcata* (Fleming), with a specimen of *Pectinaria Belgica.* *Buccinum undatum* and *Mya arenaria* were met with at all heights on the Brandy Pots Island from the edge of the water to the summit, the height of which might be about sixty feet over high water-mark, many of them lying on the green moss and other plants. They had the strength, enamel and color of living shells, and had probably been carried up by crows or gulls. The remains of the animal were in some of these dead shells, and the people of the island informed me that they frequently obtained the species alive between high and low water-mark.

On first landing on Hare Island we saw a number of the common Canadian hare from which it takes its name. They quickly escaped into the interior of the island on seeing us, but our Indians, returning next day, succeeded in shooting one of them. While walking through the woods of Hare Island I observed numbers of *Helix hortensis* on the trunks of trees and on the leaves of wild grasses. The species is one well known to be imported from Europe, and the number of vessels from Europe which take advantage of the safe anchorage of the place readily accounts for their presence.

Great numbers of the black guillemot, *Urea grylli* (Linn.), exist around the Brandy Pots Island. At the time of our visit they were just beginning to hatch. The crevices and holes in the cliff on the north side of the island afforded them excellent places on which to lay their eggs, and we found numbers of their nests. There were invariably two eggs in each nest, and we occasionally caught the bird sitting on them. The birds were at the time in their jet-black summer plumage, with a white spot on the wing coverts. We consumed all we could procure, both of the birds, which were very fat, and of the eggs, and found them of excellent flavor. The head and feet of one individual and some of the eggs were preserved as specimens.

We left the Brandy Pots Island on the 12th of June, with a fair wind, which continued until we reached the Magdalen on the 14th. The Magdalen River is about 230 miles farther down than Hare Island, being about 330 miles from Quebec and sixty miles above Cape Rosier. It is one of the largest rivers on the south-east side of the St. Lawrence flowing into salt water, and affords a pretty good harbor, though not a roomy one. It is considered a good fishing-station, although it is not much used as such, except by a few Americans, who annually visit it for some months in the summer. Out in the middle of the bay, which is just below the mouth of the river, we saw codfish taken in three or four fathoms of water, as fast as they could be drawn in, and they are even caught in considerable numbers with lines and nets from the shore. One fine evening, while watching the fishermen hauling in codfish with their seines, I was astonished to observe a whole shoal of the fish, chased probably by some enemy outside, swim with such rapidity towards the shore that a large number of them grounded in the shallow water, and three or four of the foremost were thrown out about their own length on the sandy beach. Being taken by surprise, my attempts to secure some of them were not successful. They quickly struggled back into their element, and after floundering about and creating with their grounded companions a great turmoil in the shallow water, they all disappeared. When the fish approach so near the shore many of them are occasionally speared from the beach by the fishermen.

The bait used at this time for taking the cod is the capeling (*Mallotus villosus*, Cuvier). The fishermen set nets to catch the capeling in the mouth of the Magdalen, where the water is salt, and seine nets are used for the purpose when the fish come in shoals near the shore. These shoals are occasionally so dense that, the fish on the outside preventing those on the inside from escaping, a fisherman may go in among them without a possibility of their getting away, and take them out with a bucket or any other vessel, as you have informed me your Indians did in 1845 with a frying-pan, and in this way obtain bushels of them in a very short time. On such occasions many of them are sometimes thrown on the beach by the waves, and they occasionally appeared to me to leap ashore, dying before they could struggle back. I observed hundreds of them lying dead along the margin of the water, and I can readily believe what I have heard, that in some parts they are occasionally found lying in heaps which would contain several bushels, mingled with shells, seaweed, and the remains of land plants. One heap observed by yourself in 1845 you have informed me measured thirty paces along the margin, while it was a foot deep in the middle and several feet wide, tapering away at each end.

While preparations were making to ascend the river, I had an opportunity of collecting shells in the vicinity of the harbour. Of those inhabiting salt water a few large living specimens of *Buccinum undatum* were found, among many dead ones, at Cape Magdalen, the largest of which measured 3 inches 6 lines in length. *Mytilus edulis* was observed filling up inequalities in the rock where water remained when the tide was out. At either end of the bay there was an accumulation of their dead shells at high-water mark, extending in each case about a-quarter of a mile along the shore on a rough rocky bottom, in some parts of which the shells were heaped up to a depth of two feet with a breadth of five feet. *Mesodesma arctata* (Conrad sp.) was found cast ashore alive in considerable numbers on the sandy beach on the west side of the bay. Of *Natica heros* (Say) only one living specimen was observed, but dead shells were abundant, mixed up with the accumulations of *Mytilus*. I also found in the same place a few dead specimens of a shell which I take to be *Natica triseriata* (Say). *Balanus crenatus* was found in great abundance on the rocks at low water-mark, but never far up the shore between tides. *Lottia testudinalis* was rather scarce, but a few living specimens were met with in the same localities as *Balanus crenatus*. *Littorina tenebrosa*, *L. palliata*, and *L. rudis* were very abundant on the rocks at the extremities of the bay.

The species of land shells met with were not numerous. The most abundant was *Helix hortensis*, of which both varieties occurred, the banded variety being in the greater number. They were generally found on cedar, balsam-fir or poplar trees, and often at considerable heights from the ground, sometimes as high as fifteen feet. *H. alternata* (Say) gave me but one living specimen; its greatest diameter was 5¾ lines, but several dead shells were met with at the mouth of the river, one of them measuring 8¾ lines. I afterwards procured a living specimen of about the same measure three miles inland. *H. striatella* (Ant.) was very abundant on damp ground and among decayed leaves on the bank on the west side of the bay. *H. labyrinthica* (Say), *H. egena* (Say), and *H. lucida* (Drap.) were met with in the same locality in company with *H. striatella*. Along the same bank *H. lucida* occurred in rotten wood and among dead leaves. *H. pulchella* was another species of the same locality, as also *H. harpa*, of each of which I found only one specimen. *Succinea obliqua* (Say) was abundant on moist ground along the steep clay bank facing the east side of Cape Magdalen; and in the same locality, where the ground was more moist, *S. vermeta* (Say) occurred in great numbers. *Vetrina pellucida* (Drap.) was found among decayed leaves along the same bank on the west side of the bay, where the chief part of the *Helices* occurred.

We commenced our ascent of the Magdalen on the 20th of June, and at the end of four weeks we had reached the highest point to which canoes could be navigated. At this place the river, though shallow, was sixty feet broad, and still contained a considerable body of water. The only shell found in the river in the whole distance was *Limnea umbrosa* (Say). The shells were generally found adhering to stones in sheltered places. After passing the Mountain Portage, five miles from the mouth of the river, they were obtained in quiet pools always occurring on the right bank of the river. The river is subject to great freshets at the melting of the snows in the spring, and we could perceive, by the injury done to the bark on the stems and branches of the trees by ice or floating wood, that these freshets sometimes raise the water ten feet above the level at which we saw it. These floods extend through the woods on each side of the summer banks of the stream and often produce changes in the channel. It is estimated by Mr. Richardson that in the sixty-two miles which we ascended there is a rise of about 2000 feet. The river, in addition to the falls, is rapid in all its parts, and the absence of shells is probably owing to these constant and periodical disquieting circumstances.

Land shells were met with in many places in the woods along the river, the species being *Helix hortensis*, *H. striatella*, *H. lucida*, *Succinea obliqua*, and *S. vermeta*. The *Helix hortensis* was a large specimen of the banded variety; it was obtained on the 29th of June about 450 feet above the sea and five miles up the river, and had a number of eggs at the aperture of the shell.

The Canada porcupine (*Hystrix dorsata*, Linn.,) was very abundant along the river; in going up we killed several. A young one which I obtained on the 9th of July was entirely jet-black, with the exception of the lower portion of a few quills on the hinder part of the back. It was heavier than a large house cat, and could run tolerably fast. The movement of the old ones does not appear to exceed in speed that of a man's ordinary walk. The old ones were generally brownish-black, with white quills tipped with black; but one was killed of a decided reddish-brown. Having run short of provisions before returning, porcupine flesh constituted our principal article of food. We always found it tender, and it appeared to me to resemble veal in taste. A day seldom passed without our procuring one of them, and one day we killed three of very large size, and saw a fourth, which escaped among the brushwood. One of these when we went to attack it appeared to wait for us, keeping its tail turned towards us, no doubt for defence, and merely turning its head to look at us. One of our Indians maintained that the animal had the power of darting its quills, and many believe this to be the case. The quills no doubt are but slightly held in the skin of the animal, particularly in the tail, and when any object is struck by it, the barbed nature of the quill causes it to stick in the object more readily than in the skin of the animal. But of twenty that we killed not one of them darted any of its quills. We always despatched those we obtained with our hammers or with sticks, and it appeared to be rather singular that all of them but one were females. The skin of the animal is thin and tender, and I am not aware that it can be turned to any very useful purpose, but I believe that the Indians, in addition to availing themselves of the quills for embroidering birch-bark and other ornamental work, occasionally make a species of belt of the skin.

I observed a great number of flat green worms crawling about on the exterior of the intestines of one specimen while the body was being disemboweled; the worms were rather broader at one end than the other, and ribbed or striated across. They very much resembled a worm occasionally found in the animal of the *Unio*, and the largest of them was about three-quarters of an inch long. In another specimen long white worms not much thicker than threads were found folded up and tangled between the skin and the flesh. Some of these, when extended, measured about eight inches. The fat of the Canada porcupine exactly resembles bear's-grease, and we were informed that the Indians frequently sell quantities of it as such.

Besides porcupines we met with the common Canada hare *(Lepus borealis)*, the red squirrel *(Sciurus Hudsonius)*, the chipmonk *(Temasias lysteri)*, and the flying squirrel *(Pteromys volucella)*. The numerous marks of the beaver and otter indicated that these were very abundant along the river. We frequently saw trees upwards of a foot and a-half in diameter which had been cut down by the former. We also observed tracks of the bear and the caribou, and learned that two families of Indians, who had passed a winter near the high mountains at the head of the river, had killed forty of the latter during that season.

The birds we saw most frequently were the Canada grouse

(*Tetrao Canadensis*, Linn.), the king-fisher (*Alcedo alcyon*, Linn.), as well as large owls, hawks, mergansers, wild ducks, small plover, and several other birds of which I could not ascertain the species. We frequently observed in the precipitous banks of the river holes leading to the nests of the king-fisher. On the 16th of July one of the holes within about six miles of the highest part to which we took the canoes was opened. It was situated about ten feet above the level of the water, and penetrated a layer of sand in a bank of gravel. The bird flew out of the hole as we approached it, and at the depth of about four or five feet we found about six eggs lying on a nest of feathers. The number of the eggs is not quite certain, as we broke some of them in the attempt to get them out. They appeared to be quite fresh; they were pure white in color and nearly globular in form, being scarcely so large as those of the common tame pigeon.

Snakes and frogs were rather scarce, and trout were the only kind of fish we obtained in the river above the high fall of the Mountain Portage; but below this fall salmon are very plentiful in most seasons. The fishermen say that they deposit their spawn in the pool at the foot of the high fall, and that the young salmon winter there.

The wood along the Magdalen consists of white spruce, pine, cedar, balsam, white birch and poplar; and in smaller quantities, mountain ash, (which we saw in blossom on the 1st July), hard maple, yellow birch, tamarack and black ash.

When we got back to the mouth of the river the fishermen were engaged in catching mackerel, halibut, codfish and salmon. I procured a number of fresh shells of *Pecten islandicus* (Chemn.) which they had taken from the stomachs of the halibut. Some of the shells have *Spirorbis nautiloides?* adhering to them. I also obtained a number of razor shells (*Solen ensis*, Linn.), and odd valves of *Mactra ovalis*, with star-fish, most of them six-rayed, not satisfactorily identified, but resembling *Asterias rubens* and *A. neglectus*, as well as sea urchins (*Echinus granularis?*) and a number of *Scutella* resembling *S. parma*. There were great flocks of crows (*Corvus Americanus*) at the mouth of the river, but we did not see one inland.

After making the necessary arrangements, we commenced a second ascent of the river on the 2nd of August, and proceeding about twenty miles, we left our canoes, striking into the woods on foot in a course somewhat east of south. Guided by the geology of the district we subsequently turned nearly east towards Gaspé Bay, which we reached on the 16th of August, after a portion of the party had separated from us to return to the Magdalen.

On the way we killed a number of Canada grouse every day, but other game was rather scarce. The grouse were always very tame, and we generally killed them in a way that would surprise most people. When we came upon a covey we gave it a sudden start, which made the birds fly up into the surrounding trees. A rod was then cut, to the end of which was fastened a noose. This was held up close in front of the nearest bird, which generally darted its head into the noose; but if it did not do so then the noose was gently passed over the head, and by a sudden jerk the bird was brought to the ground. In this way we went from one bird to another, and usually secured all we saw that were within reach. Sometimes they are killed with stones, and it is wonderful to see how pertinaciously a bird will sit, however near the stone may whiz past it, until it receives such a blow as will knock it over. Even when struck, if not severely injured, it will occasionally remain sitting.

We killed also several porcupines, all females with the exception of one. The Indians were always very careful in preserving the under part of the tail, which they consider an excellent brush. I preserved a quantity of the quills of one individual, the largest of which measures four and a-half inches. Small snakes were very numerous in rocky places.

In the valley of Cold Water Brook through which the first part of our walk conducted us, we met with no shells. The water of the brook, which is very rapid, appeared to be low in temperature, and it was probably deficient in lime, the rocks from which it receives a large part of its supply being sandstone. On the York River I obtained a *Limnea* resembling the *L. umbrosa* of the Magdalen, but which Dr. Lea of Philadelphia who has most kindly examined twenty-six of the land and fresh water species obtained on our exploration, is inclined to regard as new. *Succinea vermeta* was obtained in the woods at the same place.

On the 10th of August we came to two ponds or small lakes, more than half-way between the place where we left the York River and Gaspé Basin. In the mud at the bottom of one of them *Planorbis parvus* (Say) was found, and a *Limnea* which Dr. Lea considers a new species nearest to *L. groenlandica* (Beck), but differing from it in being more attenuated; of American species it is nearest to *L. Philadelphica* (Lea). In the same place and along the margin of the pond a *Cyclas* occurred in abundance, but the shells have been too much broken to permit the species to be determined.

On the Dartmouth River a few miles above its entrance into Gaspé Bay, *Limnea catascopium*, (Say) and *Physa heterostropha* (Say) were collected. Between Gaspé Bay and Griffon Cove on the St. Lawrence, *Helix hortensis* of the banded variety was met with on the Ruisseau de la Grande Carrière about three miles from the bay. The only shell obtained in Gaspé Bay was *Mya arenaria;* but I afterwards obtained a valve of *Pecten magellanicus*, (Lam.) from a fisherman who had shortly before found it there, and judging from the large number of this species brought by yourself in 1844 from Cape Gaspé, they must be very abundant in that neighbourhood.

The woods between the Magdalen River and Gaspé Bay are of the same description, and the species of trees are about in the same proportion to one another, as on that river, with the exception of pine, of which we saw very little. Between Griffon Cove and Gaspé Bay some hard maple occurs.

After remaining a week at Gaspé Bay we ascended the Dartmouth about fourteen miles, and then crossed through the woods to the Grand Etang, which is the most extensive fishing station of those we visited on the coast. Here Mr. Richardson purchased a boat of about five tons burden in which we coasted up to the Magdalen, but as we landed but once on the way and that in the night, I had no opportunity of adding to our collection of shells.

We arrived at the mouth of the Magdalen on the 30th August, and found that the rest of the party had reached it in safety two weeks before. Putting all our provisions and luggage on board the boat, we left the river with the first fair wind, and coasted along the south-east shore about 210 miles, until reaching Apple Island, some ten or eleven miles below Cacouna; we then crossed over to the Saguenay. The various places we visited on the voyage were in the succession in which they came, Grôs Maule, Mont Louis, Peter River, Martin River, Ruisseau Vallée, River Chatte, River Capuchin, Matan, Grand Métis, Rimouski, near Trois Pistoles, Basque Island, Apple Island, Bergeronne and Tadousac.

Littorina tenebrosa, *L. palliata*, *L. rudis* and *Mytilus edulis* were found in every one of these places where rocks and pools existed between high and low water-mark. *Balanus crenatus* was observed as high as Cape St. Ann. *Purpura lapillus* (Lam.) and the young of *Buccinum undatum* from 5 lines to 1 inch 6 lines in length were found in great abundance between Ruisseau Vallée and River St. Ann. The fishermen gather them in bucket-fulls, and use them as bait after the capeling have disappeared. Of *Glycymeris seliqua* (Lam.) I found two specimens containing the animal at the mouth of Peter River, among the offal of codfish where the fishermen had just been cleaning them, and it is probable that they came from the stomach of one of the fish. On the sand-bar, at the mouth of Peter River, I met with one shell of *Unio complanatus*, one of *Pecten magellanicus*, and three of *P. islandicus*, which were of a red color. Good specimens of *Solen ensis*, the loose shells of *Mactra ovalis* and living crabs, *Plathycarcrinus irrogatus* (Say) were thrown up on the shore in considerable numbers. The largest valve of *M. ovalis* measures 5 inches 3 lines in length, and though none of the species were found containing the animal there were three which seemed rather fresh and had the valves united by the ligament.

On the shore at Rimouski I met with one specimen of *Scalaria groenlandica* (Gould), and one of *Fusus borealis* (Dekay), and being detained here some days by a head wind, I had an opportunity of collecting fresh-water shells in the neighborhood. Of *Alasmadonta arctuata* (Barnes) I found a number of good specimens in the river about half-a-mile above the falls. *Physa heterostropha* was very abundant in the ditches on each side of the road between the wharf and church. *P. aurea* (Lea) was found in the Rimouski above the falls, and in a brook joining it about half-a-mile above the bridge; in this brook *Limnea apacina* (Lea) and *L. catascopium* (Say) were very abundant. In a spring above the saw-mill I found a specimen of young *L. modicella*, and in another spring near, two specimens of *Physa ancillaria* (Say).

On our visit to Basque and Apple Islands just before crossing the St. Lawrence the water was very calm, and as we sailed round parts of these islands we saw incalculable numbers of sea urchins *Echinus granularis?* adhering to the stones at the bottom where the water was not very deep. *Tellina groenlandica* was in immense numbers on the shores of both islands. After crossing the St. Lawrence, while walking on the beach below Tadousac, I observed vast numbers of *Mya arenaria*, burrowed in the sand, the largest obtained measured 2 inches 11 lines in length. *Tellina groenlandica* and the three species of *Littorina* so often mentioned before were also abundant, and the latter were observed to extend fifteen miles up the Saguenay. Below Tadousac I obtained an empty shell of *Mesodesma arctata.* and one valve of *Carduim islandicum.* A worn valve of a *Unio*, perhaps a new species, was met with on the beach, but whether derived from some of the small streams near or brought by the ice down the St. Lawrence or the Saguenay it is impossible to say.

We were informed by several fishermen that the herrings come up as far as the Brandy Pots Island, the halibut as far as Green Island, and the codfish to Grand Métis.

We reached Chicoutimi, sixty-five miles up the Saguenay, on the 27th of September, and proceeded thence to Lake St. John, thirty-five miles more, by Lakes Kenogami and Kenogamishish. At Chicoutimi one large living specimen of *Helix alternata* was obtained, and at Lake Kenogami two of *Planorbis trivolvis* (Say). The shells which were collected on Lake St. John were several varieties of *Unio complanatus*, *Margaritana* *margaritifera* (Schum.), *Anodonta subcylindracea* (Lea), *Helix striatella*, *Physa elliptica* (Lea), and *Limnea modicella.*

The fish found in the lake, when we were there in October, were young salmon, pike (some of them being large), trout, white-fish and chub, and we were informed that tommycods were also seen in the lake at certain seasons. In navigating the lake we saw large flocks of black ducks, probably *Fuligula Americana.* They appeared to fly with difficulty, probably from excessive fatness.

The timber found growing round Lake St. John was of the following kinds: white birch, balsam, pine, spruce, cedar, elm, poplar, ash, yellow birch, bass-wood, and a little hard maple. Acorns were found on the shore, shewing that oak must exist somewhere in the neighborhood.

Although Lake Saint John is two degrees of latitude immediately north of Quebec, indian corn, wheat, and all other kinds of grain grow and ripen well in the settlements of the valley. Garden vegetables, including pumpkins, squashes, cucumbers and potatoes, seem to thrive as well as they do at Montreal. The land around the lake, with the exception of a sandy strip on the north side, is excellent, and is now in great part surveyed. There is a good Government road almost completed from Chicoutimi to the lake, so that great inducements are offered to settlers to emigrate thither. To find so fine a climate and such an extensive area capable of prosperous settlement so far north, and having such easy access to the sea, was to me an unexpected circumstance.

I have the honor to be,

Sir,

Your most obedient servant,

ROBERT BELL.

REPORT

OF

JAMES HALL, Esq.,

ADDRESSED TO

SIR WILLIAM E. LOGAN, F.R.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

Albany, 1*st March*, 1858.

Sir,

In reply to your enquiry regarding the Graptolites and other allied genera, confided to me for description on behalf of the Geological Survey of Canada, partly in 1854, and partly at a subsequent time, I have the honor to inform you that six plates of the Graptolites have been engraved, and are now only waiting to be lettered, and that drawings for ten more plates are in the engraver's hands.

The description of twenty-four species accompanies the present communication, and the plates will follow as fast as they are completed.

In April 1855, I communicated to you a note upon these remarkable Graptolites, discovered in the progress of the Geological Survey during the previous year. This discovery gave for the first time a knowledge of the true forms and mode of growth of these fossils, of which fragments and detached branches have for so many years been described as complete forms. Neither up to that time, nor so far as I am aware to the present, has any evidence of the existence of perfect forms such as these been given to the public.

Two of the species were described in the note transmitted to you in 1855, and I have preceded the description of the remainder by a repetition of that note.

I have the honor to be,

Sir,

Your most obedient servant,

JAMES HALL.

DESCRIPTIONS

OF

CANADIAN GRAPTOLITES.

NOTE upon the Genus GRAPTOLITHUS, and descriptions 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 in April, 1855.]

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 short 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 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.*, by H. B. Geinitz, 1852.

The radix-like appendages, known in some of our American as well as in some European species, have 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 are 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 individuals, 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 the first three of 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* (*Retiolites* 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 analogous, 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 simple stipes or of few or many simple or variously bifurcating branches, radiating more or less regularly from a centre, and in the compound forms 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 the living state we may suppose those with the corneous disks, and numerously branched fronds 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. 1–4.

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, 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 impressed 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 branches 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 appearance 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 skeleton ; 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.

Plate III. Fig. 1.

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 branches radiating 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.

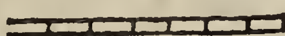
Since the date of the above communication, great numbers of Graptolites have been added to the Canada collection; and with an increased number of species, our knowledge of the structure of these animals has been very much extended. Had we at that time possessed all the materials which we now have, the 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.

Plate III. Fig. 2-6.

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. 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. It is still true that the serratures are always less developed towards the base of the frond.

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.

Fig. 2. A part of an individual showing the central connecting stipe or vinculum from the radicle, two of the main branches on one side and one on the other, with some of the branches disconnected by the breaking of the slate in which the fossil is imbedded. The celluliferous margins of the branches towards the base are imbedded in the slate, and it is only as they recede from the centre that the serratures become gradually visible, until finally some of them are exhibited of their full width as the branchlets become turned fully upon one side and laterally compressed.

Fig. 3. A fragment of slate preserving parts of three individuals, all presenting the non-celluliferous side upwards, some of the outer branchlets being turned so as to show the serratures.

Fig. 4. Enlarged view of a part of one of the branches and its branchlets, showing in some parts shallow serratures upon both sides of the branch from compression, as before explained. These sometimes appear almost equally upon the two sides, and in other parts are barely visible on one side; while one of the branchlets is so turned as to show near its extremity the full depth of the serratures.

Fig. 5. View of a portion still farther magnified, showing the branchlets where the serratures are vertically compressed.

Fig. 6. Enlarged view of a fragment which is compressed laterally.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—J. Richardson and E. Billings.

Graptolithus rigidus.

Plate IV. Fig. 1–3.

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. This character is partially represented in fig. 1, pl. 4, in which the parts of the individuals, other than the principal one, are represented in a more subdued tone than they really exhibit in the specimen, where all are equally prominent.

Fig. 1. A portion of the surface of a slab of slate, in which a single individual is preserved nearly entire, with parts of several others shown in the figure.

Fig. 2. A portion of a branch of a larger individual showing the branchlets from above the second bifurcation.

Fig. 3. A fragment of slate showing the extremities of some branchlets partially turned on one side, and having obscure serrations.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—J. Richardson and E. Billings.

GRAPTOLITHUS OCTOBRACHIATUS.

PLATE V. Fig. 1-6, and PLATE VI. Fig. 1-3.

Description.—Frond composed of eight simple undivided branches, 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 at each extremity 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 an 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.

Plate V. Fig. 1. A part of an individual of this species showing the exterior side with the disk partially preserved, with parts of the eight branchlets, which are seen to be gradually turned to one side as they recede from the centre, and are compressed laterally, showing the serratures.

Fig. 2. A fragment preserving a part of the disk very perperfect and much extended. The exterior only of the branches is shown upon the stone.

Fig. 3. Enlarged view of a portion of the exterior of a branch, showing the obliquely striated surface.

Fig. 4. A similar fragment of a branch which is turned to one side far enough to show an undulating margin caused by the serratures.

Fig. 5. A fragment exposing the serratures partially.

Fig. 6. A fragment showing the serratures as seen when the branch is compressed laterally.

Plate VI. Fig. 1. An individual retaining a part of the disk, and the outline and impression of the remainder, with the eight branches, some of which are broken off near the centre and others variously bent and folded, while two of them retain a length of more than six inches, and one a length of eight and a-half inches.

Fig. 2. A smaller individual retaining the branches in part, and showing the lateral and exterior surfaces, with an irregular disk.

Fig. 3. A small specimen preserving the base of the branches with the disk removed. This one shows more clearly than any other specimen the bifurcation of the branches beyond the vinculum.

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 outer margins 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 discrimination, 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; Hudson River Group

Collectors.—J. Richardson, E. Billings.

Graptolithus quadribrachiatus.

Plate VII. Fig. 1-5.

Description.—Frond composed of four simple undivided branches arranged bi-laterally, 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.

Figs. 1 and 2. Fragments of this species from which the disk has been entirely removed, but preserving the vinculum and bases of the branches, which show the serrations partially.

Fig. 3. An individual in which two of the branches are well preserved, showing the serratures.

Fig. 4. An enlarged view of a portion of a branch showing the form of the serratures.

Fig. 5. A fragment preserving the disk, which has the branches broken off just beyond its margin.

Locality and formation—Point Lévy; Hudson River Group.

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

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 exhibits 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 present 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; from 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-eighths 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.

Graptolithus Headi.

Description.—Frond robust, four-branched; disk large, sub-quadrangular, moderately extended along the branches; branches strong, much elongated, sub-angular exteriorly; serratures small, acute, from twenty-two to twenty-four in an inch; fine distinctly marked striæ extend from the base of the serratures nearly across the branch.

The specimen described presents the disk, which in its diameter across the centre between the branches is nearly one inch and an eighth, or nine-sixteenths of an inch on each side of the centre; while from the centre to its extent along the branches it varies from about three-fourths of an inch in one branch to an inch in another. The substance of the disk is strong and somewhat rugose, either from its original character or from the accidents accompanying its imbedding in the rock. The specimen exhibits the inner or serrated side, and the branches are turned so as to be compressed laterally at a distance of two inches or more from the centre; one of the branches presents a length of nearly seven inches from the centre. This species is named after its discoverer, Mr. John Head.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—Mr. John Head, and Sir W. E. Logan.

Graptolithus alatus.

Description.—Frond composed of four branches; disk much extended along the sides of the branches, giving them an extremely alate character; branches strong, angular on the lower side; upper or serrated side unknown. Some indentations on the exterior side of the branches, which may indicate the place of serratures on the opposite side are about one twenty-fourth of an inch distant.

The only specimen of this species yet recognized is a part of the disk with three of the branches, two of which present the corneous expansion apparently entire, extending about two inches from the centre along the branches, while its margin in the indentation between the branches is not more than three-eighths of an inch from the centre. This species is much more robust than *G. quadribrachiatus* or *G. bryonoides*, and the form of the disk when preserved will always be a distinguishing feature.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—Mr. John Head, and Sir W. E. Logan.

GRAPTOLITHUS FRUTICOSUS.

Description.—Branches bifurcating from a long slender filiform radicle, and each division again bifurcating at a short distance above the first; branches and branchlets short, narrow linear; serratures apparently commencing in the lower axil, where there are one or two between the first and second bifurcations. Serratures somewhat obtuse at the tip; lower side longer, upper margin nearly at right angles to the rachis; about sixteen serratures in the space of an inch. Substance of the branches thin, fragile.

In one specimen the position of the serratures is such as to present elongate acute apices in one of the branches.

This species has the general habit of *G. nitidus* and *G. bryonoides*, but is very distinct in its long, slender radicle, narrow fragile branches, and distant, obtuse serrations. Two individuals only have been obtained, but the form and habit are so precisely alike, and so distinctive in both of these, as to mark it a very well characterised species.

Locality and Formation.—Island of Orleans; Hudson River Group.

Collectors.—J. Richardson, E. Billings.

GRAPTOLITHUS INDENTUS.

Description.—Frond consisting of two simple branches, diverging at the base from a slender radicle, and continuing above in a nearly parallel direction; branches narrow, slender;

serratures very oblique, somewhat obtuse, truncated above almost rectangularly to the line of the rachis ; about twenty-four in the space of an inch ; a depressed line reaching from the serrature to near the base or outer margin of the branch where it terminates in a small node ; surface of branches striate.

This species resembles the *G. nitidus* in form, except that it is less divergent, the divergence from the base being at an angle of about thirty-six degrees for half an inch or more, after which the two branches continue nearly parallel. Though it is probable that this character may vary in some degree, it seems nevertheless to mark the species, and in numerous individuals of *G. nitidus* I have seen none with parallel or converging branches. The serratures in the two species differ in some degree in form, and the proportional distances, thirty-two and twenty-four, form a very characteristic distinction. A single fragment of a branch measures six inches, but the full extent when perfect is not known.

Locality and Formation.—Point Lévy ; Hudson River Group.

Collectors.—Sir W. E. Logan, James Hall.

Graptolithus nitidus.

Description.—Frond composed of two simple branches, diverging from a small radicle ; branches narrower towards the base, gradually expanding towards the extremities, which in perfect specimens appear to be rounded, and the last serrations a little shortened ; serratures small, shorter at the base and becoming gradually developed as they recede from this point ; acute at the extremities, almost vertical to the line of the rachis, and making an angle of about sixty degrees, the two sides being almost equal in length ; about thirty-two in the space of an inch. A well-defined groove or depressed line extends from the base of the serrature obliquely towards the base of the branch, and at its termination the surface of the branch is marked by a minute but distinct round tubercle.

This beautiful little species differs very distinctly from any others of this genus, in the thickened substance of its branches, the closely arranged serratures, and the minute tubercles at the base of the grooves or striæ. The specimens usually preserve considerable substance, and are far less flattened than most of the other species, owing either to their original character or to the nature of the surrounding matrix. The impressions of the oblique lines or striæ are often well preserved in imprints of the fossil left in the slate.

The impressions of *G. bryonoides* resemble those of this species; but the branches are broader, and the striæ are less rigid and less distinctly impressed, while the absence of tubercles, and the coarser serratures, when visible, at once serve to distinguish the species.

In mode of growth and general aspect this species resembles the *G. serratulus* (Pal. N. Y., vol. 1, p. 274, pl. 74, fig. 5, a, b,) of the Hudson River shales; but in the latter the serratures are coarser and more oblique, the lower side being much the longer. The branches of that species are also more distinctly linear, while in this they become gradually wider from the base, and are very distinctly striate and tuberculate in well-preserved specimens.

The preceding description applies to the specimens of this species where the branches diverge abruptly, or nearly at a right angle, from the radicle.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—J. Richardson, E. Billings.

Graptolithus bifidus.

Description.—Two-branched; branches very gradually and uniformly diverging from the base to the extremities; surfaces obliquely striated; serratures moderately oblique; extremities often nearly vertical to the rachis, and submucronate (?); from thirty-eight to forty in the space of an inch; radicle short.

This species resembles in general features the *G. nitidus*, and might be mistaken for that species with the branches approximated by pressure. In several individuals examined the serratures are much closer, being from six to eight more in the space of an inch, while the general form is constant. The outer margins of the branches are curved for a short distance from the radicle, and thence proceed in a uniform divergent line. The entire branch is very narrow at the base, but becomes gradually wider, the full width being attained at about half an inch from the bifurcation, while a few of the serratures towards the outer extremity, not having attained their full development, leave the branches narrower in that part. The same feature is observed in *G. nitidus* and others of this general character, and probably may be observed in all species where the extremities of the branches are entire.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—J. Richardson, E. Billings.

Graptolithus patulus.

Description.—Frond composed of two simple widely diverging branches from a small radicle; branches long-linear, having a width from the base of the serratures to the back of the branch of from one-sixteenth to one-twelfth of an inch; serratures oblique, with vertical mucronate points, which from base to apex are more than half as wide as the branch. A well defined line or ridge extends downwards from the apex of the denticle two-thirds across the branch.

Fragments of this species are numerous upon some slabs of greenish or blackish-green slate where no other species occurs. The fragments are sometimes five or six inches in length, offering in different individuals little variation in width. Sometimes the branches are compressed vertically, and present the smooth linear base or exterior, which is less in width than when compressed laterally.

The lateral faces of the branches exhibit considerable variety of surface, dependant on the degree of compression, or in some instances, the replacement or filling of the interior by iron pyrites. In such cases, or when the branch is not flattened, the surface is deeply striated or wrinkled obliquely. In some of the extremely compressed individuals the surface has an appearance of vesicular structure; but this is probably due to influences attending the mineralization of the fossil, or the filling up of the original canal, and not to the structure of the substance itself.

Locality and Formation.—Point Lévy ; Hudson River Group.

Collectors.—J. Richardson, E. Billings.

Graptolithus extensus.

Description.—Frond probably two-branched ; branches long-linear, varying in width in different individuals from one-twelfth to one-tenth of an inch exclusive of the serratures, and from one-tenth to one-eighth of an inch including the serratures. Serratures oblique, with the extremities slender and nearly erect, mucronate at the tip ; about twenty in the space of an inch ; base of branch scarcely narrowed, showing a few smaller serratures ; surface strongly striated, the striæ being preserved in those specimens which are extremely compressed.

The branches of this species bear a very close resemblance to those of *G. octobrachiatus*, but an individual in which the base is preserved shows in its peculiar curving and smaller serratures a feature which belongs only to the two-branched forms. The serratures also appear to be more slender, and are slightly closer in their arrangement ; branches of the same size in the two, presenting respectively eighteen and twenty serratures.

This species in separate branches of from three to six or eight inches in length, is abundant on some slabs of decomposing grayish-brown shale, associated with *G. bryonoides*, *G. nitidus*, and others.

Locality and Formation.—Point Lévy ; Hudson River Group.

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

Graptolithus denticulatus.

Description.—Frond apparently consisting of two broad branches, (the base and junction of which are obscure in the specimen ;) margins defined by a rigid line, beyond which on the inner side, are serratures having the form and character of small denticulations inserted upon the margin of the branch and vertical to its direction, broad at base, abruptly tapering above, and ending in mucronate points; about sixteen in the space of an inch.

This very peculiar species is readily recognised by the denticulations, which have the character of small sharp teeth fixed upon the margin of the branch. These denticles are more widely separated than those of any other species observed, as well as different in character.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—Sir W. E. Logan, James Hall.

Graptolithus pristiniformis.

Description.—Stipe simple, with serratures on both sides; serratures closely arranged, very oblique, acute, mucronate; thirty-two in the space of an inch.

This species approaches to *G. pristis* (Pal. N.Y., vol I., p. 265, pl. 72, fig. 1), but the serratures are more ascending, and the extremities more distinctly mucronate. The specimens observed however, are imperfect fragments, which are very closely compressed, being barely a film upon the surface of the shale, and the determination is somewhat unsatisfactory.

Locality and Formation.—Point Lévy; Hudson River Group.

Collector.—J. Richardson.

Graptolithus ensiformis.

(*Genus* Retiolites? Barrande.)

Description.—Stipe simple, sub-ensiform or elongate-spatulate, usually broader in the middle and narrower towards the extremities; a central rib, with strongly marked obliquely ascending striæ which reach the margins; serratures obscure, apparently corresponding to the striæ; margin usually well defined.

Several specimens of this form occur on a single slab of slate, associated with *G. tentaculatus* and *G. quadribrachiatus*.

The oblique striæ apparently indicate the direction of the serratures, and in one specimen there is an appearance of obtuse indentations upon the margin; but it is scarcely possible at the present time to define satisfactorily the character of these serratures. In form and general character this species differs from all the others sufficiently to be readily distinguished.

Locality and Formation.—Point Lévy; Hudson River Group.

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

Graptolithus tentaculatus.

(*Genus* Retiolites, Barrande.)

Description.—Stipe simple, linear, elongate-lanceolate or sometimes elongate-elliptical when entire; midrib double, extending much beyond the apex of the frond; exterior margins when entire, reticulate and armed with mucronate points, (and with mucronate points alone, or smooth, when imperfect,) with an extended setiform tentacle-like process from each side of the basal extremity; substance of the centre reticulate or cellular?

This species presents much variety of appearance dependant upon the condition of preservation. In specimens most nearly entire, the double midrib often extends beyond the apex nearly as far as the length of the frond; the margins present a series of oval or sub-hexagonal reticulations, every second one (and sometimes each one,) of which is armed by a minute mucronate spinule. When these outer cells or reticulations are broken away, the transverse walls between them often remain, and the specimens then present an undulating margin, with a short mucronate extension, which is the original wall between the marginal reticulations, and which is continuous with the striæ or fibres which traverse the frond from the midrib to the margins. On each side of the basal extremity the long setiform fibres extend obliquely forward to the distance of half an inch, and between these are two short terminal ones, like the processes on the sides of the frond.

In many specimens the whole exterior reticulate portion is removed, leaving the frond with straight or nearly straight parallel sides, the long extended midrib above, and the two setiform processes from the lower extremity; while in some specimens these parts also are removed. The serratures cannot well be determined in any of the numerous individuals examined, but they doubtless correspond to the vein-like markings of the centre, and the reticulate marginal extension.

Some specimens indicate that the central portion may be finely reticulate, which character, with that of the exterior, would be regarded as sufficient to warrant us in referring it to the genus *Retiolites*.

Locality and Formation.—Point Lévy; Hudson River Group.

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

Phyllograptus.

Among the various forms in this Canadian collection of *Graptolitideæ* there are several which approach in general form to *G. ovatus* of Barrande, and *G. folium* of Hisinger. They present however some differences of character, varying from broad-oval with the extremities nearly equal, to elongate oval or ovate, the apex usually the narrower, but in a few instances the base is narrower than the apex. These forms are sometimes extremely numerous in the shales, and present on a cursory examination a general similarity to the leaves of large species of *Neuropteris* in the shales of the coal measures.

Instead of the narrow filiform mid-rib represented in the figures and descriptions of the authors mentioned, these specimens present a broad linear mid-rib continued from the apex to the base, and extended beyond the base in a slender filiform radicle, usually of no great extent, but in some instances nearly half an inch in length. The mid-rib is rarely smooth, varying in width, with its margins not often strictly defined. In examining a great number of individuals of one species, I have discovered that this mid-rib is serrated; and though for the most part the serratures are obscure, they nevertheless present all the characteristics which they exhibit in graptolites of other forms, in which the branches have been compressed vertically to the direction of the serratures.

In this view, the lateral leaf-like portions appear to be appendages to the central serrated portion; but these are nevertheless denticulate on their margins, and the intermediate spaces are well-defined, as if admitting of no communication by serratures or cellular openings with the centre.

In another species the central axis or mid-rib is strong and broad, often prominent and distinctly serrate, the edges of the interspaces being all broken off as if the extremities had been left in the slate cleaved from the surface. At the same time the lateral portions are so well preserved as to show distinct cellules upon each side. We have therefore three ranges of cells visible, the central axis projecting at right angles to the two lateral parts. This remarkable feature leads to the inference that this graptolite was composed of four semi-elliptical parts joined at their straight sides, and projecting rectangularly to each other, presenting on each of the four margins a series of serratures, which penetrating towards the centre, were all united in a common canal, and all sustained upon a simple radicle.

In another more elongate form, the specimens examined are extremely compressed, and I have not been able to detect serratures in the axis, which however is sufficiently wide to admit of this feature.

For these remarkable forms, whether consisting of bilateral or quadrilateral foliate expansions, or with two or four series of cellules, I propose the name of PHYLLOGRAPTUS, from their leaf-like appearance when compressed in the slaty strata.

It is easy to perceive how bodies formed as these are may present different appearances, dependant upon the line of separation of the parts by the slaty luminæ. When separated longitudinally through the centre, the cells of the parts laterally compressed would be seen with the mid-rib not strictly defined; and the bases of the cells of that part vertically compressed, scarcely or not at all visible. When a small portion of the base of that part which is vertically compressed is preserved, the bases of the cells remain and mark the axis.

When instead of being imbedded so that two parallel sides are compressed laterally and the other vertically, the whole frond lies in an oblique position, the two adjacent rectangular parts are spread open and flattened upon the surface of the slate, the specimen then appears as if the cells were conjoined at their bases, or as if separated by a filiform mid-rib. An individual compressed in this manner and then separated through the middle, will present the bases of the two adjacent divisions with the cells lying obliquely to the plane of the slaty laminæ. These and other varieties of appearance are due to the position in which the fossil was imbedded, and the direction of the cleavage or lamination of the slate.

Phyllograptus. (New Genus.)

Description.—Frond consisting of simple, foliate expansions celluliferous or serrated upon the two opposite sides; margins with a mucronate extension from each cellule; or of similar foliate forms united rectangularly by their longitudinal axes, and furnished on their outer margins with similar cellules or serratures, the whole supported on a slender radicle.

These bodies which usually appear upon the stone in the form of simple leaf-like expansions, may possibly have been attached in groups to some other support; but the form of some of them, and the character of the projecting radicle at the base, indicates that we have the entire frond. These forms furnish perhaps the best illustration of all the *Graptolitideæ*, of the lesser development of the cells at the base, and their gradual expansion above, until they reach the middle or upper part of the frond. Many of them diminish from the centre upwards, and rarely the cells are more developed above the centre, reversing the usual form, and leaving the narrower part at the base.

Phyllograptus typus.

Plate VIII. Fig. 1-11.

Description.—Frond elliptical, elongate-ovate or lanceolate, broad-oval or obovate; margins ornamented by mucronate points; serratures closely arranged, about twenty-four, rarely twenty-two and sometimes twenty-six in an inch, usually obscure at the margins; axis or mid-rib broad, often crenulate or serrate; radicle usually short; frond robust.

This species assumes considerable variety of form; and from the examination of a few specimens of the extremes of the series one might be disposed to regard them as distinct species. After examining several hundred individuals however, I have not been able to find reliable characters in the form, or subordinate parts, to establish specific differences. The individuals figured represent the principal varieties noticed, though a greater number of forms might have been given. I have not thus far observed forms intermediate between the short broad ones and the more elongate oval ones; but it is probable that larger collections will furnish such. The number of serratures in entire fronds varies in different individuals from twenty-five or twenty-eight to fifty on each side, depending on the size and form of the specimen. The smallest examined have about twenty-five on each side.

The specimens of this species examined are all so much compressed that the rectangular arrangement of the parts of the frond, as seen in *P. ilicifolius*, cannot be shown, the only evidence of this character being the serratures along the central axis, which are transverse to those of the two sides.

Figures 1, 2, 3, 4. Examples of the ordinary forms of this species. Fig. 1 shows a smooth axis; while figures 2, 3 and 4 show indistinct serratures along the mid-rib.

Figures 5, 6, 7. Specimens which are more elliptical than the ordinary forms; the mid-rib or axis is well defined, but preserves no evidence of serratures.

Fig. 8. A broad oval form, showing serratures along the axis.

Fig. 9. An obovate form, showing serratures along the axis.

Fig. 10. A very large and elongate frond, shewing more than fifty serratures on each side; the central axis shows no serratures.

Fig. 11. A fragment of slate preserving twelve individuals of small size, upon the surface.

Locality and Formation.—Point Lévy; Hudson River Group

Collector.—J. Richardson.

PHYLLOGRAPTUS ILICIFOLIUS.

Description.—Frond apparently broadly oval or ovate, with the margin ornamented by mucronate points; mid-rib or axis broad, serrated; the extension of the serratures broken off in the separated laminæ of shale; radicle short. Serratures from thirty to thirty-two in the space of an inch, varying slightly with the proportionate length of the frond.

The form in reality however is that of two broadly oval or ovate leaves or fronds, joined rectangularly at their centres or by the longitudinal axis, and in a transverse section presenting a regular cruciform figure. The expansions of the two sides, which are laterally compressed, show distinct serratures or cells with projecting mucronate extensions. Those which are vertically compressed have their outer portions broken off in the separated laminæ of slate, and present the bases of the cells, which, having sometimes been filled and distended with mineral matter before imbedding, are very conspicuous. In a few instances the cells of the lateral portions are filled in the same manner, presenting the character of curving, conical tubes, with the broader extremity outwards.

The condition of preservation in several species examined is such as to render unavoidable any other conclusion as to their mode of growth than the one I have given above, however anomalous it may seem. This species differs from *P. typus* in its thicker substance, proportionally shorter and broader form, and more closely arranged serratures.

Locality and Formation.—Point Lévy; Hudson River Group.

Collector.—J. Richardson.

PHYLLOGRAPTUS ANGUSTIFOLIUS.

Description.—Frond elongate-elliptical or elongate-lanceolate, closely serrated; serratures furnished with mucronate extensions, about twenty-four in the space of an inch; mid-rib broad, smooth; radicle scarcely preserved.

This species is readily distinguished from either of the preceding by its narrow and elongate form. The individuals examined are very numerous, but being for the most part upon slaty laminæ, which are extremely compressed, they preserve scarcely any substance; a mere outline with a more brilliant surface being almost the only remaining character by which they are recognized.

The individuals of this species are, in several specimens, equally abundant with those of *Phyllograptus typus* represented in pl. 8, fig. 11. The mucronate extensions upon the margins of this species are not so abrupt as in *P. typus* and *P. ilicifolius*, the substance of the cell-margin being more extended along the mucronation. The number of serratures upon each side of the frond varies according to the size of the individual, being ordinarily from eleven or twelve to twenty-four, while in a single individual of nearly two inches in length there are forty-three or forty-four on each side. The mid-rib in this species though broad, like those of the preceding species, is not conspicuously serrate in any of the specimens examined. This feature how ever may have been obliterated by pressure.

Locality and Formation.—Point Lévy; Hudson River Group

Collector.—J. Richardson.

Phyllograptus similis.

Description.—Frond broad-oval; margins ornamented by slender, sub-mucronate serratures, which are closely arranged, being in the proportion of thirty-two to an inch, usually from thirteen to sixteen upon each side; axis disjoined; radicle unknown.

This species exhibits much variety of aspect. The more perfect forms are broadly oval, the diameters being about as six to seven. The central portion is open and free from any organic substance, as if there had originally been a cavity in the place of the longitudinal axis. In other specimens the parts are separated at one extremity, and appear like three or four branches closely joined at the other extremity, giving it the aspect of a four-branched frond. On examining numerous specimens they appear to have been originally arranged like the species of this genus already described, with perhaps this difference, that the margins of the axial portion were not closely united, or were quite disjoined along the centre. From the equal extremities of the frond, and the almost rectangular serratures, conjoined with the very obscure condition of the specimens, it has not been possible to determine whether the separation of the parts at the extremities has taken place at the base or the summit.

This species occurs associated with *G. Logani* and *G. quadribrachiatus.*

Locality and Formation.—Point Lévy ; Hudson River group.

Collectors.—Sir W. E. Logan and James Hall.

Besides the forms described in the preceding pages, there are several others belonging to the genus *Graptolithus*, of which I have not specimens in sufficient perfection to furnish a proper description ; and there are others which, possessing some abnormal characters, I hesitate to describe as distinct species, until I shall have an opportunity of seeing more specimens. One of these, having the general character of *G. octobrachiatus*, has but seven branchlets, three from one extremity of the vinculum and four from the other, bifurcating as in the species named above. The branches, however, are more slender than in *G. octobrachiatus*, and it may prove to be a distinct species.

Another form having the general habit of *G. Logani* has but nine branchlets, four from one and five from the other side of the vinculum. The exterior side only is visible, and the branches being broken off a short distance from the vinculum, no opportunity is offered of examining the serratures. It seems quite probable that this may prove a distinct species.

A single fragment of a ramose form, with two branches like *G. ramosus*, of New York, has been observed, but I have not thought it desirable to give its characters at present.

Among other forms of the *Graptolitideæ*, there are at least three species of *Dictyonema*, which are of common occurrence, associated with the Graptolites of Point Lévy.

The genus *Dictyonema* was described in the Palæontology of New York, vol. 2, p. 174, from an examination of the broad flabelliform or sub-circular expansions of corneous reticulated fronds common in the shales of the Niagara group. These forms were described as having "the appearance and texture of Graptolites, to which they were doubtless closely allied," Further examinations have demonstrated the truth of this remark in the discovery of serratures, like those of *Graptolithus*, on the inner side of the branchlets of both *D. retiformis* and *D. gracilis.* The celluliferous side adhering more closely to the stone than the opposite, as in *Retepora* and *Fenestella*, is much more rarely seen than the other. The mode of growth, though probably flabelliform in some species, is clearly funnel shaped in *D. retiformis*, the serratures being upon the inner side as in *Fenestella.*

The generic characters heretofore given may therefore be extended as follows.

DICTYONEMA.

Generic characters.—Frond consisting of flabelliform or funnel-shaped expansions, (circular from compression) composed of slender radiating branches, which frequently bifurcate as they recede from the base; branches and subdivisions united laterally by fine transverse dissepiments; exterior of branches strongly striated and often deeply indented; inner surface celluliferous or serrate, as in *Graptolithus.**

The general aspect of the species of this genus is like that of *Fenestella*, both in the form of the fronds and the bifurcation of the branches. Some of the species have hereto-

* A paper by J. W. Salter, Esq., Palœontologist of the Geological Survey of Great Britain, read before the American Association, for the advancement of Science, at the Montreal Meeting, 1857, describes a new genus of the Graptolite family under the name of *Graptopora.* Athough having had no opportunity of examining this paper, it appears to me that the forms described are true *Dictyonema.*

fore been referred to that genus, and others to *Gorgonia*. They may be known from either of these genera by the striated and serrated corneous skeleton, and absence of round cellules, which latter character, with a calcareous frond, marks the *Fenestella*.

Since the essential characters of *Dictyonema*, with figures of two species, have been given long ago, and their similarity to Graptolites pointed out, I am disposed to retain the name, and to describe the Canadian species under that designation.

There are still two other types in this collection which seem to merit generic distinction. One of these consists of imperfect branching fronds, the smaller branchlets of which are often rigidly divergent from the main branch at an angle of about thirty-six degrees. In others the branchlets diverge in a similar manner, but are less rigid. Exterior of branches smooth, interior surface celluliferous. There are two or three forms of this type which I propose to designate as DENDROGRAPTUS.

Another form consists of fronds which are strong stipes near the base, and become numerously and irregularly branched, ending in a great number of filiform branchlets, one side of which is serrated. The general aspect is that of a shrub or tree in miniature. For these forms I would propose the generic name of THAMNOGRAPTUS.

There is also a single species approaching in character to that published in the Report of the Fourth Geological District of New York as *Filicites?* The lateral branchlets are much longer, more lax and slender, being in this respect more nearly like *Filicites gracilis* of Shumard, (Geol. Report of Missouri, part 2, p. 208, pl. a. fig. 11) but the branchlets in the Canadian species are longer and more slender. They have all the same general plumose character, and from the well preserved corneous structure in the Canadian specimens, I regard them as belonging to the Graptolitideæ, although the celluliferous or serrated margins have not been seen. For these forms of Canada, New York and Missouri, should they prove generically identical, I propose the name of PLUMALINA, making the *Filicites?* cited above, the type of the genus with the name of *Plumalina plumaria*, while the western species will receive the name of *P. gracilis*.

The disk-like forms which are described in the Palæontology of New York, vol. 1, p. 277, under the name of *Discophyllum*, are probably the disks of a species of *Graptolithus* with numerous branches. One specimen preserves a thick corneous substance, which is the exterior surface, while the other preserves the mould of the opposite side, the radiating impressions of which are crenulated. There are no evidences of branches extending beyond the margin of the disk.

We have now so many well-established forms in the family *Graptolitideæ*, that we have the means of comparison with other allied families among palæozoic fossils.

Although numerous species in this collection are shown to be of compound structure, or to consist of fronds composed of two or more branches, and many of them originating in, or proceeding from a disk of thickened corneous substance, yet it is not improbable that there are among true Graptolites simple stipes or stems, as all the species have been usually heretofore regarded. I am disposed to believe that those Graptolites where the stipe is serrated on the two sides (*Diplograpsus*) may have been simple from the base; and that the branching forms having both sides, or one side only of the branches serrated, may possibly also have been simple, or bearing no more than a single stipe from the radicle. The bifurcate appearance at the base of *G. bicornis* however, offers some objections to this view, and these too may have been compound, like those which have only one side serrated.

The numerous compound forms shown in this collection, and the great variety of combination in the mode of branching, induces the belief that all those with a single series of serratures have been originally composed of two, four, or more branches, either diverging from a radicle or connected by a vinculum from which the radicle has extended.

The *Phyllograptus*, although apparently an anomalous form, is not more so with our present knowledge of the Graptolites than *G. Logani* or *G. octobrachiatus* would have been considered a few years since.

It is not among the least interesting facts, that we should find the *Graptolitideæ* simulating in their mode of growth so many of the Palæozoic *Bryozoa*. We have *Fenestella* represented in *Dictyonema*, the ramose forms of *Retepora* in *Dendrograptus* ; *Glauconome* and *Ichthyorachis* in *Plumalina* ; while the spirally ascending forms figured by Barrande appear to simulate in their mode of growth the spiral forms of *Fenestella* or *Archimedes*.

The forms of Graptolites now known are so numerous as to deserve especial considerations in their relations to other groups or families of fossil or living forms. They have been referred to the *Radiata* and to the *Bryozoa*. They were all originally composed of a thin corneous film which enclosed the bodies of the animals inhabiting the cells, and formed the general canal or source of communication along the axis. The substance of the Graptolites was then unlike that of the *Radiata* of the same geological age ; the sub-divisions are in twos, or some multiple of two, except in a few instances which appear to be abnormal developments ; and when the sub-divisions are irregular there is far less similarity with *Radiata*.

From all Palæozoic *Bryozoa* the Graptolites differ essentially in the form and arrangements of the cellules, and the nature of the substance and structure of the skeleton ; and simulate only the general forms of Bryozoan genera.

JAMES HALL.

REPORT

FOR THE YEAR 1857,

OF

E. BILLINGS, ESQ., PALÆONTOLOGIST,

ADDRESSED TO

SIR W. E. LOGAN, F.R.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 1*st March*, 1858.

SIR,

During the time which elapsed between the date of my last report and the 1st of last September, I was principally employed in the arrangement of the Museum, a work which had then become sufficiently advanced to permit of my taking the field for the remainder of the season. Under your instructions therefore, I ascended the Ottawa and Bonne-chere rivers, for the purpose of collecting specimens and investigating some points bearing upon the grouping of the organic remains in the Black River and Trenton limestones, as well as noting the distribution of these formations wherever they might be met with in the district to be examined.

Having proceeded up the Bonne-chere to the village of Eganville, I there engaged Mr. J. McMullen, whose extensive knowledge of the geographical features of that region I found would be of much service, to accompany me for a few days. At the lumbering depot of Messrs. Egan & Co. we procured a supply of provisions, and Messrs M. & J. Hickey obligingly furnished us with camping utensils. I then visited Lake Clear, in the newly surveyed township of Sebastopol, and was engaged in that neighbourhood seven days. During my examinations, I received much information from T. P. French, Esq., the Government agent for the settlement of the Crown lands upon the Opeongo road. Mr. French hospitably entertained us for two nights, and did all in his power to further the objects which I had in view.

After leaving Lake Clear I returned to Eganville, and ascended the river to Golden Lake, the shores of which I examined, and then made an excursion from the south side through the woods nearly to the hills presently to be mentioned. I then returned to the Fourth Chute, and was fortunate in arriving there at a time when the channel of the river was laid nearly dry in consequence of the water being cut off by the closing of the feeding apparatus of the slide at the foot of Mud lake. I had made arrangements to have this effected, but as it was also required by the workmen engaged in the construction of a bridge at Eganville, the water was shut off without being done on my account.

After examining the section at the Fourth Chute, and making a collection of fossils, I returned to Montreal. The following are the observations made during this expedition;

Lake Clear.

This lake is about six miles in length, and extends diagonally nearly across the northern half of the township of Sebastopol, its direction being about W.N.W. and E.S.E. It is of an oblong-oval shape, and three miles across in its widest part. There are fifteen small islands in it, lying principally at the south-east end. The south shore rises with a somewhat rapidly increasing slope from the water's edge, until it attains a height of from one hundred to three hundred feet. Viewed from the north shore this high land appears to be a ridge of hills or mountains, but on crossing over it is found not to be too steep towards the lake to interfere materially with cultivation, and accordingly séveral good farms have been there commenced. The timber is principally hardwood on the south and east shores, but on the north and east spruce and pine.

On the north side there are several smaller lakes connected with the principal one by small creeks. In these I found that extensive deposits of shell marl were in the progress of accumulation. The fresh water mollusca from whose shells these valuable deposits are being formed, I ascertained to be *Physa heterostropha* (Say), *Planorbis campanulatus* (Say), *P. bicarinatus* (Rackett), *Paludina decisa* (Say), and *Cyclas orbicularis?* (Say). There were also two species of Naiades, the widely distributed *Unio complanatus* (Lea), and *Anodon fluviatilis* (Lea). While coasting round the lake I saw hundreds of these two, but none of the others so common in the Ottawa. The same fact was observed with respect to their distribution in Golden Lake, but at the Fourth Chute of the Bonne-chere, *Margaritana marginata* (Lea), and *M. rugosa* (Lea), were seen.

The marl however consists almost altogether of the shells of the species of gasteropoda above mentioned, and as the living specimens do not appear to be more numerous in the lake than they are upon the shores of some of the rivers of the country, it must have required a great length of time for their remains to accumulate to the depth of several feet, which is often attained by these beds of marl.

The lake abounds with fish, the most abundant species being the Perch, *Perca flavescens* (Cuvier), the Sun-fish, *Pomotis vulgaris* (Cuvier), the Rock-bass, *Centrarchus æneus* (Cuvier), the Pike, *Esox reticulatus* (Lesueur), and the Salmon-trout, *Salmo namaycush* (Pennant). This latter species during the spring and summer months, according to the information I received from the settlers, retires to the deepest parts of the lake, and is rarely seen in shallow waters, but in the month of October it appears upon the shoals in vast numbers, the bottom being sometimes literally covered with them. They are then easily captured, and in such quantities that one of the inhabitants is in the habit of feeding his pigs with them. The method of taking them is by spearing at night from a canoe, the light used being a torch of the roots of the pitch pine or the bark of the white birch. Several barrels have been taken in one night by a single party.

The formations observed in the neighbourhood of Lake Clear are the Laurentian and Trenton. The former occupies the whole of the north and east shores, and a portion of the south shore ; all the islands consist of Laurentian rocks. The Opeonga road runs nearly parallel with the lake, at a distance of from half a mile to one mile and a-half from the south shore. Following this road through the township of Sebastopol, numerous exposures of gneiss were observed, but no Silurian limestones except in scattered blocks, which by their included fossils were ascertained to have been in general derived from some deposit of the age of the Black River. At Eganville, distant about ten miles, there is, as stated in former reports, an outlier of this rock, but it is situated at a level three hundred feet below some of the hills upon which these boulders are now found. If they have been derived from this outlier, this locality affords a good example of the transport of boulders from a lower to a higher level.

The rock exposed on the road consists of different varieties of gneiss, with no crystalline limestone except in one locality, lot 53, where a one-foot bed was seen. The gneiss in numerous places where I examined it has a dip of about 45° towards the north-east. This appears to be the prevailing dip from Renfrew to Golden Lake, a distance of forty miles. White crystalline limestone occurs at the south east end of the lake, but in no great quantity. It is there interstratified with the gneissoid rocks.

In order to ascertain the distribution of the Silurian limestone mentioned in Mr. Murray's Report of 1853, I coasted along the south shore of the lake in a canoe, starting from lot No. 49 which is occupied by Mr. French. The whole of the shore east of this point is occupied by the Laurentian formation. Proceeding westerly no exposures of rock in place were seen until at the distance of about one mile from lot No. 49, I found the Trenton limestone at the water's edge. There were only two beds visible, each about six inches in thickness. Half a mile further west another small exposure was found, which like the former, is at the water's edge. The only fossils seen were *Strophomena alternata* (Conrad), *Leptæna sericea* (Sowerby), and *Pleurotomeria umbilicata*, (Hall). Further on in the same direction on lot No. 16 in the tenth range, at Michael Mulroy's clearing, the same rock occurs in place at the water's edge. The shore here rises to the height of eighty feet, and is no doubt an ancient cliff of Trenton limestone, as the whole face of the hill is a mass of angular fragments of that rock. The fossils are *Petraia corniculum* (Hall), *Monticulipora dendrosa* (Billings), *Leptæna sericea* (Sowerby), *Strophomena alternata* (Conrad), *Orthis testudinaria* (Dalman), *Bellerophon bilobatus* (Sowerby), *Murchisonia bellicincta* (Hall), *Pleurotomaria umbilicata* (Hall), *Oncoceras constrictum* (Hall), *Asaphus gigas* (Dekay), *Illœnus* ———, *Heterocrinus Canadensis* (Billings.)

With a view of ascertaining how far the limestone might extend back from the lake I ascended the hill and proceeded in a southerly direction. At the distance of about four hundred yards from the shore there is a terrace of drift, the top of which is estimated to be one hundred and fifty feet above the first terrace. Then succeeds a flat space, with but a gentle rise for five hundred paces, when we come to a cliff of gneiss running parallel with the lake. This cliff is a portion of the ridge of hills which runs the whole length of the lake, and is continued further on in the same direction beyond Golden Lake. No limestone was found west of Mulroy's clearing on the lake shore, the land at that end being low and exhibiting no exposures of rocks of any kind.

It appears therefore to be quite certain that the fossiliferous rocks at Lake Clear are confined to a narrow strip, not more than five hundred yards in width, extending along the south shore from within a mile of lot. No. 49, westerly.

But, although on the south shore its limits are thus confined, there can be but little doubt that the limestone underlies the flat land at the west end of the lake, and extends three or four miles further. In that direction I found the land in many places covered with fragments of the rock, and on lot No. 7 in the fourteenth concession, occupied by John Ryan, there is a small exposure which appears to be at the base of the Trenton. The fossils are *Monticulipora petropolitana* (Pander), *Orthis tricenaria* (Hall), *Strophomena alternata* (Conrad), *S. filitexta* (Hall). Beyond this point no other exposure of the rock could be found.

At Golden Lake there are some indications of Silurian rocks at a point on the north shore about two miles west of Mr. Thomas's house, which is situated at the eastern extremity of the lake. Fragments of an argillaceous limestone are there seen abundantly along the shore, presenting all the characters of having been derived from underlying beds, and I was informed that in low water, about half a mile from the shore opposite this point, the bottom can be seen to be composed of the same material. It resembles some of the beds of the Chazy, and probably forms the bottom of much of the lake. Elsewhere the shores and surrounding lands are all of the Laurentian formation wherever rock can be seen in place. The ridge of high land which passes along the south of Lake Clear runs also past the south side of Golden Lake, but at the distance of about four miles from the shore. The intervening space is partly swampy land, and in part, consists of low hills of gneiss for at least two miles, which is as far as I proceeded in that direction.

The Fauna of the Black River Limestone of Canada compared with that of the same formation in the State of New York.

While preparing the first volume of the Palæontology of New York, Professor Hall found that in the Potsdam sandstone three species were then known, which were strictly confined to that formation. The several species of *Protichnites* published by yourself and Professor R. Owen of London in the Journal of the Geological Society, have as yet only been seen in the same rocks.

In the Calciferous sand-rock Professor Hall found thirteen species, only one of which passed upwards into succeeding strata; in the Chazy limestone forty-five species, all except one confined to this rock; in the Bird's-eye limestone nineteen, one of these passing upwards. In the Black River limestone thirteen, and out of these three were also found in the Trenton limestone.

Out of the seventy-seven species found in the Chazy, Bird's-eye and Black River limestones, only three pass the line between the last-mentioned and the Trenton in the State of New York. These formations have been therefore very properly described as almost totally distinct from each other in that country. In Canada, however, the case is very different. The discovery of the connection between the Black River and Trenton limestones was first made by yourself, and communicated to the British Association at their meeting, held at Ipswich in July, 1851. On that occasion Mr. Salter, Palæontologist to the Geological Survey of Great Britain, also read a paper on the fossils collected at Pauquette's Rapids on the Ottawa, which confirmed your previously expressed views. Since that time a great deal of additional evidence has been accumulated, and one of the objects of my visit to the Bonne-chere was to ascertain if the same intermingling of the fossils could be observed in the exposures of the rock on that river.

The locality most specially examined is at the Fourth Chute, near Mr. C. Merrick's mill, where Mr. Murray measured the section published in his report for 1854, pages 96 and 97. The strata of limestone and shale there exposed are in all forty-six feet in thickness and well charged with fossils. The lowest bed visible at low-water mark on the south side of the stream at the foot of the timber slide, holds *Columnaria alveolata*, *Stromatocerium rugosum*, *Ormoceras tenuifilum*, and *Orthoceras multitubulatum* of the Black River limestone. This bed is continued across the channel and forms the base of the cliff on the North side opposite the foot of the slide. From this level up to the mouth of the cave through which the water flows to Mr. Merrick's mill there are about thirty-five feet in thickness of shales and limestone in which the following species of fossils occur.

1. *Calumnaria alveolata*........................	(Goldfuss).	Black River.
2. *Stromatocerium rugosum*,....................	(Hall).	Black River.
3. *Monticulipora dendrosa*	(Billings).	Trenton.
4. *Glyptocrinus priscus*..........................	(Billings).	
5. *Columns of Thysanocrinus.*		
6. *Orthis gibbosa?*................................	(Billings).	
7. ——— *insculpta*	(Hall).	Trenton.
8. ——— *tricenaria*..............................	(Conrad).	Trenton.

9.	*Strophomena alternata*	(Conrad).	Trenton.
10.	*Rhynconella increbescens*	(Hall).	Trenton.
11.	——— *bisulcata*,	(Emmons).	Trenton.
12.	*Eichwaldia subtrigonalis*,	(Billings).	
13.	*Vanuxemia inconstans*,	(Billings).	
14.	*Cyrtodonta Canadensis*,	(Billings).	
15.	*Raphistoma staminea*	(Hall).	Chazy.
16.	*Pleurotomaria subconica*	(Hall).	Trenton.
17.	——— *umbilicata*	(Hall).	Trenton.
18.	*Murchisonia gracilis*	(Hall).	Trenton.
19.	——— *bicincta*	(Hall).	Trenton.
20.	——— *ventricosa*	(Hall).	Trenton.
21.	——— *perangulata*	(Hall).	Birdseye.
22.	*Subulites elongatus*	(Emmons).	Trenton.
23.	*Orthoceras bilineatum*	(Hall).	Trenton.
24.	——— *multitubulatum*,	(Hall).	Black River.
25.	——— *tenuifilum*,	(Hall).	Black River.
26.	*Illaenus arcturus*	(Hall).	Chazy.
27.	*Phacops callicephalus*,	(Hall).	Trenton.
28.	*Cheirurus pleurexanthemus*,	(Green).	Trenton.
29.	*Acidaspis? spiniger*	(Hall).	Trenton.

In the above list all the species marked Chazy, Birdseye or Black River, are confined to these formations in the State of New York with the exceptions of *Pleurotomaria umbilicata* and *Monticulipora dendrosa.* The former occurs in both the Birdseye and Trenton in New York, and the latter which is the same as the branched form of *Chætetes lycoperdon* ranges from the Calciferous upward, perhaps to the Upper Silurian. Those marked Trenton do not occur below that formation in New York, although some of them are found in higher groups. The new species in the above list have been seen in Canada in the Black River only. The list contains sixteen Trenton limestone species, four of the Black River, one of the Birdseye, and two of the Chazy, besides three new species as yet confined to the Black River and one; *Glyptocrinus priscus*, which occurs also in the Trenton. The columns of *Thysanocrinus* appear to be those of *T. pyriformis.*

Orthis gibbosa is a species described by me under that name in last year's Report, but having since received from Dr. Shumand a very perfect specimen of *O. subæquata* (Conrad) from the Hudson River group at Cincinnati, I find upon comparison that the two forms are almost identical, and I have therefore marked it doubtful. I have never seen it in the Trenton.

Orthis insculpta.—The specimens are in no respect distinguishable from those of the Hudson River group, except that the dorsal valve exhibits a slight mesial depression. It occurs in the Trenton in Canada.

Raphistomea staminea.—The specimens vary much in the proportional depth and breadth as well as in the amount of the elevation of the spire and sharpness of the outer edge.

There are several species of Bryozoa, one of which appears to be *Stictopora fenestrata* of the Chazy and another *S. ramosa*.

From the mouth of the cave up to the top of the section, there is, including the large flat exposure above the bridge, a thickness of about twelve feet consisting of limestones and shales. In this part of the section the fossils are more numerous and their state of preservation is precisely that exhibited by specimens collected at Pauquettes Rapids and Lake St. John. The grouping of the species is also the same as at Pauquettes Rapids. Above the bridge on the shore of the river and in the neighbouring fields a large proportion of all the species that have been found in the Black River in Canada were either collected or observed in place. As they will all be given in the next list it is not necessary to enumerate them separately, and I shall not therefore designate them here.

It would be very difficult to decide by mere fossil evidence whether the rocks at this locality should be classified as belonging to the Trenton limestone, or to the Black River formation. If we call them Trenton, then we must suppose that the fauna of the Black River age, after becoming extinct in other places, lingered on for a while in this spot, until the Trenton period had become well advanced. But if these rocks are to be called Black River, then the Trenton species were introduced here in advance of the period usually assigned for their appearance in the Silurian seas. Such would be the only explanation that could be given, if the line between these formations so strongly defined in New York, is to be regarded as a good natural horizon of separation. If on the other hand, it be granted that the Black River and Trenton fossils constitute but one zoological group, then of course, a great portion of the difficulty would be removed, the only question remaining being to decide upon a name for the formation.

The following is a list of fossils found in the beds which hold the characteristic species of the Black River limestone in Canada, all new forms not known to occur in the Trenton, and all species not clearly identified being excluded. A list shewing the number of Trenton species which occur in the Chazy is in preparation.

! Signifies common, !! abundant.

			Position in New York.
1.	*Tetradium cellulosum!!* (Hall sp.) This is the *Phytopsis cellulosum* of the Paleontology of New York. Professor Safford has shewn that these species belong to the Genus *Tetradum* of Dana; *T. fibratum* (Safford) of the Lower Silurian of Tennessee is closely allied to ours, and I should not be surprised if it should be found identical. [See Safford's paper on *Tetradium*, *Silliman's Journal*, 2d series, vol. 22, page 236.]		Birdseye.
2.	*Columnaria alveolata*	(Goldfuss)	Black River.
3.	*Monticulipora dendrosa*	(Billings)	Trenton.
4.	*Petraia profunda!*	(Hall sp.)	Black River.
5.	———*corniculum!*	(Hall sp.)	Trenton.
6.	*Receptaculites occidentalis!*	(Salter)	Trenton.
7.	*Stromatocerium rugosum*	(Hall)	Birdseye and Black River.
8.	*Glyptocrinus priscus* (Billings). This species is not reported as occuring in New York. The only perfect head was found by myself in the mouth of the cave in the Bonnechere section several years ago. I have ascertained its existence in the Trenton in Canada.		
9.	*Strophomena alternata*	(Conrad)	Trenton.
10.	———*filitexta!!*	(Hall)	Trenton.
11.	*Leptæna sericea*	(Sowerby)	Trenton.
12.	*Orthis testudinaria*	(Dalman)	Trenton.
13.	———*gibbosa?*	(Billings)	
14.	———*insculpta!*	(Hall)	Trenton.
15.	———*tricenaria*	(Conrad)	Trenton.
16.	*Rhynconella increbescens!*	(Hall)	Trenton.
17.	———*recurvirostra!*	(Hall)	Trenton.
18.	———*bisulcata*	(Emmons),	Trenton.
19.	*Ctenodonta levata*	(Hall)	Trenton.
20.	———*nasuta!!*	(Hall)	Trenton.
21.	———*gibbosa*	(Hall)	Trenton.
22.	———*dubia!!*	(Hall)	Trenton.
23.	*Euomphalus uniangulatus!!*	(Hall)	Calciferous.

This species occurs in the Calciferous sandrock, Black River and Trenton limestones in Canada.

24. *Raphistoma staminea* (Hall) .... Chazy.
25. *Maclurea Logani*.......................... (Salter),
26. *Pleurotomaria lenticularis!*.......................... (Hall), Trenton.
27. ———— *rotuloides* .... (Hall), Trenton.
28. ———— *umbilicata!!*.......................... (Hall), Trenton.

Occurs also in theBlack River in New York.

29. ———— *subconica !*.......................... (Hall), Trenton.
30. *Murchisonia bicincta !* .... (Hall), Trenton.
31. ———— *tricarinata !*.......................... (Hall), Trenton.
32. ———— *ventricosa!*.......................... (Hall), Birdseye.

Occurs in the Trenton in Canada.

33. ———— *perangulata* .... (Hall), Birdseye.
34. ———— *bellicincta!*.......................... (Hall), Trenton.
35. ———— *gracilis!!*.......................... (Hall), Trenton.
36. ———— *subfusiformis* .... (Hall), Trenton.
37. *Subulites elongatus !*.......................... (Emmons), Trenton.
38. *Bellerophon sulcatinus !*.......................... (Emmons), Chazy.
39. ———— *rotundatus !* .... (Hall), Chazy.
40. ———— *bilobatus !* .... (Sowerby), Trenton.
41. ———— *expansus !* .... (Hall), Trenton.
42. ———— *bidorsatus !* .... (Hall), Trenton.
43. ———— *punctifrons !* .... (Emmons), Trenton.
44. *Crytolites compressus*.......................... (Conrad Sp.), Trenton.
45. *Orthoceras* (*Ormoceras*) *tenuifilum* .... (Hall), Black River.
46. ———— *multicameratum* .... (Conrad), Birdseye.
47. ———— *recticameratum* .... (Hall), Birdseye.
48. ———— *fusiforme* .... (Hall), Birdseye.
49. ———— *arcuoliratum!!* .... (Hall), Trenton.
50. ———— *bilineatum !* .... (Hall), Trenton.
51. ———— *anellum !*.......................... (Conrad), Trenton.
52. ———— *amplicameratum*.......................... (Hall), Trenton.
53. ———— *strigatum* .... (Hall), Trenton.
54. ———— *laqueatum* .... (Hall), Trenton.
55. ———— *Allumettense !* .... (Billings), Trenton.
56. ———— *Ottawaense!!* .... (Bllings), Trenton.
57. ———— *hastatum !* .... (Billings), Trenton.
58. ———— *decrescens !*.......................... (Billings), Trenton.
59. ———— *Huronense !*.......................... (Billings), Trenton.

The five last mentioned species are common in the Trenton and Black River in Canada and *O. Allumettense* is also found in the Chazy sandstone at Aylmer and Hawkesbury.

60. *Gonioceras anceps*.......................... (Hall), Black River.
61. *Orthoceras subcentrale*.......................... (Hall), Black River.
62. ———— *longissimum*.......................... (Hall), Black River.
63. ———— *multitubulatum*.......................... (Hall), Black River.

64.	———— *annulatum*	(Hall),	Trenton.
65.	*Oncoceras constrictum !*	(Hall),	Trenton.
66.	*Cyrtoceras annulatum*	(Hall),	Trenton.
67.	———— *macrostomum*	(Hall),	Trenton.
68.	———— *multicameratum*	(Hall),	Birdseye.
69.	*Lituites undatus*	(Emmons),	Black River.
70.	*Asaphus extans*	(Hall),	Birdseye.
71.	*Illænus arcturus ! !*	(Hall),	Chazy.
72.	*Ceraurus pleurexanthemus*	(Green),	Trenton.
73.	*Phacops callicephalus*	(Hall),	Trenton.
74.	*Illaenus ovatus !*	(Conrad),	Trenton.
75.	*Acidaspis ? spiniger*	(Hall),	Trenton.

In the above list we have sixteen species given as occurring in the Birdseye or Black River limestones of New York, forty-four of the Trenton, four of the Chazy and one of the Calciferous. (There are six new species known to occur in both Black River and Trenton in Canada and two only known in the Black River.) Out of seventy-five species, fifty-two are common to the two formations. Besides these there are about thirty others known to pass from the Black River into the Trenton, part of which are new and undescribed, while the others appear to be the same as some of those figured in the first volume of the Palæontology of New York.

On the other hand however, we have about eighty species of *Echinodermata*, consisting of *Cystideæ*, *Crinoideæ* and *Asterideæ* in the Trenton, not yet found in the Black River. As these fossils however are thought to have a very limited vertical range they do not materially affect the main question, whether the Black River and Trenton limestones were deposited during a period in which the bulk of the fauna remained unchanged, and in which there occurred no catastrophe such as an almost total destruction of life, immediately followed by a new creation.

The Fauna of the Black River Limestone of Canada compared with that of the Lower Silurian of Tennessee.

The lists of fossils published by Professor Safford of Tennessee bear directly upon this subject, and as they may be of service to those studying geology in Canada, I beg to transcribe them into this report.* The Lower Silurian limestones of Middle Tennessee are about five hundred feet thick and are divided into two principal groups.

1. THE STONES RIVER GROUP from 240 to 260 feet in thickness. This division corresponds to the Black River and Trenton formations of Canada.

The lowest seventy-five feet of this formation consists of "blue and brownish-blue limestones, mostly fine grained and thick bedded, some of the strata of which abound in dark flinty layers." They are called the *Stones River beds*, and contain the following fossils:—

1.	*Stromatocerium rugosum*	(Hall),	Black River.
2.	*Orthis bellarugosa*	(Conrad),	Trenton.
3.	*Atrypa hemiplicata*	(Hall),	Trenton.
4.	" *recurvirostra ?*	(Hall),	
5.	*Leptæna incrassata.*		
6.	*Pleurotomaria umbilicata*	(Hall),	Black River & Trenton.
7.	*Gonioceras anceps*	(Hall),	Black River.
8.	*Actinoceras tenuifilum*	(Hall),	Black River.

Excluding the doubtful forms, there are in this list three Black River species, two Trenton, and one which is both Black River and Trenton.. They are all found in the Black River in Canada.

Above these beds Professor Safford says there are from fifty to sixty feet of thin bedded "sky-blue layers, sometimes separated by seams of argillaceous matter." They are "coarsely crystalline and abound in calcareous remains." The fossils are :—

1.	*Chætetes*, new species ! ! allied to *Lycoperdon.*		
2.	" *?* new species.		
3.	*Trematopora*, two new species.		
4.	*Stictopora ! !* four or five new species.		
5.	*Retepora fenestrata*	(Hall),	Chazy.
6.	*Escharopora*, new species.		
7.	*Graptolithus amplexicaulis*	(Hall),	Trenton.
8.	*Schizocrinus*, new species.		

* *The Silurian Basin of Middle Tennessee, with notices of the Strata surrounding it;* by James M. Safford, A.M., Prof. of Chemistry and Geology, Cumberland University, Lebanon, Tenn. Silliman's American Journal of Science, Vol. xii., 2nd series, page 352.

9. *Fragment of a cystidean*, new genus.
10. " *of a Sphæronite*, new species.
11. *Stems of Cystideæ.*
12. *Leptæna incrassata ! !* ....(Hall), Chazy.
13. " *sericea* ....(Sowerby), Trenton.
14. " *filitexta* ....(Hall), Trenton.
15. " three species, new and undetermined.
16. *Orthis deflecta ! !*.........................(Conrad), Trenton.
17. " *subæquata ! !* ....(Conrad), Trenton.
18. " *perveta*................................(Conrad), Trenton.
19. " *tricenaria !* ....(Conrad), Trenton.
20. " *bellarugosa*...........................(Conrad), Trenton.
21. " ——— ? allied to *O. disparalis.*
22. *Atrypa increbescens ?*
23. ——— allied to *A. recurvirostra.*
24. *Ambonychia amygdalina* ....(Hall), Trenton.
25. " *obtusa*...............................(Hall), Trenton.
26. *Edmondia ventricosa* ....(Hall), Trenton.
27. *Maclurca magna*............................(Lesueur), Chazy.
28. *Pleurotomaria umbilicata*.............. (Hall), Trenton & Black River.
29 ——————— *subconica*.......... ....(Hall), Trenton.
30. ——————— *lenticularis* ....(Sowerby), Trenton.
31. *Subulites elongatus !*.......................(Emmons), Trenton.
32. *Holopea*, new species.
33. " ——— ? allied to *H. obliqua.*
34. *Murchisonia bicincta !*......................(Hall), Trenton.
35. *Cyrtolites compressus* ....(Conrad), Trenton.
36. *Bucania bidorsata* ....(Hall), Trenton.
37. ——— *expansa* ....(Hall), Trenton.
38. *Carinaropsis*, new species.
39. *Endoceras proteiforme !*.....................(Hall), Trenton.
40. ——— new species.
41. *Orthoceras fusiforme !*......................(Hall), Black River.
42. ——— *multicameratum ?*
43. ——— *undulostratum ?*
44. *Actinoceras tenuifilum !* .... (Hall), Black River.
45. *Gonioceras anceps*...................... ...(Hall), Black River.
46. *Oncoceras constrictum*.......................(Hall), Trenton.
47. *Lituites ?* new species.
48. *Cyrtoceras*, allied to arcuatum ....(Hall).
49. *Cytherina fabulites ! ! !*.....................(Conrad).
50. *Ceraurus pleurexanthemus* ....(Green), Trenton.
51. *Calymene Blumenbachii ! !* Trenton.
52. *Illaenus ovatus* ....(Conrad), Trenton.
53. ——— species ?
54. *Phacops callicephalus* ....(Hall), Trenton.
55. *Isotelus megistos.*
56. *Tail of Lichas.*

This list contains three Chazy species, three Black River species, twenty-four Trenton species, and one common to the Black River and Trenton.

There are eight Trenton species which have not yet been found in the Black River in Canada, but in Canada we have in this rock twenty-eight Trenton species not given in these lists as occurring in Tennessee.

This last list contains the fossils of that part of the Stones-River group which Prof. Safford calls the *Lower Lebanon limestone*. The next beds in the ascending order called the *Upper Lebanon limestone*, are from one hundred and ten to one hundred and thirty feet thick, consisting of brownish-blue thick-bedded strata, with about twenty feet of thin beds interstratified occasionally with seams, and rarely beds of clay. Fossils are not very abundant, but "the middle portion of the member is everywhere characterised by groups of silicified *Columnaria alveolata*, *Streptclasma profunda* (Hall), and the rough spherical masses of *Stromatocerium rugosum*, to which we may add *Actinoceras tenuifilum*." The following species occur in this group:—

1. *Stromatocerium rugosum ! !*.................................Hall.
2. *Columnaria alveolata ! !*.................................Goldfuss.
3. *Astrocerium*, new species.
4. *Chætetes lycoperdon ?*.................................Say.
5. " *columnaris*.................................Hall.
6. *Streptelasma profunda*.................................Hall.
7. *Clathropora*, species undescribed.
8. *Stictopora*, two new species.
9. *Atrypa recurvirostra*.................................Hall.
10. *Leptæna filitexta*.................................Hall.
11. *Pleurotomaria rotuloides*.................................Hall.
12. ——— ——— *subconica*.................................Hall.
13. *Murchisonia bicincta*.................................Hall.
14. *Actinoceras tenuifilum ! !*
15. *Orthoceras anellum ?*
16. ———— *multicameratum ?*

It is evident from this list and from the remarks of Professor Safford, that the Upper Lebanon rocks are more strongly marked with a Black River fauna than the Lower Lebanon formation, while the latter is characterized principally by Trenton species. In fact we have here a Trenton formation lying below a group of rocks which in Canada or New York would be called Black River, provided we are to designate as such all rocks holding *Columnaria alveolata* and *Stromatocerium rugosum.*

Such groupings as these show the immense importance of obtaining many other lists of fossils from localities widely separated from those already examined. Otherwise in mapping a new country, large tracts may receive a colour that must be afterwards removed.

But although there is in Canada this intermingling of forms characteristic of the two groups, there has, thus far, been no confusion, because in all instances where the transition can be observed, the Black River strata pass upwards into a group three hundred or more feet in thickness, exclusively charged with Trenton forms. It is easy therefore to determine which is the lower or upper part of the group, even should the Black River and Trenton be regarded as characterised in a general way by the same fauna. In Tennessee, on the other hand, the Trenton limestone appears either not to have been deposited, or if deposited at all it was during the Black River period, because the Upper Lebanon formation is followed immediately by strata charged with fossils of the Hudson River age.

Galt Limestone, Onondago and Corniferous Limestones, &c.

On the 9th October last I left Montreal for the purpose of examining the limestones in Western Canada, in which work I was engaged until the middle of November. The weather, during a part of the time, was very unfavourable, and I did not accomplish all the objects I had in view. I spent one week in the neighbourhood of Trenton, Belleville, and Shannonville, in the County of Hastings, collecting fossils, and then proceeded by the Grand Trunk Railway to Guelph and Galt, thence to Dundas, Hamilton, Thorold, Port Colborne and Cayuga. In all these places I made collections, but as a great many of the species are either new, undescribed, or difficult of determination without comparison with European specimens, it is thought advisable not to report upon them until they shall have been further examined.

The principal object of the expedition being to examine the organic remains of the country, not much attention was given to physical geology. Of the facts observed the following are some of the most important.

Rocks at Port Colborne.—The Welland Canal as it approaches Lake Erie has a direction nearly north and south for a distance of seven miles before it reaches the turn near Port Colborne, called Rama's Bend. Throughout this distance it has been excavated in a level clay country, no rock cuttings having occured in the construction of the work. At Rama's Bend, which is about two miles distant from the Lake, the first rocks were met with. On the east side, opposite the bend, the land rises fifteen or twenty feet above the level of the canal, and displays several quarries of an impure nodular limestone, with a few fossils in the face of the slope. In the banks of the canal no exposure of rock is to be seen above the level of the water. Between Rama's Bend and the railway, a distance of about a mile-and-a-half, there are large quantities of rock among the material thrown out of the excavation and placed on the west bank of the canal. Upon inquiry I found that this had been taken from a cutting through the rock to a depth amounting on an average to fifteen feet. The fossils and the nature of the rock shew that this excavation has been made through strata which form the junction between the Onondaga Salt Group and the Onondaga and Corniferous Limestones. As however the strata were altogether beneath the water at the time of my visit, the only opinion which I could form as to their character was necessarily based upon the examination of the *debris* upon the shore.

At Rama's Bend this consists of three kinds of rock, a blue stone with numerous irregular cavities. Proceeding towards the lake from this point in the first hundred yards, we find shale, a light drab water? limestone, and a dark drab lime- among the debris blocks of rock holding small masses of snowy gypsum. At the end of 200 yards the shales disappear. The dark coloured limestone disappears at 350 yards, but the porous limestone with gypsum continues, with some limestone holding silicious nodules. At 800 yards from the bend, all the rock disappears, and the debris consists only of blue clay. At 1560 yards from the bend the rock is again heaped up on the bank, and consists of the same materials as before, with the addition of some thick beds holding numerous corals of species identical with those of the corniferous limestone.

The shales and limestone holding the gypsum belong no doubt to the upper part of the Onondaga Salt Group, and as the fossiliferous limestone evidently succeeds it, or reposes upon it in the cutting in the canal, it follows that the Oriskany sandstone is absent at this locality.

Being desirous of ascertaining whether the same succession could be found in the tract lying between the Welland canal and the Niagara river, I went to Fort Erie and after proceeding down the river about two miles made an excursion westerly until I found an escarpment of the water-lime on lot No. 5, in the 10th concession of Bertie. This outcrop strikes directly for Port Colborne and is no doubt the same as that which crosses the canal at Rama's bend; I followed it four miles and was informed that it could be traced continuously for fourteen miles in a line parallel with the lake shore and distant from it two to three miles.

After leaving Port Colborne, I proceeded to Cayuga in the County of Haldimand and spent a week in that neighbourhood. The country is in general covered with drift clay and there are few good exposures of fossiliferous rocks. The most interesting is a tract of the Oriskany sandstone situated on the town line between Oneida and Cayuga, formerly noticed by Mr. Murray. This rock I found to be abundantly stored with the characteristic fossils of the formation. The extent of the exposure has since my visit been ascertained by Mr. J. DeCew, D. P. L. S., of Decewsville, who is much interested in the study of geology. Mr. De Cew's plan shews that on the town line the sandstone occurs on the lots Nos. 46, 47, 48, 49 and 50, and the whole area exposed is only 230 acres. The locality is of much interest as being the only one known in

Western Canada, where good collections of the fossils of the Oriskany sandstone can be procured.

Many of the species which I collected in this expedition are new, and as they require much consideration, I beg to reserve them for the next Report. The following are some that I have determined during the present year.

Genus Fistulipora (McCoy).

Favosites Canadensis

(McCoy, *British Palæozoic Fossils*, p. 11.)

Generic Characters.—" Corallum incrusting, or forming large masses, composed of long, simple, cylindrical, thick-walled tubes, the mouths of which open as simple, equal, circular, smooth-edged cells on the surface, and have numerous transverse diaphragms at variable distances ; intervals between the tubes occupied by a cellular network of small vesicular plates, or capillary tubules traversed by diaphragms."

This genus has no radiating lamellæ, a character which constitutes the only difference between it and *Heliolites* (Dana.)

1. Fistulipora Canadensis (Billings).

Description.—Corallum forming irregular, contorted masses, or wide, flat, undulating expansions or layers from one-half of an inch to one inch in thickness, which are based upon a thin, concentrically wrinkled epitheca. Cell-tubes half a line or less in diameter, and about one line distant from each other ; the mouths of the tubes protruding a little above the general surface. Transverse diaphragms thin, horizontal or flexuous, and sometimes very numerous, there being in some of the tubes three or four in half a line of the length of the tube. The intercellular tubules are polygonal, and about four in the diameter of one of the principal cells ; their transverse diaphragms are well developed, usually four or five to one line of the length.

F. Canadensis differs from the other described species in the following respects :—From *F. decipiens* (McCoy) in having the cell-tubes more distant and the diaphragms more numerous, and from *F. minor* (McCoy) in the same particulars, the cell-tubes of the latter species being still smaller and closer together than in *F. decipiens.*

This coral much resembles *Heliolites porosa* (Goldfuss), but can be readily distinguished by the absence of the radiating septa.

Locality and Formation.—Devonian; Corniferous or Onondaga limestone; lot 6, con. 1, Township of Wainfleet; at the east end of Lake Erie.

Collector—A. Murray, Esq.

Genus Columnaria (Goldfuss).

Generic characters.—Composed of large masses of elongated sub-parallel corallites, which when separate are round, but when in contact polygonal. Radiating septa either rudimentary, or well developed, sometimes reaching the centre. Transverse diaphragms numerous, usually complete, and either horizontal, oblique or flexuous.

Columnaria Goldfussi (Billings).

Description.—This species is found in large amorphous or sub-globose masses composed of long straight or flexuous polygonal corallites with an average diameter of about half a line; transverse diaphragms from four to six in a line; radiating septa rudimentary, but distinctly striating the interior walls.

Formation and Locality.—Hudson River group? Snake Island and Traverse point, Lake St. John.

Collector.—J. Richardson.

Columnaria Blainvilli (Billings).

Description.—Forming large sub-globose pyriform or hemispheric masses of polygonal corallites one line and a-half in diameter; about eighteen radiating septa which reach the centre; transverse diaphragms three or four to one line.

The radiating septa in fractured specimens where the interiors of the tubes are well exposed, striate the surface exactly as in *Columnaria alveolata*, from which species and from *Favistella stellata*, Hall, it only differs by its smaller size.

Formation and Locality.—Hudson River Group. Snake Island, Lake St. John.

Collector.—J. Richardson.

COLUMNARIA RIGIDA (Billings).

Description.—Forming large masses of polygonal corallites, usually three lines in diameter, but with numerous smaller ones, and occasionally others of a larger size; radiating septa, about twenty, not reaching the centre; transverse diaphragms from two to four in one line.

This species also resembles *C. alveolata*, but differs in the greater development of the radiating septa which extend about half-way to the centre. The tubes are also about the same size as those of *Favistella stellata*, Hall, which differs in the septa not only reaching the centre, but also in their often being so strongly developed there, as to produce by their junction the appearance of a pseudo-columella.

Formation & Locality.—Hudson River group? Lake St. John.

Collector.—J. Richardson.

COLUMNARIA ERRATICA (Billings).

Description.—Forming large masses of corallites either in contact or separate. The separate cells are round, those in contact more or less polygonal, the radiating septa rudimentary, forming about four sulci in the breadth of one line upon the interior; diameter of corallites from two to five lines, in general about three and a-half lines. The transverse diaphragms are not visible in the specimens examined. The walls of the separate corallites are thick and concentrically wrinkled.

One specimen with corallites two lines in diameter appears to be a variety of this species.

Formation and Locality.—Trenton; Blue Point, Lake St. John.

Collector.—J. Richardson.

Genus Palæophyllum, (Billings.)

Generic characters.—Corallum fasciculate or aggregate; corallites surrounded by a thick wall; radiating septa extending the whole length; transverse diaphragms either none or rudimentary; increase by lateral budding.

This genus only differs from *Petraia* or *Streptelasma* by forming long fasciculate or aggregate masses instead of being simple.

Palæophyllum rugosum (Billings).

Description.—Corallum in large aggregations of scarcely separate corallites, which where they open out upon the surface of the rock are from one to six lines in diameter, the average adult size being about four lines. Radiating septa reaching the centre; about twenty-two septa in a corallite four lines in diameter, with an equal number in a rudimentary state between.

The great disparity in the size of the tubes in the same mass is owing to the mode of increase and gradual growth of the young corallites. These, of all sizes from one line in diameter and upwards, are uniformly intermingled with the adult individuals.

Formation and Locality.—Trenton; Lake St. John, Little Discharge.

Collector.—J. Richardson.

Petraia rustica (Billings).

Description.—Straight or slightly curved, covered with a strong epitheca, which is more or less annulated with broad shallow undulations; radiating septa about one hundred or usually a little more; much confused in the centre, where they form a vesicular mass; every alternate septum much smaller than the others, only half the whole number reaching the centre. Length from two inches and a half to three inches and a half. Diameter of cup one inch to one inch and a half; depth of cup half an inch or somewhat more.

This species appears to be the same as that described by Edwards and Haime under the name of *Streptelasma corniculum*. The true *S. corniculum* of Mr Hall is a very different species, being always shorter and much curved.

Formation and Locality.—Hudson River group; Snake Island, Lake St. John.

Collector.—J. Richardson.

Genus SYRINGOPORA (Goldfuss.)

Generic characters.—The fossils of this genus are fasciculated or composed of large aggregations of long cylindrical corallites somewhat parallel to each other and connected by numerous smaller transverse tubes. The exterior walls consist of a well developed solid epitheca; the cells circular; radiating septa rudimentary; transverse diaphragms infundibuliform or placed one within another like a series of funnels.

About twenty species of this genus are known, and these are found in the Upper Silurian, Devonian and Carboniferous formations.

SYRINGOPORA DALMANII (Billings).

Description.—Forming large masses; corallites long sub-parallel, slighly radiating, occasionally a little flexuous, annulated, one line or rather more in diameter, distant usually half a line, occasionally in contact or where flexures occur, more than one line apart; connecting processes very short, about two lines distant.

Formation and Locality.—Upper Silurian, Head of Lake Temiscaming.

Collector.—Sir W. E. Logan.

SYRINGOPORA COMPACTA (Billings).

Description.—Forming large hemispherical masses of straight parallel or slightly diverging corallites, which are so closely aggregated as to compose a nearly solid mass; about six corallites in two lines.

This species differs from all others of this genus hitherto described in the closeness of the corallites. These are so small, straight and closely united that large masses broken in the longitudinal direction of the tubes have the aspect of some species of *Monticulipora.*

Formation and Locality.—Upper Silurian. L'Ance a la Vieille, Gaspé.

Collector.—Sir W. E. Logan.

Syringopora verticilata, (Goldfuss.)

(Goldfuss, *Petr. Germ.*, vol. i. p. 76, note 25, 26.)

Description.—Forming large masses, corallites nearly straight, about two lines in diameter, and from two to three lines distant; connecting tubes three or four lines distant, verticilating, or three or four radiating from the tube at the same level in different directions, like the spokes of a wheel.

Formation and Locality.—Upper Silurian. Head of Lake Temiscaming. Goldfuss specimens were from Lake Huron.

Collector—Sir W. E. Logan.

Syringopora reteformis (Billings).

Description.—Forming large masses; corallites much geniculated, frequently anastomosing or connecting by stout processes; diameter of corallites about two-thirds of a line, distant from each other from half-a-line to a line and a-half; distance of connecting processes one line to three lines, usually about two lines.

Formation and *Locality.*—Upper Silurian. Isthmus Bay; Lake Huron.

Collector.—A. Murray.

Syringopora debilis (Billings).

Description.—Corallites a little more than half a line in diameter, distant one or two diameters; connecting processes slender, distant one or two lines.

Formation and *Locality.*—Upper Silurian; L'Anse à laVieille.
Collector—Sir W. E. Logan.

SYRINGOPORA TUBIPOROIDES, (Yandell and Shumard.)

(*Contributions to the Geology of Kentucky*, page 8; 1847.)

(M. Edwards and L. Haime, *Polypiers fossiles des terrains palæozoiques*, p. 292.)

Description.—This species is found in large masses of long slightly flexuous corallites. These have a diameter of about one line and a-half, and owing to their flexuosity, are at times in contact, and often two, three or four lines a part. In large colonies which have grown luxuriantly without the interference of disturbing causes, the corallites are more regular than in the smaller or stunted groups, in which the corallites are much bent and confused. The connecting processes are very short and distant, and appear to be sometimes mere inosculations of the stems. The corallites after growing separately for a short distance, approach each other and seem to grow together or adhere to each other for the space of a line and a-half or more, they then diverge and again unite. These points of contact occur at distances varying from three lines to six, nine, or even twelve lines. Externally they exhibit numerous other indistinct annulations, and also faint indications of longitudinal striæ.

Formation and *Locality.*—Devonian; abundant in the Corniferous limestone of Canada West.

Collectors.—A. Murray, E. Billings.

SYRINGOPORA NOBILIS (Billings).

Description.—Corallites three lines in diameter, distant two to four lines. The connecting processes in this species have not been observed, but the size of the corallites is quite sufficient to separate it from any known species.

Formation and *Locality.*—Devonian; Corniferous limestone, near Woodstock Canada West.

Collector—A. Murray.

Syringopora elegans (Billings).

Description.—Corallites, one line in diameter, sometimes a little more or less, distant a little less than one line; connecting tubes half a line in diameter, and distant from one line to one line and a half, usually projecting at right angles, but sometimes a little oblique. Epitheca with numerous annulations, generally indistinct, but under certain circumstances of growth sharply defined and deep, so much so as to give to the corallites the appearance of the jointed stalk of a crinoid. The young individuals are produced by lateral budding, and in one specimen examined the whole colony appears to be based upon a broad lamellar foot secretion like that which forms the base of a Favosite.

The distance of the corallites is usually about a line, but like all the other species, this one varies a good deal in this respect. When some cause has intervened to prevent their regular growth they are much flexed and consequently at times more distant than when they have been disturbed. The connecting tubes on the same side of the corallite are three or four lines distant, but generally on the other sides one or two others in the same space occur, making the average distance one line or one line and a half.

Formation and Locality.—Devonian; Corniferous limestone, near Woodstock Canada West.

Collector—A. Murray Esq.

Syringopora Hisingeri (Billings).

Description.—This specie forms large masses of very long, nearly parallel or slightly varying, slender corallites, which are closely aggregated and present a rugged or knobby appearance from the great number of the connecting tubes. The diameter of the corallites is one-third of a line, or a little more. The tubes of connection are distant from two-thirds of a line to one line and a-half. The distance between the corallites is for the greater part less than their diameter. The young corallites branch from the sides of the adult individuals, and immediately become parallel with the parent, and connected with it again by the usual tubes of connection.

Formation and Locality.—Devonian; Corniferous limestone, Canada West. (common.)

Collectors—A. Murray and E. Billings.

Affinities of S. Hisingeri.—Edwards and Haime have described two species from Ohio, collected in rocks of the age of the Onondaga and Corniferous limestones, which appear to be closely allied to this; the following are their descriptions:

"SYRINGOPORA VERNEUILLI.—Corallites long, distance between them twice or thrice their diameter, subflexuous and angular at the points of the origin of the tubes of connection, these are distant two or three millimetres; diameter of the corallites two-thirds of a millimetre."—Devonian, Columbus, Ohio. (*Polypiers Fossiles*, p. 289.)

"SYRINGOPORA CLEVIANA. — Corallites slightly flexuous, distant once or twice their diameter, which is two-thirds of a millemetre."—Devonian, Carolton and Dayton, Ohio. (*Polypiers Fossiles*, p. 295.)

The first of these species is different from S. Hisingeri in the greater distance of the corallites. The description of the second is too incomplete to enable us to decide whether it refers to the same species or not. The authors state that their specimen was imperfect, and that they were not certain that it had not been previously described.

Genus MICHELINIA (De Koninck).

Generic Characters.—"Corallum compound, forming rounded, or conoidal masses of inseparably united, thick-walled, polygonal tubes of large size, marked internally with numerous vertical lamellar striæ, and communicating pores; base of cells filled up by very irregular, numerous, highly inclined vesicular plates, not forming distinct horizontal diaphragms; external or basal epitheca of the general mass, strong, concentrically wrinkled, and sometimes spinose."—*McCoy, British Palæozoic Fossils, page* 80.

This genus differs from Favosites in the vesicular character of the transverse diaphragms, and in the radiating lamellæ being represented by vertical striæ on the inner surface of the cells, instead of series of minute spines. The cells are usually much larger than in Favosites. The genus appears to be confined to the Devonian and Carboniferous formations.

MICHELINIA CONVEXA (D'Orbigny).

(*Prodr. de Paléont.*, t. 1, p. 107, 1850.)

Description.—Corallum forming hemispherical, or erect rudely cylindrical masses, several inches in diameter; the base covered by a strong wrinkled epitheca. Adult calices from four to five lines in diameter; about forty septal striæ in each; pores small, arranged in several vertical series in some of the tubes, irregularly distributed in others; distant from half a line to more than one line. Diaphragms very convex in the centre of the tubes, and usually with three or four smaller rounded prominences on their surface; a vertical section shews that they are more vesicular at the sides of the cells than in the centre, where they are from half a line to one line and a-half distant.

MM. Edwards and Haime in their description of this species say that there are two vertical series of pores on the larger plane sides of the cells and one on the smaller. Our specimen, however shew that this is not a constant character.*

Formation and Locality.—Devonian; Onondaga and Corniferous limestones. Rama's farm, Port Colborne. Savage's quarry, lot 6, con. 1, Wainfleet. Oxford, near Woodstock and in numerous other localities in Western Canada. This species occurs in Michigan and in Preston County, Virginia.

MICHELINIA INTERMITTENS (Billings).

Description.—Corallum forming large hemispherical masses; calyces nearly equal in diameter, with periodical constrictions within at the distance of half a line to one line and a-half. Diaphragms numerous, thin, slightly convex, sometimes shewing four or five vesicular swellings upon a single surface. The septal striæ are but slightly developed, about fifty to the

* See Polypiers Fossiles des Terrains Palæozoiques, page 251.

inner circumference of the cell. Pores only visible in the intervals between the constrictions where the walls are thin, three or four series on each plane side of the tube. The cells are from three to four lines in diameter.

The constrictions give to the cells of this species a circular aspect, whereas they are in fact polygonal. I am not certain that this fossil is different from the species described by Edwards and Haime (op. cit. p. 299,) under the name of *Chonostegites Clappi.* If so it should I think be called *Michelinia Clappi*, as it exibits all the characters of Michelinia. The constrictions appear to be occasioned only by the periodical thickening of the walls of the cells. Where not constricted the cells have the usual prismatic shape, with pores and septal striæ.

Formation and Locality.—The only specimen I have seen was collected by Mr. Murray, near Woodstock, C. W. It was found loose, but in lithological characters, it resembles the other species from the Corniferous limestone of that region.

Michelinia favosoidea (Billings).

Description.—Corallum forming large hemispheric or flattened masses; cells unequal in size, adult diameter about two lines and a half; diaphragms, flat, horizontal, with small vesicular swellings, usually around the margins of the upper surface; septal striæ very obscure, six to eight on each plane side of the cells; pores, very small, irregularly distributed, sometimes in rows of five or six across the cell, about one-sixth of a line distant from each other in some places, and sometimes absent in spaces of half a line in width. This species has much of the aspect of *Favosites favosa*, Goldfuss, but is notwithstanding very clearly a true Michelinia.

Formation and Locality.—Corniferous. Rama's farm, Port Colborne.

Collector.—E. Billings.

Genus Zaphrentis (Rafinesque).

Generic Characters.—Corallum simple, elongated, free and turbinated, surrounded by a complete epitheca; cup more or less deep; no columella ?; a single fossette well developed and occupying the place of one of the radiating septa; these are in general well developed, denticulated upon their margins, and extend upon the surface of the transverse diaphragms to the central of the visceral chambers.

Edwards and Haime in the *Polypiers Fossiles*, page 326, have in substance given the above definition of this genus. In some of the species there is a rudimentary columella, and sometimes even in the same species the radiating septa may or may not reach the centre in different individuals.

Zaphrentis prolifica (Billings).

Description.—Corallum simple, turbinate, curved, with a few broad shallow encircling folds. Septal fossette of a pyriform shape, gradually enlarging from the margin towards but not quite reaching the centre, variable in its position in relation to the curvature of the fossil. Radiating septa in the adult specimens between sixty and seventy-five of the larger size, alternating with a like number of smaller ones, the former in some of the individuals extending to the centre on the bottom of the cup, where they are spirally twisted or irregularly contorted, in other specimens not reaching the centre, which is then occupied by a smooth space or often with a columella elongated in a direction from the septal fossette towards the opposite side. The septa are also sharp-edged for about half the distance from the bottom of the cup to the margin, then become gradually less projecting until at the edge of the cup they are reduced to mere flat rounded ridges. Length from four to five inches or a little more. Width of cup from two inches to two inches and a half. Depth of cup about one inch.

Very numerous specimens of young individuals of this species, one inch and a-half and upwards in length, and with fifty or more principal radiating septa occur along with those full grown. These small ones might perhaps be regarded as constituting distinct species, but when good specimens can be observed they all exhibit the characters which are persistent in the large individuals.

The presence of the columella seems at first sight to be a sufficient ground for placing the individuals in which it occurs in the genus *Lophophyllum* (Edwards and Haime). I have however examined a great number of specimens and have found every gradation between the following characteristics.

1st. Specimens with a perfectly smooth space in the bottom of the cup, no columella.

2nd. With a columella slightly developed.

3rd. Columella large and prominent, with a smooth space all round.

4th. Columella well developed, but with a number of irregular often elongated tubercles in the surrounding smooth space.

5th. The septa reaching the columella, no smooth space.

6th. Septa covering the columella.

7th. Septa reaching the centre, with the columella either prominently, slightly or not all indicated beneath.

This last mentioned form must certainly be regarded as a true *Zaphrentis*, all other characters of the genus being present, and from it there is a regular series of forms leading in the seven directions above indicated or more. It appears to me therefore that so far from these specimens being divisible into several genera they only constitute one species.

The most persistent characters are the rounded edges of the septa near the margin of the cup, and the oval shape of the septal fossette, in the bottom of which where it reaches the side of the cup is a single septum which projects a little and partially divides the fossette.

This species somewhat resemble *Z. cornicula* (Lesueur), but differs in the edges of the septa, which are not dentated as in that species.

Formation and Locality. Devonian; Corniferous limestone. Extremely abundant at Rama's Farm near Port Colborne Canada West.

ZAPHRENTIS SPATIOSA (Billings).

Description.—Corallum short, turbinate, moderately curved and very broadly expanding. At the margin of the cup about ninety radiating septa alternately a little unequal and with their edges broadly rounded as in *Z. prolifica.* Length measured on the side of the greater curvature, about three inches, width of cup two inches and a-half. Septal fossette unknown.

This species is closely related to *Z. prolifica*, and may perhaps be united with it when its characters become more fully known.

Formation and Locality.—Devonian, Onondaga and Corniferous limestones, Rama's Farm, near Port Colborne Canada West.

Genus CYSTIPHYLLUM (Lonsdale.)

Generic Characters.—Corallum simple, turbinate, entirely filled with vesicular celluliferous structure; radiating septa, rudimentary or obsolete.

CYSTIPHYLLUM SULCATUM (Billings.)

Description.—Short, turbinate, much curved, expanding at the rate of between forty and forty-five degrees from the minute sharp curved point upwards; cup oblique, the lower margin being on the side of the lesser curvature, moderately deep and nearly regularly concave, the bottom covered with obscure coarse rounded radiating ridges; a shallow rounded groove or fossette extending from the centre to the higher margin, and in some specimens two others much less distinct radiating to the sides at right angles to the main groove. Exterior encircled by obscure undulations, and longitudinally striated by the rudimentary radiating septa. The vesicular structure consists of irregular sub-lenticular cells from half a line to two lines in width; length of the convex side from one inch and a half to three inches, the usual length appears to be about two inches or a little more; width of cup from one inch to one inch and a half; depth about half an inch.

This species when the interior cannot be seen might be mistaken upon a superficial examination for a small curved *Cyathophyllum* or *Zaphrentis.* It is about the size and shape of the curved specimens of *Petraia cornicula.*

Locality and Formation.—Rather common in the Corniferous or Onondaga limestone on Rama's farm, Port Colborne.

Collector—E. Billings.

Genus CYRTODONTA (Billings).

Generic Characters.—Equivalve, inequilateral; umbones near the anterior end; general form obliquely tumid, transversely sub-rhomboidal or ovate, posterior extremity larger than the anterior and usually broadly rounded; two muscular impressions, of which the posterior is superficial and the anterior sometimes deeply excavated; three oblique, often more or less curved, anterior teeth, situated either beneath or a little in front of the umbones; two or three remote posterior lateral teeth parallel with the hinge line; pallial line simple; ligament external; some of the species have a narrow area between or behind the beaks.

CYRTODONTA RUGOSA (Billings).

Fig. 1.

Fig. 2.

Figure 1. Exterior of right valve.
" 2. Interior of same specimen.

Description.—Small, sub-rhomboidal or sub-quadrate, the dorsal and ventral margins being somewhat parallel, and the anterior and posterior extremities obtusely rounded, the latter broader than the former; obliquely tumid from the beaks to the posterior ventral angle; the beaks rather small and incurved; a broad, shallow, scarcely perceptible depression extending from the ventral margin obliquely forward and upward towards the umbones; surface concentrically striated, and also marked with several more or less prominent sub-imbricating concentric ridges of growth; hinge line nearly straight, a little curved; interior shewing in the right valve three anterior teeth, the central one of which is the largest, and two posterior lateral teeth. In the left valve there appear to be four anterior teeth; but as the specimens are somewhat imperfect, this may not be the correct number. Width nine lines; length from the centre of the hinge line to the centre of the ventral margin, seven lines; depth of a single valve, three lines.

None of the specimens that I have seen are larger than the one represented in figures 1 and 2.

Locality and Formation.—Fourth Chute of the Bonne chère, Pauquette's Rapids, and at La Petite Chaudière Rapids near the city of Ottawa north side, associated with numerous fossils of the Trenton and Black River formations.

Collectors—Sir W. E. Logan, J. Richardson, E. Billings.

CYRTODONTA HURONENSIS (Billings).

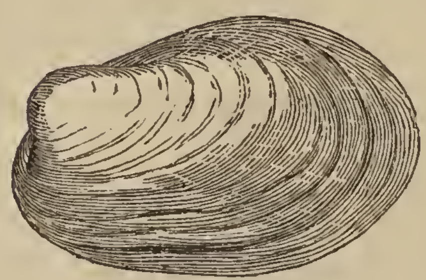


Fig. 3.

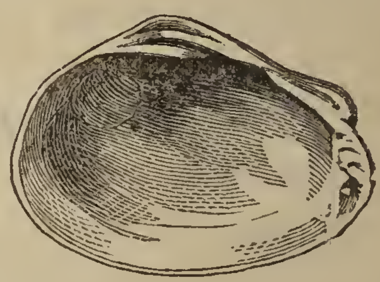


Fig. 4.

Figure 3. View of left valve from Lake Huron.
" 4. Interior of another specimen, same locality.

Description.—Transversely oval; anterior and posterior extremities rounded; ventral margin moderately convex, dorsal margin a little more convex than the ventral; umbones rather small, incurved; greatest tumidity extending from the umbones obliquely towards the posterior ventral angle; surface concentrically marked with fine striæ and ridges of growth. Width one inch five lines; length at the centre, one inch.

Locality and Formation.—The specimens are from an island in the group lying off Point Palladeau, Lake Huron, where they were found associated with Chazy, Black River and Trenton fossils; also at Point Claire, Island of Montreal.

Collector—A. Murray.

CYRTODONTA SUBCARINATA (Billings).

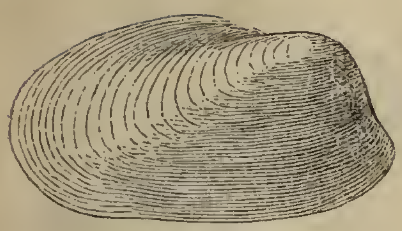


Fig. 5.

Fig. 6.

Fig. 7.

Figure 5. A specimen from Pointe Claire.
" 6. Dorsal view of same specimen.
" 7. A cast from lot 26, con. 5, Osnabruck.

Description.—Transversely sub-oval; ventral margin scarcely convex, straight or slightly sinuated for a small space of the centre; dorsal margin elevated in the centre and sloping with a slight curve towards the posterior end, which is narrowly rounded, or truncate in the casts of the interior; umbones moderately small, incurved, and somewhat carinate for a greater or less distance; surface marked with obscure concentric ridges of growth. The interior has not been seen. Width one inch three lines; length nine lines.

This species may perhaps be considered a variety of the last; but the proportions are somewhat different, and it is always characterised by the strong, rounded carina, which extends from the umbones to the posterior ventral angle.

Locality and Formation.—Occurs at Pointe Claire and in numerous localities in the valley of the Ottawa in the top of the Chazy, throughout the Birdseye and Black River limestones, and in the base of the Trenton.

Collectors—Sir W. E. Logan, A. Murray, J. Richardson, E. Billings.

Cyrtodonta Canadensis (Billings).

Fig. 8.

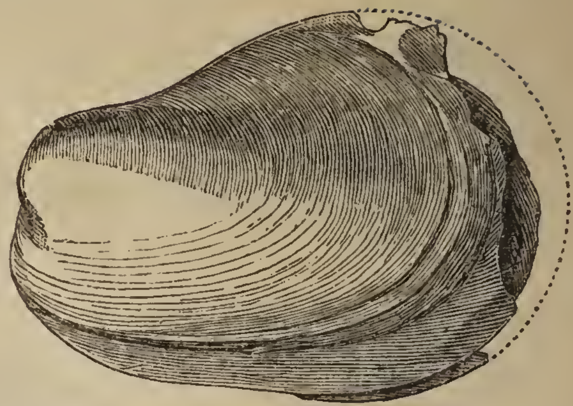


Fig. 9.

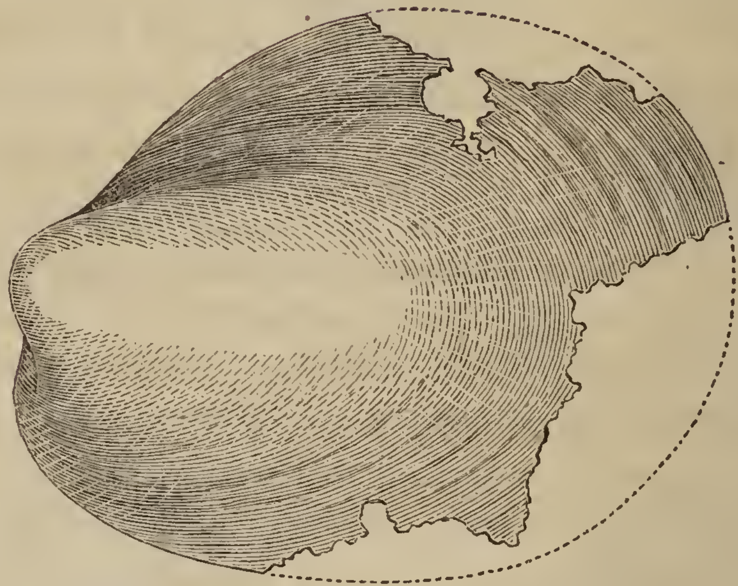


Fig. 10.

Figure 8. A small specimen from the north side of St. Joseph's Island, Lake Huron.

" 9. An elongated variety from the lower beds opposite the foot of the timber-slide, 4th Chute of the Bonne chère.

" 10. A large specimen from Pauquette's Rapids.

Description.—Transversely broad-oval; anterior, posterior, and ventral margins, and also the posterior half of the dorsal margin regularly rounded; a portion of the ventral margin about the centre of the width is sometimes nearly straight; dorsal margin elevated, somewhat compressed; diagonally and rounded ventricose from the umbones towards the posterior ventral angle; beaks short, obtusely rounded, incurved; surface nearly smooth or obscurely marked with concentric ridges; a few strong imbricating lamellæ of growth near the margin of some specimens. Width from fifteen lines to two inches and one-fourth; length from eleven lines to twenty-one lines.

Some of the specimens are a little more transverse than others; but there are intermediate forms connecting the specimen, represented by Figure 9, with Figures 8 and 10.

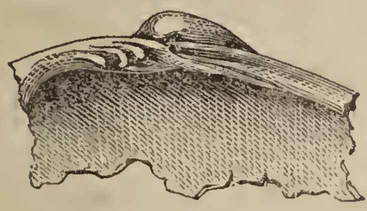


Fig. 11.

Fig. 11. A fragment, shewing the anterior teeth.

The anterior teeth are short, the central one being the longest and the most curved; the posterior teeth of the specimen represented by Fig. 10 are two in number, elongated and prominent.

Locality and Formation.—Island of St. Joseph's Lake Huron; La Petite Chaudière Rapids near the City of Ottawa; Fourth Chute of the Bonne chère and Pauquette's Rapids; associated with fossils of the Trenton and Black River formations.

Collectors—Sir W. E. Logan, J. Richardson, A. Murray, E. Billings.

CYRTODONTA SPINIFERA (Billings).

Fig. 12.

Description.—Small, sub-circular; greatest length and breadth about equal; moderately convex; hinge line much elevated; umbones small, incurved; dorsal margin nearly straight from the umbones about half-way to the posterior extremity of the hinge line; anterior, ventral, posterior and posterior half of dorsal margins broadly and regularly rounded; surface smooth, with a few short stout spines.

The specimen figured shews the anterior teeth: they are three in number, and do not differ from those of *C. rugosa* Length eight lines; breadth the same.

Locality and Formation.—Pauquettes Rapids, and Fourth Chute of Bonne chère, associated with fossils of the Trenton and Black River formations.

Collectors—Sir W. E. Logan, J. Richardson, E. Billings.

CYRTODONTA OBTUSA (Hall sp.)

(*Ambonychia obtusa*, Hall, Palæontology of New York. Vol. 1, p. 167. Plate 36; Figures 8*a*, 8*b*.)

Fig. 13.

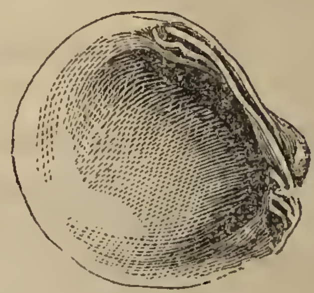


Fig. 14.

Figure 13. Left valve from Pauquette's Rapids.
" 14. Interior of some shewing the teeth.

Description.—The following is Professor Hall's description: "Obliquely ovate, short, gibbous; umbones short, obtuse, scarcely incurved or bending forwards; shell somewhat compressed towards the lower margin, convex on the centre and becoming inflated above; anterior side obtuse, rounded, scarcely extending beyond the umbones; posterior side compressed, scarcely alated; cardinal line straight, margin of shell curving from its posterior extremity; surface?"

"The specimens seen are casts, where the markings of the shell are not preserved. This species is distinguished from the others by its short, ovate form, as well as the shorter, very obtuse and gibbous umbones. It departs somewhat from the typical forms of the genus (*Ambonychia*); but it has nevertheless the essential features, and cannot be referred to any other genus." (Pal. N. Y., vol. 1, page 167.)

Locality and Formation.—City of Ottawa, Belleville, and at Trenton on the Bay of Quinte, in the Trenton limestone; at the Fourth Chute of the Bonne chère, and also at Pauquette's Rapids very perfect specimens are common, associated with fossils of the Trenton and Black River formations.

Collectors.—Sir W. E. Logan, J. Richardson, and E. Billings.

Cyrtodonta sub-truncata (Hall sp.).

Edmondia sub-truncata, Hall, Palæontology of New York, Vol. i., page 156, Plate 35, Figure 3 c, (not Fig. 9, Plate 34.)

This species is common in the Trenton and Black River limestones of Canada at all the localities above mentioned. The silicified specimens shew the internal characters of Cyrtodonta very clearly.

Cyrtodonta sub-angulata (Hall sp.).

Edmondia sub-angulata, Hall, Palæontology of New York, Vol. i., page 156, Plate 35, Figures 2 a, b.

A specimen of this species from Pauquette's Rapids exhibits in the right valve two posterior lateral teeth and an area between the beaks. That portion of the hinge line occupied by the anterior hinge teeth is destroyed, so that their character cannot be observed. There is an anterior muscular impression as in the other species.

It occurs at Pauquette's Rapids and at La Petite Chaudière.

Cyrtodonta cordiformis (Billings).

Description.—Sub-rhomboidal; cordiform; extremely ventricose; umbones strongly incurved; obtusely carinate on their upper side; the carination extending backwards and diagonally downwards, becoming more rounded and nearly obsolete before reaching the posterior ventral angle; the hinge-line is straight, short, and about at right angles to the direction of the carina; from the extremity of the hinge-line the posterior side slopes abruptly, but with a moderate curve, to the posterior ventral angle; ventral margin a little convex, and about as long as the posterior side; anterior margin half the length of the ventral, not much curved; anterior muscular scar oval and distinctly marked; surface concentrically striated. Length of largest specimen examined from the beaks to the posterior ventral angle, thirteen lines; length of hinge-line, seven lines; length of posterior and ventral sides, about ten lines each. The diagonal carina is not straight, but has a strong upward curve.

Locality and Formation.—East point of St. Joseph's Island, Lake Huron, Trenton Limestone.

Collector.—A. Murray.

CYRTODONTA SIGMOIDEA (Billings).

Description.—Sub-rhomboidal, ventricose, a strong obtusely angular carina extending from the closely appressed beaks with a sigmoid curve to the posterior ventral margin; anterior end rounded, projecting a little in front of the beaks; ventral margin longer than the dorsal and moderately convex; posterior extremity obliquely truncate. Width one inch and a half; length from the umbones to the ventral margin thirteen lines.

Locality and Formation.—Hudson River group, Anticosti.

Collector.—J. Richardson.

Sub-genus VANUXEMIA (Billings).

Generic characters.—Ovate; beaks terminal or sub-terminal; posterior extremity rounded; anterior more or less acuminated; two muscular impressions; anterior teeth variable in number, sometimes curved and striated; posterior lateral teeth from two to four.

VANUXEMIA INCONSTANS (Billings).

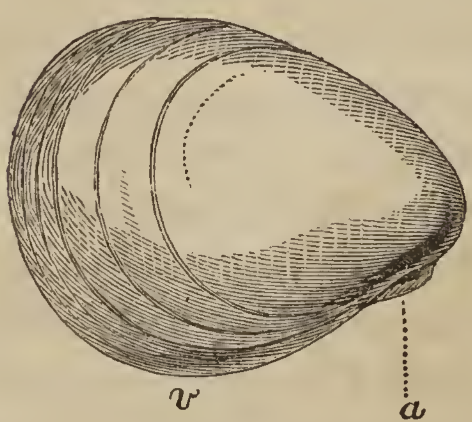


Fig. 15.

Fig. 16.

Figure 15. Right valve; *v*, ventral margin; *a*, the small anterior ear.
" 16. A fragment shewing the teeth obscurely; *m*, the muscular impression.

Description.—Ovate; moderately convex; beaks terminal gradually expanding from the beaks to the posterior extremity, which is broadly rounded; dorsal margin slightly and uniformly convex from the beaks to the posterior angle; anterior extremity represented by a very small projection beneath the beaks; ventral side regularly rounded, except a short space near the beaks, which is sometimes concave and partly occupied by the small projection of the anterior extremity. Three strong curving anterior teeth; two posterior lateral teeth; shell very thick towards the anterior end; a small area between the beaks; the anterior muscular impresssion is apparently excavated in the edge of the very thick shell. Surface with a few more or less strongly marked concentric furrows of growth. The beaks are short, rounded, and closely incurved.

The proportional length and breadth varies. The specimens are usually an inch and a half in length from the beaks to the posterior extremity, the greatest width from the dorsal to the ventral side being an inch and three or four lines. There is a small variety, scarcely an inch in length, and more obtuse at the anterior end, than the specimen figured; it is also more ventricose.

Locality and Formation.—Fourth Chute of the Bonne chère, La Petite Chaudière Rapids near the city of Ottawa, and numerous localities in the valley of the Ottawa, associated with fossils of the Black River and Trenton formations.

Collectors.—Sir W. E. Logan, E. Billings, J. Richardson.

VANUXEMIA BAYFIELDII (Billings).

Fig. 17.

Figure 17. Interior of the left valve of *V. Bayfieldii.*

Description.—Very ventricose; ovate; the anterior extremity, including the beaks, narrowly rounded; the posterior end broadly rounded; shell very thick; seven anterior teeth; four posterior teeth; anterior muscular impression large, deep, and excavated in the very much thickened edge of the shell; posterior muscular impression sub-circular, superficial and situated just beneath the posterior extremity of the hinge line.

The specimen figured is deeply imbedded in a coral *(Monticulipora petropolitana)*, and only exhibits the edges and inside of the shell. From the great thickness of the shell, casts of the interior must bear very little resemblance to a perfect specimen. The form is very like that of *Vanuxemia inconstans*, but the characters of the interior leave no doubt as to its distinctness.

Locality and Formation.—Bayfield Sound, Lake Huron a single loose specimen; Lower Silurian appears to be of the Hudson River Group.

Collector.—A. Murray.

Genus Matheria (Billings.)

Generic Characters.—Transverse; equivalve; inequilateral; beaks near the anterior end; dorsal and ventral margins sub-parallel; two small obtuse cardinal teeth in the left valve, and one in the right; no lateral teeth; two muscular impressions; ligament external.

This genus is dedicated to Mather, one of the Geologists of the New York Survey.

Matheria tener.

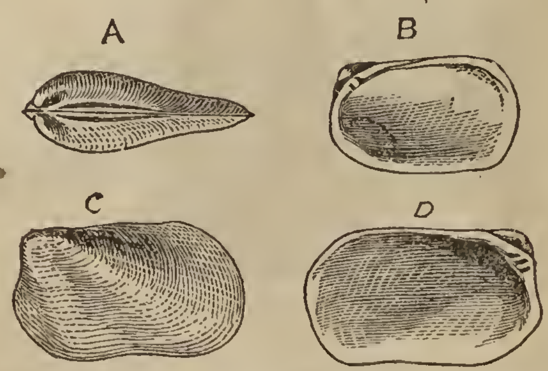


Fig. 18.

Figure 18. A, dorsal view of *Matheria tener*; B, interior of right valve; C, exterior of left valve; D, interior of left valve.

Description.—Small, oblong, depressed; dorsal and ventral margins nearly straight and parallel; upper half of posterior extremity obliquely truncate; lower half rounded; anterior extremity sub-truncate from the beaks nearly to the anterior ventral angle, which is rounded, and projects slightly beyond the umbones. From the beaks to the anterior ventral angle extends a prominent obtusely angular canina; surface marked with fine concentric striæ. Width eight lines; length four lines.

Locality and Formation.—Blue Point, Lake St. Johns; Trenton limestone.

Collectors—J. Richardson, R. Bell.

Genus OBOLUS (Eichwald.)

OBOLUS CANADENSIS (Billings.)

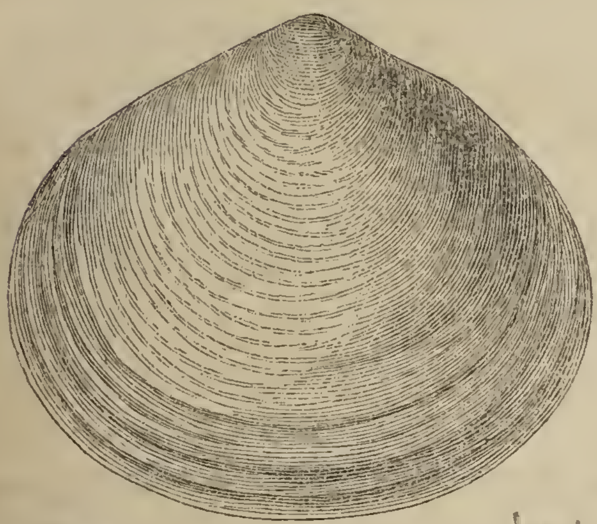


Fig. 19.

Fig. 20.

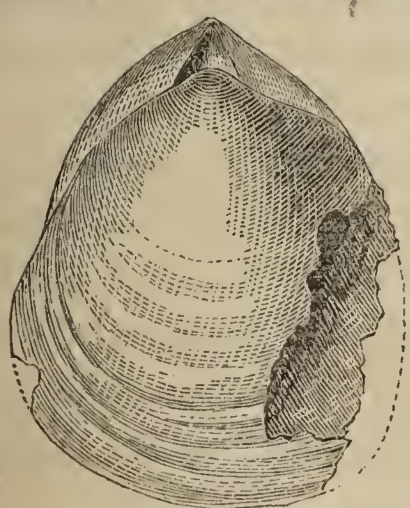


Fig. 21.

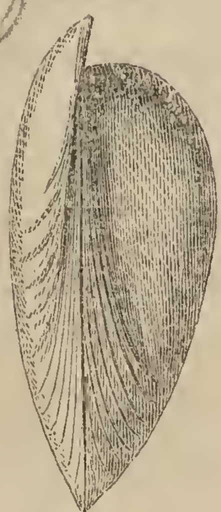


Fig. 22.

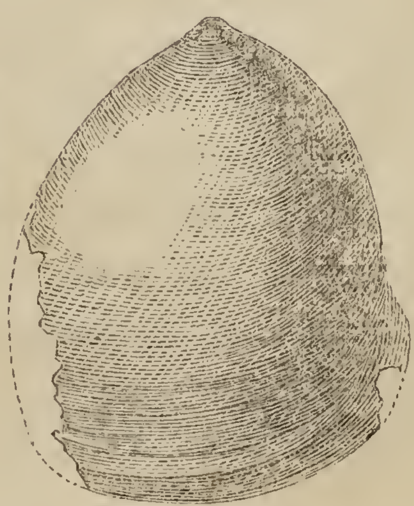


Fig. 23.

Figure 19. Dorsal valve.
20. Interior of dorsal valve.
21. Dorsal view of an elongated specimen which has both valves in place but a little distorted.
22. Side view of the same specimen.
23. Ventral view.

Description.—The form of this magnificent species is somewhat variable, the width being often greater than the length, and sometimes less. Usually, it is transversely broad-oval; the apex of the dorsal valve obtusely angular, and that of the ventral rather acute. The dorsal valve is moderately and pretty uniformly convex; the ventral valve depressed-convex. The beak of the ventral valve projects about two lines above that of the dorsal valve, and exhibits a wide, scarcely concave area, with a triangular excavation representing the obsolete foramen; the surface is smooth, or with a few concentric imbricating furrows of growth. In the inside of the dorsal valve there are near, but above the centre, two pyriform muscular impressions, with their pointed extremities close together and directed downwards, while in the upward direction they diverge outwards; they are separated by an obscure rounded ridge, and surrounded on the lower side by an elevated angular border, which forms a projecting point just below their lower extremities. Beneath and close to the hinge there is a narrow and deep flexuous furrow. The muscular impression at the cardinal angles figured by Davidson in *O. Apollinis* (Eichwald), *O. transversa* (Salter), and *O. Davidsoni* (Salter), are very indistinct in this species; the area of the ventral valve does not appear to be striated. The interior of the ventral valve is not clearly shewn in any of our specimens. Width usually about two inches, but some of the fragments undoubtedly belonged to individuals which were three inches wide. The length from the beaks to the base, is either equal to or a little greater or less than the width, the dimensions being variable.

Locality and Formation.—Occurs abundantly at the Fourth Chute of the Bonne chère, Pauquette's Rapids, and in the Townships of Stafford and Westmeath, County of Renfrew, associated with fossils of the Trenton and Black River limestones.

Collectors—Sir W. E. Logan, J. Richardson, and E. Billings

Genus EICHWALDIA (Billings.)

Generic Characters.—Large valve perforated on the umbo for the passage of the peduncle; the place of the foramen beneath the beak occupied by an imperforate concave plate, the interior divided by an obscure medio-longitudinal ridge; interior of smaller valve divided throughout from the beak to the front by a very prominent medio-longitudinal ridge; no hinge, teeth, sockets, or other articulating apparatus in either valve.

After a great deal of examination and comparison I have not been able to refer the species for which the above generic name is proposed to any of the described genera. Although several silicified specimens exhibiting the interior have been obtained, they do not show any muscular impressions. The perforation on the back of the beak was at first supposed to be a fracture, but we have now specimens which exhibit its characters so completely that I do not think it possible there can be any mistake. The internal structure of the larger valve somewhat resembles that of *Pentamerus* or *Camarophoria*, the concave plate beneath the beak appearing to be the homologue of the floor of the triangular chamber found in these genera. I cannot make out however, that it is in any way connected with the medio-longitudinal ridge as is the case in both *Pentamerus* and *Camarophoria*. In removing the limestone from silicified specimens the delicate processes in the interior of species of brachiopoda are very often destroyed, and it is possible that the connection in question may exist in perfect specimens, but not appear after treatment with acids. It is therefore uncertain whether or not it is attached to the plate beneath the beak. If it should be hereafter ascertained that it is so connected, the foramen on the umbo would still be sufficient to show that this is a new genus, to the establishment of which the characters of the smaller valve and the absence of any articulating and apophysary apparatus would be additional characters. As other specimens can be procured and as the internal characters cannot be well shewn by wood-engraving, I shall for the present give figures of the exterior only.

Eichwaldia subtrigonalis (Billings.)

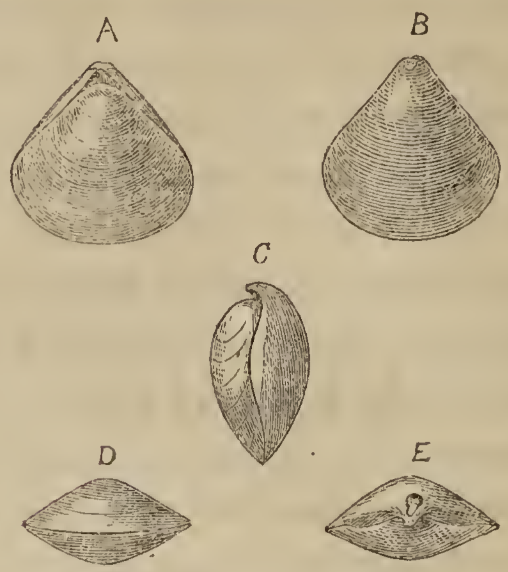


Fig. 24.

Figure 24. A, dorsal view; B, ventral; C, side; D, front; E, apex, shewing the foramen.

Description.—Sub-triangular; both valves moderately convex and smooth, apical angle about ninety degrees or a little less; sides from the beak to about one half the length straight, then rounded; front more or less broadly rounded; beak of larger valve extended, incurved at the point and with a moderately large concave area; beneath beak of smaller valve strongly incurved apparently entering the visceral cavity beneath the area of the larger valve; length and width about equal.

Locality and Formation.—Fourth Chute of the Bonne-chère and Pauquette's Rapids, associated with numerous fossils of the Black River and Trenton Formations.

Collectors—Sir W. E. Logan, J. Richardson, E. Billings.

I have the honour to be,

Sir,

Your most obedient servant,

E. BILLINGS.

REPORT

FOR THE YEAR 1857,

OF

T. STERRY HUNT, Esq.,

CHEMIST AND MINERALOGIST TO THE GEOLOGICAL SURVEY OF CANADA,

ADDRESSED TO

SIR W. E. LOGAN, F.R.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 1st *March*, 1858.

SIR,

I have now the honour to lay before you some of the results of my chemical investigations in connection with the Geological Survey during the past year. In the first place, and in continuation of the inquiries suggested in my last report, I have to offer a series of analysis of various dolomites and magnesian limestones, and to give the results of some experiments which serve to explain the conditions and mode of their formation. In this connection it may be well to recall some of the principal facts in the history of dolomites, as a preliminary to the researches and discussions which are to follow.

DOLOMITES.

The name of dolomite, as is well known, is employed to designate a mineral which in its purest state is composed of equivalent weights of carbonate of lime and carbonate of magnesia, these being in the proportions of 50 to 42, or in 100 parts of 54·35 of carbonate of lime, and 45·65 of carbonate of magnesia. This compound is distinguished from carbonate of lime by its greater density (which is from 2·85 to 2·90), and by its somewhat superior hardness. It is also much less readily attached by acids than carbonate of lime, and at ordinary temperatures does not perceptibly effervesce with nitric or muriatic acids, unless reduced to powder. When calcined it gives a mixture of lime and magnesia, which is said to yield a stronger mortar than ordinary lime, but which slakes slowly and with but little evolution of heat.

A portion of the magnesia in dolomite is often replaced by protoxyd of iron, and more rarely by oxyd of manganese. The dolomites containing carbonate of iron are generally yellowish or reddish on their weathered surfaces, from the change of a portion of the iron into hydrated peroxyd, and those containing carbonate of manganese become brownish-black on the exterior from a similar cause. Both of these cases may be observed in the dolomites of the Eastern Townships of Canada.

Besides the crystallized dolomites which occur in veins and cavities in various rocks, and have received the names of *bitter-spar* and *pearl-spar*, (the latter in allusion to the pearly lustre of the faces of the rhombohedron, which are generally curved), we find this double carbonate forming great beds of a rock which is also known by the name of magnesian limestone. The yellow magnesian limestones of the Permian system in England are those best known, and have in some cases a total thickness of 300 feet. They are immediately overlaid by gypseous marls, to which succeed the limestones, gypsum and rock-salt of the Triassic series. Similar magnesian limestones occur in the Devonian and Carboniferous formations of England and Russia. Descending in the geological series, we find in the Saliferous group of Western Canada and New York, beds of dolomite with gypsum, (see Report for 1856, p. 475); and immediately below, in the Niagara group, there occurs a remarkable deposit of dolomite about to be described. In the Report just cited, p. 465, I have described the dolomites which occur interstratified with pure limestones in the Hudson River group. The examinations of Messrs. Owen and Whitney have shown that in Michigan, Iowa, and Minnesota, the calcareous strata immediately overlying the Potsdam sandstone, and corresponding to the Calciferous sand-rock, are highly magnesian, often constituting true dolomites; and I have found thin layers of dolomite among the limestones of the Chazy division on the island of Montreal. The argillaceous limestone from this formation at Hull, which is employed as a hydraulic cement, also contains about 20 per cent. of magnesian carbonate.

Beneath the oldest known fossiliferous rocks, and among the limestones of the Laurentian series, we meet with great beds of dolomite, sometimes ferriferous, and often containing serpentine and other silicious minerals (see Report already cited, pp. 366 and 482.)

When on the other hand, we ascend from the Permian, we find the Jurassic formation of the Alps containing immense masses of dolomite, which also occur in the same formation in France and Germany. In the Cretaceous formation dolomites occur in Gascony, and in the Paris basin; and in 1855 I visited in company with the members of the Geological Society of France, a deposit of dolomite in the Tertiary strata at Pont St. Maxence, in the valley of the Oise, in France, since described in the Bulletin of the Society. The dolomite, which there reposes upon the nummulitic limestone, and is overlaid by the *calcaire grossier*, forms irregular beds or masses several feet in thickness. It is in the form of an incoherent sand, which consists according to Damour, of nearly pure crystalline dolomite, with a little bitumen and some quartzose sand. Between it and the overlying fossiliferous limestone, is a thin layer of yellowish tufaceous cellular limestone, which does not contain a trace of magnesia. (See Bulletin of the Geol. Soc. of France, vol. xiii., p. 67.)

We are indebted to Mr. J. D. Dana for the discovery of a dolomite of recent origin in Matea, an elevated coral island near Tahiti, where among the limestones which he supposes to be formed by the solidification of coral mud, is one containing 8.3 per cent. of carbonate of magnesia, and another which according to Prof. Silliman, jr., yields 38.07 per cent. of carbonate of magnesia. This dolomite, which is compact, finely granular and very tenacious, is at the same time cavernous, and I found its density in powder to be 2.83, its hardness being above 4.0. Analysis gave me 38.25 per cent. of carbonate of magnesia, 0.30 of silica, and 60.50 of carbonate of lime.—(*Am. Jour. of Science*, [2] xiv. p. 82, and xix. p. 429.)

The preceding dolomites belong to marine formations, but dolomites are said to occur in the lacustrine limestone at Dächingen near Ulm, and in the brown-coal formation at Giessen.

It appears then from the facts which we have here cited, that the production of dolomites was continued from the time of the earliest known stratified rocks up to the tertiary period, and is perhaps even now going on.

Physical Characters of Dolomites.—Apart from the altered crystalline dolomites of metamorphic strata, the generally crystalline texture of those of unaltered regions is remarkable. In some cases the rock is an aggregate of pearly, cleavable grains of dolomite, which occasionally have but little coherence, or are in the form of loose sand. At other times the rock is concretionary, having an oolitic or a botryoidal structure, the masses often exhibiting a radiated arrangement; more rarely compact varieties of dolomite are met with. The concretionary action has sometimes, according to Lyell, so far disturbed the original arrangement as to obliterate the marks of stratification. Most dolomites exhibit cavities, which have often been filled by subsequent deposits of other minerals, and seem to indicate a contraction, apparently attendant upon chemical change after the deposition of the rock.

A remarkable mode of occurrence is that in which dolomite forms the cement of breccias and conglomerates. I have in my last report described rocks of this kind from the Quebec division of the Hudson River group, where rounded fragments of limestone, shale, and even of dolomite, have been re-cemented into a rock by the introduction of a crystalline ferriferous dolomite. Analogous to this is the well-known conglomerate of the Permian system near Bristol, and in other parts of England, where in hollows of the Mountain Limestone, are found accumulations of fragments of this limestone, with others of coal-shale, mixed with bones and teeth of saurians; the whole cemented together by a red or yellow dolomite, and resting unconformably upon the Carboniferous strata. Similar conglomerates occur in the same formation in Normandy, where they enclose concretionary masses of nearly pure dolomite, while in the Permian rocks of the Vosges concretions of sandy dolomite occur imbedded in layers of micaceous sandy clay, itself sometimes agglutinated by a dolomitic cement. (*Explication de la Carte Géologique de France*, ii., pp. 15 and 128.)

In this connection I must recall the existence of a crystalline ferriferous dolomite filling the shells of *Orthoceras*, *Pleurotomaria* and *Murchisonia*, as also small fissures in the non-magnesian Trenton limestones of Ottawa, described in the Report for 1852, p. 174; and I have to remark the existence of similarly replaced fossils in the Chazy limestone at Montreal. But while these dolomitic casts occur in pure limestone, I have presently to describe beds from the Niagara formation, in which, on the contrary, purely calcareous corals occur imbedded in a yellow magnesian limestone.

Having thus brought together the principal facts in the history of magnesian limestones, I proceed to give the analytical results in support of several of these points, at the same time referring to previous Reports already cited for other analysis :—

Dolomites of the Laurentian series: 1846, p. 124; 1853–56, pp. 366—482.
Dolomites of the Silurian series: 1852, p. 174; 1853–56, p. 465.

Analyses of Limestones and Dolomites.

Chazy Limestone.—Between the beds of the dark compact fossiliferous limestone at the quarries near the St. Lawrence toll-gate, Montreal, there are found irregular interrupted layers, occasionally an inch or more in thickness, of a yellow pulverulent material, containing great numbers of fragments of encrinal stems. The matrix is easily crushed, permitting us to separate the organic remains by means of a seive. A portion of the yellow powder thus obtained was dissolved with effervescence by hydrochloric acid, leaving only a residue of white silicious matter, and the solution contained lime, magnesia and iron, but no alumina ; nor could the presence of manganese, nickel, or any allied metals, be detected. The analysis, which represents a very ferriferous dolomite with an excess of iron, gives the iron as carbonate, while it exists in part as peroxyd, and hence the slight increase. 100 parts gave me :—

Carbonate of lime,	40·95
" of magnesia,	24·19
" of iron,	27·03
Insoluble sand,	9·01
	101·18

A portion of grayish crystalline limestone, distant about an inch from the magnesian layer, left on solution in acid, 18·4 per cent. of white insoluble matter, and gave only 1.09 per cent. of carbonate of magnesia, the rest being carbonate of lime.

At the above locality there are found casts of orthoceratites, consisting of a coarsely lamellar white dolomite, weathering reddish-yellow, crumbling, and evidently very ferruginous. These are imbedded in a nearly black, fine-grained limestone, which, as in the case of similar specimens from Ottawa, is traversed by thin, irregular veins of dolomite, leading to the casts. A portion of this black limestone was dissolved in hydrochloric acid, during which process the carbonic acid gas evolved contained traces of sulphuretted hydrogen. A little iron pyrites remained in the insoluble residue, and was dissolved by nitric acid with separation of sulphur. The residue thus purified, was black when dry from the presence of carbonaceous matter, but became white by ignition in the air, and then equalled 12·8 per cent. of the rock. A dilute solution of soda, aided by heat, removed from the calcined residue 9·47 per cent. of silica, leaving a matter having nearly the composition of a feldspar. It was examined for sulphate of baryta, which I once detected in the insoluble residue of an earthy limestone, but contained only a trace of sulphuric acid. An analysis by fusion with an alkaline carbonate, gave me :—

Silica,	73·02
Alumina,	18·31
Lime,	·93
Magnesia,	·87
Alkalies, by difference,	6·87
	100·00

Dolomite of Dudswell.—In your Report for 1847, p. 54, you have described the Upper Silurian limestones of Dudswell, which are often more or less micaceous and interstratified with micaceous schists, but contain, in a state which admits of their identification, the characteristic fossils of the Niagara group. Sometimes the rock consists of masses of corals of the genera *Cyathophyllum*, *Porites* and *Favosites*, imbedded in a yellowish granular paste. The dark, almost black colour of the polished corals, which generally exhibit organic structure, contrasts agreeably with the yellow base. In other portions the structure of the rock seems to be due to the fact that beds of gray fossiliferous limestone have been broken and shattered, generally in the plane of stratification, and the fissures subsequently filled up with the yellow paste, which forms layers, sometimes half an inch thick, occasionally enclosing the fragments of gray limestone. Blocks of this variety which you have caused to be cut and polished, yield a marble of considerable beauty.

A chemical examination of these rocks shows that while the fossils, and the grayish base which often envelops them, are pure carbonate of lime, the yellowish portions are magnesian. A fragment of the gray, finely granular limestone, gave me 6·2 per cent. of insoluble sand, a trace of oxyd of iron, and 1·3 per cent of carbonate of magnesia, the rest being carbonate of lime.

A specimen of the yellow portion freed from iron pyrites, which is often disseminated through it in crystals, gave me as follows :—

Carbonate of lime,	56·60
" of magnesia,	11·76
" of iron,	3·23
Insoluble quartz sand,	26·72
	98·31

The proportion of magnesia here present is far from being sufficient to form with the lime a dolomite. Karsten, however, many years since pointed out that acetic acid in the cold scarcely attacks dolomite, although readily dissolving carbonate of lime; so that magnesian limestones, when treated with this acid, leave a residue of dolomite. By taking advantage of this reaction, I found a lamellar crystalline limestone from Loughborough, which contains 7·5 per cent. of carbonate of magnesia, to be a mixture of dolomite and carbonate of lime, (Report 1853–6, p. 366), and the same mode of analysis was now applied to the yellow magnesian limestone of Dudswell. When reduced to powder it effervesced freely with acetic acid in the cold, and when a renewed application of the acid no longer produced effervescence, the residue was carefully washed and dried. A weighed portion of it was then digested with dilute hydrochloric acid, which left a residue of 52·0 per cent. of sand and pyrites. The composition of the soluble part was as follows:—

Carbonate of lime,	51·75
" of magnesia,	35·73
" of iron,	12·52
	100·00

The above numbers correspond very exactly to a dolomite, in which a portion of magnesia is replaced by protoxyd of iron, while the portion dissolved by acetic acid contained 4·0 per cent. of carbonate of magnesia, and only a trace of iron. The pyrites of this magnesian limestone contained no traces of cobalt or nickel.

Portor Marble.—The resemblances as to color and structure, between the marble of Dudswell and the black and yellow marble from northern Italy, known by the name of *Portor*, were such, that I was induced to examine the latter. This marble is chiefly wrought in the Gulf of Spezzia, and according to Savi, belongs to the Neocomian formation. It has a black or dark-gray ground, susceptible of a high polish, and is penetrated by irregular veins of a deep yellow or reddish-brown color. These seem to envelope the black masses, and sometimes to give rise to a breccia.

A well characterized specimen of Italian portor was chosen for examination. The black compact portions dissolved in hydrochloric acid, leaving no appreciable residue, and contained 1·0 per cent. of carbonate of magnesia, the rest being carbonate of lime. The yellow veins were granular in their texture, closely resembling those of the Dudswell marble. By solution in hydrochloric acid, they left a residue of silicious sand equal to 4·6 per cent., and the solution gave besides lime and a little oxyd of iron, magnesia equal to 35·5 per cent. of magnesian carbonate.

Dolomitic Conglomerate of St. Helen.—In your Report for 1857, p. 15, you have described as occurring on the Island of St. Helen, a peculiar conglomerate rock, made up of pebbles of shale, chert, sandstone, and sometimes of limestone, which latter contain organic remains of Lower Silurian age, the whole cemented by a calcareo-silicious paste into a mass exceedingly tough, and so solid, that a fracture from a blow passes equally through the pebbles and the matrix. The rock is grayish within, and weathers deeply of an ochre-yellow. In the report already cited, you expressed a doubt as to the age of this conglomerate, which at St. Helen reposes upon the Utica slate, but you have since recognized it as belonging to the Lower Helderberg series of the New York geologists.

Acids at the ordinary temperature, have but little effect on this rock; but by the aid of heat, dissolve from it a large amount of carbonates with effervescence. A portion of the fine-grained paste gave to hydrochloric acid 46·0 per cent. of soluble matters, consisting of lime, magnesia and protoxyd of iron, with but a trace of alumina, and left a silicious sand. The composition of the soluble part was as follows :—

Carbonate of lime,		57·8
"	of magnesia,	16·4
"	of iron,	25·8
		100·00

You subsequently found a similar yellow-weathering conglomerate reposing on the Calciferous sand-rock at Isle Bizard; and Mr. Richardson has observed it in a like position at Ste. Anne; also resting upon Laurentian rocks at Mont Calvaire; and at the White-Horse Rapids upon the Trenton limestone. I have examined specimens of the conglomerate from the last three localities, and have in each case found the cement to be a magnesian carbonate of lime, with a large amount of carbonate of iron. These conglomerates however offer some varieties in their colour and their imbedded minerals. That from Ste. Anne has a base somewhat greenish in color, while that from Mont Calvaire is bluish, and holds in addition to pebbles of chert and sandstone, fragments of orthoclase, and others of the violet-coloured triclinic feldspars of the Laurentian rocks. It also contains in abundance, masses of cleavable black augite, and others of brownish-black mica. The conglomerate of the White-Horse Rapids has a dark greenish base, apparently more homogenous than the preceding, and contains in addition to quartzite, augite and mica, small fragments of a mineral resembling obsidian. Large blocks of a similar conglomerate, with a greenish, reddish-weathering dolomitic base, are found along the shores of the Island of Montreal, near Lachine. In some of these blocks, rounded masses of black cleavable augite an inch or two in diameter are met with, besides large plates of mica, and more rarely fragments of dark green olivine, half an inch in diameter.

The cement of these conglomerates is not however always dolomitic, for some of the beds at Mont Calvaire are distinguished by the absence of any yellow colour on the weathered surfaces, and by effervescing freely with acids. The cement of these is a nearly pure carbonate of lime, without iron and with but a trace of magnesia.

Point Lévis.—In my last report, (p. 464) I have described the conglomerates of Point Lévis, which in a paste of silicious yellow-weathering dolomite, hold pebbles of pure limestone, and others of yellow crystalline dolomite. One of the latter yielded on solution 4·6 per cent. of silicious sand, and the solution, besides carbonate of lime and a little iron, gave 33·8 per cent. of magnesia. These imbedded masses of dolomite are perhaps concretionary.

A fragment of the travertine whose beds occur associated with these dolomites, gave me by analysis, 9·3 per cent. of silicious sand, and 0·75 per cent. of carbonate of magnesia, the remainder being pure carbonate of lime. Prof. J. W. Dawson, who has kindly examined a section of this limestone microscopally, finds in it no trace of organic structure, and confirms my opinion, expressed in my last report, that it is a travertine or calcareous sinter.

Gaspé.—The lower portion of the Hudson River group in Gaspé, exhibits in several parts a thin-bedded, black, very compact rock, of an argillaceous aspect, associated with graptolitic shales. It weathers reddish-yellow, and is characterized by the occurrence of thin crystalline crusts of carbonate of lime adhering to the surface of the beds, and giving to portions an appearance like what is called *moiré*. The rock is but slightly attacked by acids in the cold ; hydrochloric acid decomposes it however by heat, leaving a residue of fine white argillaceous matter. The analysis gave as follows :

Carbonate of lime,	43·17
" of magnesia,	32·12
Oxyd of iron with alumina,	4·10
Insoluble residue,	20·30
	100·00

From the proportion of argillaceous matter which this dolomite contains, it was probable that it might yield a hydraulic cement. By calcination it assumed a pale buff colour, and when afterwards pulverized and made into a paste with water, became hard after five minutes under water, and soon acquired a great degree of solidity. It will probably prove to be very valuable for hydraulic constructions.

Manganesian Dolomite.—The dolomites of the Eastern Townships have been described in previous reports as often associated with chrome, titanium and manganese. The iron ore of the 9th lot of the 9th range of Sutton occurs in part as a band of massive peroxyd, and in part as octahedral crystals of magnetite, disseminated with chlorite through a grayish granular dolomite, which weathers brownish-black from the presence of manganese. The crystals of iron ore are arranged in bands in this dolomitic belt, portions of which, an inch or two in thickness, are often free from imbedded minerals. Such a portion was taken for analysis and gave the following results:—

Carbonate of lime,	40·10
" of magnesia,	20·20
" of iron,	10·65
" of manganese,	7·65
Insoluble,	21·45
	100·00

The insoluble residue was nearly pure quartz. The associated crystals of magnetite contained no foreign metals. The dolomite, which contained no trace of nickel or cobalt, is remarkable for the large amount of carbonate of manganese, whose occurrence is interesting in connection with the presence of this metal in two distant parts of the same series of rocks. In the metamorphic strata of Massachusetts, New Hampshire and Maine, beds of manganese spar occur interstratified with micaceous schists. This spar is not a pure silicate of manganese, but contains small portions of lime and iron as silicates, together with grains of quartz, and in some cases considerable amounts of disseminated carbonates of manganese, iron and lime.

In the Island of Newfoundland, a massive carbonate of manganese has been found at Placentia Bay, imbedded in slates which are supposed to be of Silurian age. This mineral, for a specimen of which I am indebted to Prof. Dawson, is compact and impalpable in texture, brittle, with a conchoidal fracture and a feeble waxy lustre ; slightly translucent on the edges ; colour, fawn to pale chesnut-brown ; streak white ; hardness 4·0 ; density, 3·25. The specimen shows faint lines, which seem to be those of deposition, and give to the mass the aspect of a sinter. It is incrusted and penetrated in parts with black crystalline oxyd of manganese.

This mineral is not attacked by acids in the cold, but with heat readily dissolves in nitric acid with effervescence of carbonic acid, leaving a residue of 14·4 per cent. of silica, of which all but two per cent. were readily soluble in a dilute solution of potash. It contained besides, 84·6 per cent. of carbonate of manganese, with small portions of lime and iron, and a trace of magnesia. This substance is thus, apart from the intermingled silica, a very pure carbonate of manganese or diallogite. Manganese, from the facility with which it passes into a higher state of oxydation, is generally separated in the form of peroxyd from those mineral waters which contain it, although Sir Robert Kane has described a deposit of an impure earthy variety of carbonate of manganese from beneath a bog in Glendree, in Ireland. The occurrence of this carbonate mixed with silica in Silurian rocks, enables us to explain the formation of the beds of silicate of manganese which occur in the metamorphic strata of the same age.

Dolomites of Galt.—The magnesian character of large portions of the Niagara limestone in the Western United States, has been noticed by Mr. Whitney, in his Report on Lake Superior and the adjacent regions. The geodes of pearl-spar from Niagara Falls, which are associated with calcite, selenite, and more rarely with the sulphates of baryta and strontia, and with fluor-spar, occur (at least in the specimens now before me,) in a finely granular magnesian limestone. In the vicinity of Galt, we meet with a remarkable formation of dolomite, which is interposed between the Niagara limestone and the overlying Onondaga salt group, and attains, even in Western Canada, a considerable, but as yet undetermined thickness. It corresponds, according to Mr. James Hall, to the magnesian limestone of Leclaire, on the Mississippi river, which has there a thickness of 500 feet. It is characterized at Galt by the presence, in great numbers, of the casts of the interior of *Me-*

galamus Canadensis, the shells of which have disappeared. The casts, as well as the enveloping rock, are made up of a yellowish-gray crystalline dolomite. The vacant spaces left by the disappearance of the shell retain its markings, and have small crystals of dolomite scattered over their walls.

Besides the rock from Galt, I have examined four other specimens of this magnesian limestone from that vicinity, which are wrought as building stones, and which you placed in my hands. The first of these is from McDonald's quarry, Guelph ; the second from Howitt's quarry, Puslinch ; and the third and fourth from Strange's quarry, Rockwood. The first three closely resemble each other and the dolomite of Galt. They are made up of crystalline cleavable grains, which under a lens, exhibit the pearly lustre characteristic of dolomite. The rock is of a yellowish colour, cellular, exhibiting little cavities lined with crystals, and is not very strongly coherent, The first three specimens exhibited no fossils ; but the fourth specimen, which is more coarsely crystalline, and more coherent than the others, contains in great numbers, fragments of encrinal columns, replaced by a white spar, whose colour contrasts with the bluish tint of the base. This rock is cellular like the last, and is in every part a dolomite. These specimens effervesce very feebly with cold acids, but are dissolved by the aid of heat, leaving in the case of three and four, 0·90, and 0·65 per cent. of insoluble matter. They are all pure dolomites, containing 54·0 per cent. of carbonate of lime, the rest being carbonate of magnesia.*

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* The following facts with regard to the dolomites of the palæozoic rocks of the Mississippi valley have been kindly furnished me by Mr. James Hall. We have in ascending order—

1. The so-called Lower Magnesian limestone, which is the equivalent of the Calciferous sandrock, and is from 200 to 250 feet thick. It is the lead-bearing rock of Missouri, and probably contains the cobalt ores of that region.
2. The Galena limestone ; about 250 feet of dolomite interposed between the Trenton and the Hudson River group. It is the lead-bearing rock of Iowa, Wisconsin and Illinois.
3. The Niagara limestone, also dolomitic, about 250 feet thick, and sometimes holding galena and blende.
4. The Leclaire or Galt dolomite already described.
5. The magnesian limestone of the Onondaga salt group—100 feet thick.
6. A dolomitic deposit in the upper part of the Carboniferous limestone series.

Dolomites with an excess of Magnesia.—We have seen that pure dolomites consist of equal equivalents of the two carbonates, corresponding to 54·35 of carbonate of lime and 45·65 of carbonate of magnesia, and that where the carbonate of lime is in excess, it is in a state of mixture, and readily removed by acetic acid from the double carbonate. There are not wanting, however, rocks in which the magnesian carbonate predominates over the lime, leading us to suppose a mixture of magnesite with the dolomite.

The examples of dolomites with an excess of carbonate of magnesia are numerous. Of two specimens from the Muschelkalk of Thuringia, one gave to Rammelsberg, 51·54 of carbonate of lime and 48·57 of carbonate of magnesia; while the other yielded to Senft, 42·9 of carbonate of lime and 55·4 of carbonate of magnesia, besides 2·7 of carbonate of iron =101·1. (Senft, *die Felsarten*, p. 130.) A very pure bituminous dolomite from the Salzberger Alps, gave to Lippold, carbonate of lime, 51·48; carbonate of magnesia, 46·13; and a lacustrine dolomite from the brown-coal deposit near Giessen, afforded Knapp, carbonate of lime, 42·80; carbonate of magnesia, 49·63; oxyd of iron, 1·65; insoluble, 1·42.* In like manner, Whitney (Report on Lake Superior, vol. ii. p. 193,) found for a dolomite from the Calciferous sand-rock, carbonate of lime, 25·28; carbonate of magnesia, 32·57; besides 0·45 of oxyd of iron, traces of alumina, and 37·0 of sand. A direct determination of the carbonic acid confirmed the correctness of this analysis.

The variegated marls of the *keuper*, or upper part of the Triassic system in Germany, according to Alberti, often contain an excess of magnesian carbonate, and are very slightly attacked by acids. The analysis of a tender greenish-gray schistose marl from Tubingen, gave carbonate of lime, 14·56; carbonate of magnesia, 19·10; oxyd of iron, 3·40; alumina, 3·92; clay, 59·12 =100·10. (Senft, *die Felsarten*, p. 134.)

A dark-gray rock associated with limestone from the *keuper* near Solothurn gave to Völckel: carbonate of iron, 33·94; carbonate of magnesia, 54·55; carbonate of lime, 0·67; silicate

* See Liebig and Kopp's Jahresbericht, 1848, vol. ii. page 501, (Eng. ed.)—and 1851, p. 873.

of alumina, 8·89 ; water and organic matters, 1·95.—(L. & K., *Jahresbericht*, 1849, p. 581. Eng. ed.)

In these two analyses we see the transition from dolomites to a ferriferous magnesite like those of Sutton and Bolton, described in my Report for 1856, p. 460.

ON THE ORIGIN AND FORMATION OF DOLOMITES AND MAGNESIAN LIMESTONES.

This question has long been regarded as one of extreme difficulty, and among the many solutions hitherto proposed none appear to be satisfactory. I propose to notice them briefly, and to indicate the facts and experiments which bear upon the subject.

Agency of Organic Life.—In a previous Report I have alluded to the well-known fact that carbonate of magnesia occurs in but very small quantities in calcareous tufas and travertint. The same thing is true in the case of limestones of organic origin, which are generally nearly pure carbonate of lime. The limestones of Montreal and Dudswell among others, seldom contain more than one per cent. of carbonate of magnesia. Such limestones are made for the greater part of the remains, often finely comminuted, of corals and mollusks, and the living species of these are in general nearly pure carbonate of lime. The analyses of Silliman and myself, and the more recent ones of Forchammer, show that corals generally contain less than one per cent. of magnesian carbonate; and the same is true of the shells of *Nautilus*, *Pinna*, *Tritonium*, *Cerithium*, *Terebratula* and *Modiolopsis*. Forchammer however found in *Corallium nobile* 2·1 per cent. of carbonate of magnesia, in *Isis hippuris* 6·36 per cent., and in different species of *Serpula* from 1·35 to 7·64 per cent. of carbonate of magnesia; but these genera form exceptions to the general rule.

The Millepores, in like manner, are in great portion made up of carbonates; in some species the mineral matter is almost entirely carbonate of lime, while in others the carbonate of magnesia forms from 16·0 to 19.0 per cent. of the inorganic portion. These millepores are often very abundant, and a non-magnesian species forms beds on the northern shores of France, which are wrought for burning into lime, while a species containing a large proportion of magnesia is very abundant on the coast of Algiers. Mr. Damour has called attention to the part which these millepores may play in the production of magnesian limestones (*Annales de Chimie et de Physique*, 3d series, vol. xxxii. p. 362.) He however describes them as dissolving readily in acetic acid, which would seem to indicate the absence of dolomite.

The carbonates of lime and magnesia are both much more soluble in carbonated water than the double carbonate, which according to Bischoff, yields little or no magnesia to a solution of carbonic acid. Grandjean, and after him Sandberger, supposes that certain dolomites may have been formed from limestones containing an admixture of carbonate of magnesia, by the action of carbonated waters, which might give rise to dolomite and a soluble bi-carbonate of lime; the iron and other metallic oxyds, being thus concentrated in the residue, their predominance in some dolomites would be explained.—(Liebig and Kopp, *Jahresbericht*, 1848, [Eng. Ed.] vol. ii. p. 501.)

Forchammer, in attempting to illustrate by experiment the formation of dolomite, found that when a solution of bi-carbonate of lime is mingled with sea-water at a boiling heat, the precipitated carbonate of lime carries down with it 12·23 per cent. of carbonate of magnesia; while, if carbonate of soda be mixed with the solution of bi-carbonate, the proportion of magnesian carbonate in the precipitate may rise to 27·93 per cent. The amount of magnesia separated, according to him, appears to augment with the temperature.—(Ibid, vol. ii. p. 575.)

Haidinger long since endeavoured to explain the formation of dolomite and its frequent association with gypsum, by supposing that a reaction between carbonate of lime and sulphate of magnesia might give rise to sulphate of lime and carbonate of magnesia. At ordinary temperatures, it is true, the inverse affinities prevail. Mitscherlich found that a solution of gypsum was completely decomposed after fourteen days contact with carbonate of magnesia, into sulphate of magnesia and carbonate of lime, and the same decomposition takes place when solution of gypsum is filtered through dolomite. Haidinger however conjectured that at an elevated temperature these affinities might be reversed, and this has been confirmed by Morlot, who found that when a mixture of one equivalent of crystallized sulphate of magnesia and two equivalents of calcareous spar is heated in sealed tubes to 200°. Centigrade, it is completely converted into dolomite and sulphate of lime. (L. & K., *Jahresbericht*, 1848, vol. ii, p. 500.)

Marignac, in like manner, found that at 200°. Centigrade, carbonate of lime with a solution of chlorid of magnesium, slowly gave rise to a double carbonate of lime and magnesia: after six hours the product contained 52·0 per cent. of carbonate of magnesia.—(Favre. *Bull. Soc. Geol. France* [2], vi., p. 318.)

De Sénarmont found in some experiments with mingled solutions of bi-carbonate of magnesia and chlorid of calcium, that at the ordinary temperature, and at temperatures below 100°. Centigrade, a precipitate of pure carbonate of lime separates, provided that the proportion of chlorid of calcium present is more than equivalent to the magnesia in solution; but at 150°. whether the lime-salt be in excess or not, a precipitate of carbonate of magnesia is obtained, with little or no lime. The conditions of this last experiment are similar to that of Marignac, for the carbonate of lime which separates at 100°. is afterwards decomposed at a high temperature by the magnesian chlorid. By double decomposition of carbonate of soda and sulphate of magnesia at from 160°. to 175°. and also by the action of a heat of 155° upon a solution of bi-carbonate of magnesia, De Sénarmont obtained crystallized carbonate of magnesia. (*Ann. de Chim. et Phys.* [3] vol. xxxii. p. 148.)

Taking the experiments of Morlot and the theory of Haidinger as a point of departure, Favre attempts to explain the formation of dolomites. He supposes that eruptions of igneous rocks, at the bottom of a sea 500 or 600 feet in depth, would afford the necessary conditions of heat and pressure; and since the dolomites of the Alps are associated with melaphyres, which are more or less magnesian, he supposes a simultaneous evolution of sulphurous and hydrochloric acids; these, acting upon the ejected rocks, would produce the magnesian salts necessary for the conversion into dolomites of the adjacent limestones, which, according to him, are interstratified near their base with pyroxenic tufa. These dolomites of the Tyrol are filled with small cavities, while they retain the marks of stratification, and exhibit the remains of corals and encrinites. Favre supposes that they were originally deposited as pure limestones, and in their subsequent conversion into dolomites became cavernous. He conceives that the sea beneath which the volcanic eruptions took place was widely extended, and thus explains the formation of dolomites far away from any intrusive rocks. At the same time, however, he admits that the compact dolomites in many stratified rocks have been originally deposited as such and are not the result of alteration.

To this hypothesis of Favre, Coquand opposes the insufficiency of the erupted masses to heat the water to the temperature required, and he supposes waters, charged with carbonate of magnesia, to have been the agent of the alteration.

The famous theory of Von Buch, based in great part upon these dolomites of the Tyrol, supposes that the dolomization of limestones has been effected by the intervention of some volatile compound of magnesia evolved during the eruption of the porphyries of that region. In support of this hypothesis, Durocher made the experiment of heating together to low redness, in an iron tube, fragments of porous limestone and anhydrous chlorid of magnesium for some hours. The soluble matter being then washed away, the residue effervesced strongly at first with hydrochloric acid; but the action then became feebler, and the residue exhibited transparent crystals under the microscope, which were supposed to be dolomite, but do not appear to have been further examined. (*Philos. Magazine* [4], vol. ii. p. 504.)

To this theory of Von Buch it is to be objected, however, that neither the chlorid nor any other known compound of magnesium, is volatile; and that it is only by the hypothesis of Favre, which supposes the intervention of water, that we can connect the dolomization of limestones, with the eruption of the igneous rocks. Delanoüë and Daubeny have rejected the hypothesis of Von Buch; and Fournet has since shown that the melaphyres associated with the dolomites of the Tyrol, so far from being intrusive rocks, are themselves stratified rocks, probably of Carboniferous age, metamorphosed *in situ*, and that their alteration was effected long before the deposition of the dolomites, which are of the Jurassic period. Between these metamorphic strata and the dolomites are beds of unaltered Triassic rocks, including the *Muschelkalk*, and a conglomerate which holds rolled pebbles of the subjacent melaphyres. (*Bull. Soc. Geol. de France* [2,] vi., pp. 506–516.)

Delesse has remarked that in many instances limestones which have been regarded as dolomitized by the proximity of igneous rocks, have been rendered crystalline, but contain no magnesia. Delanouë has pointed out examples of a similar error in the crystalline limestones of the calamine mines in Belgium, where in cases of supposed dolomization by contact with igneous rocks, he found no increase in the proportion of magnesia.

The preceding facts show that dolomites have been formed under conditions where the theory of the intervention of volcanic and metamorphic agencies is inadmisible, and we are are to conclude that they have been deposited as magnesian sediments in seas or basins, sometimes lacustrine, from waters which often permitted the development of animal life. The conditions required for the separation of carbonate of magnesia from the sea or other waters, therefore naturally claim our attention, as a first step towards the solution of the problem before us. I have shown, in my last Report, that the precipitate produced by carbonate of soda in a water containing soluble salts of lime and magnesia, consists in great part of carbonate of lime, the magnesian salts being decomposed only after the lime has been removed. Some experiments since made with carbonated waters, serve further to illustrate this geologically important fact.

If to an artificial sea-water, containing besides common salt, chlorids of calcium and magnesium in the proportion of one equivalent of each, we add a solution of bi-carbonate of soda in water saturated with carbonic acid, a gelatinous precipitate separates, which immediately becomes crystalline. This precipitate being separated after a few hours, washed, dried and submitted to analysis, gave for three successive precipitations from the same liquid, 2·20, 2·00, and 1·23 per cent. of carbonate of magnesia, the remainder being carbonate of lime. It thus appears that the proportion of caronate of magnesia precipitated, diminished as the magnesian salt became predominant in the solution, which now gave no further precipitate with bi-carbonate of soda, but deposited, by evaporation to dryness, a granular residue of hydrated carbonate of magnesia with a little carbonate of lime. From a litre there was thus obtained by evaporation, 4·19 grams of carbonate of magnesia with 0·14 grams of carbonate of lime, while the soluble portion contained in the form of chlorid, 1·176 of magnesia, but no lime.

By boiling for thirty minutes a part of the above solution, from which the first portion (about one-third,) of the lime had been thrown down, there was obtained a precipitate, which for a litre, equalled 0·666 grams of carbonate of lime, and 0·173 of carbonate of magnesia. Another portion of the same solution gave by spontaneous evaporation, for a litre 0·805 of carbonate of lime, without any carbonate of magnesia.

If we employ a more dilute solution of bi-carbonate of soda in the preceding experiment, there is no immediate precipitate of carbonate of lime. A solution was prepared with one litre of water and 29·2 grams ($\frac{1}{2}$ eq.) of sea-salt, 13·8 grams ($\frac{1}{4}$ eq.) of chlorid of calcium, and 50·7 grams ($\frac{1}{2}$ eq.) of crystallized hydrochlorate of magnesia, with an addition of 10·0 grams of crystallized sulphate of soda. In another litre of water were dissolved 42·0 grams ($\frac{1}{2}$ eq.) of bi-carbonate of soda, and a stream of carbonic acid gas was passed through the liquid to saturation. Of this solution 500 cubic centimetres would have been required to decompose the whole of the chlorid of calcium in the first solution, and 200 were gradually added to it with stirring, without producing any visible effect; a third portion of 100 cubic centimetres caused a slight turbidness, which was soon replaced by a crystalline precipitate adhering to the sides of the vessel, and gradually augmenting in quantity. After a repose of forty hours at 68° F., the precipitate was collected and analyzed. It contained 96·7 per cent of carbonate of lime, and 3·3 of carbonate of magnesia, and equalled 4·304 grams.

The liquid, augmented by the washings of the precipitate, measured 1·400 cubic centimetres ; one-half of this was mixed with 100 cubic centimetres of the solution of bi-carbonate, being the quantity required for the decomposition of the remaining lime-salt. There was no immediate change apparent ; but after twenty-four hours a crystalline precipitate was collected, which consisted of carbonate of lime, 97·4 ; carbonate of magnesia, 2·6 ; and equalled 2·288 grams.

The explantion of these facts is found in the power of carbonate of magnesia to decompose the salts of lime, converting them into carbonate. We have already mentioned the observation of Mitscherlich, that carbonate of magnesia, and even dolomite decomposes a solution of gypsum at the ordinary temperature, with formation of sulphate of magnesia ; and Bineau has very recently shown, that if we evaporate solutions containing bi-carbonates of lime and magnesia, in presence of sulphate or muriate of lime, either at the ordinary temperature or by artificial heat, the carbonate of lime is deposited with but a trace of magnesia ; from this he concludes that the carbonates of magnesia exhibit with all the soluble salts of lime, the same reactions of incompatibility as the corresponding carbonates of potash and soda. (*Ann. de Chim. et de Phys.*, [3], vol. 51, p. 302.)

Another cause which prevents the precipitation of carbonate of magnesia with the carbonate of lime, even when other salts of lime no longer exist in the solution, is found in the great solubility of bi-carbonate of magnesia as compared with the bi-carbonate of lime. According to Bischoff, carbonate of lime requires for its solution about 1000 parts of water saturated with carbonic acid, and I have found in a solution of bi-carbonate of lime saturated under pressure and then allowed to stand for twenty-four hours, in an imperfectly closed vessel, at a temperature of 60° F., only 0.730 grams of carbonate to a litre, while by adding known portions of carbonate of soda to a solution of chlorid of magnesium in excess, and then passing a current of carbonic acid through the solution, I have found it easy to obtain solutions containing 10·0 grams of magnesia, equal to 21·0 grams of carbonate of magnesia to a litre of water, or 2·1 per cent.

Bineau found that by by the aid of a current of carbonic acid prolonged for several days, a solution might be obtained, containing 11·2 grams of magnesia, combined with very nearly two equivalents of carbonic acid, in a litre of water. Such solutions by spontaneous evaporation in the open air, lose carbonic acid and deposit carbonate of magnesia, and finally retain only 0·108 grams of magnesia in a litre, with carbonic acid sufficient to form a sesqui-carbonate. Bineau however remarked that in some cases, by the process of evaporation, solutions of sesqui-carbonate were obtained holding 0·17 grams of magnesia to the litre. These super-saturated solutions, when transferred to close vessels, deposited a portion of their magnesia in the form of carbonate. This curious reaction, which depends upon the spontaneous decomposition of the sesqui-carbonate of magnesia into the bi-carbonate and the neutral salt, I have observed in a very remarkable manner in the spontaneous evaporation of carbonated saline mineral waters. A litre of water from the Plantagenet spring was allowed to evaporate in an open porcelain basin in summer until its volume was reduced to one-fifth, during which process, a crystalline crust of carbonates of lime and magnesia, was deposited. The clear solution being poured off, and transferred to a carefully closed bottle, deposited after two or three days, a strongly adherent crystalline crust of hydrated carbonate of magnesia, chiefly upon the lower parts of the vessel. The amount of the precipitate was equal to 0·772 grams of carbonate of magnesia for a litre of the solution, which contained no lime, but abundance of chlorid of magnesium and bi-carbonate of magnesia, after the separation of the carbonate.

When recently precipitated hydrated carbonate of magnesia is added to a solution of bi-carbonate of lime, it immediately dissolves, but the transparent solution soon after becomes troubled from the precipitation of carbonate of lime.

This reaction is precisely analogous to that produced by carbonate of soda, which with bi-carbonate of lime gives a precipitate of neutral carbonate. The carbonate of lime thrown down from solutions of bi-carbonate of magnesia is always nearly pure; and the results of a great variety of experiments undertaken in the hope of producing a double carbonate of lime and magnesia have shown me that when the bi-carbonates of lime and magnesia are dissolved in pure water, in solutions of sea-salt, of chlorid of magnesium, or of carbonate of soda, and evaporated at the ordinary temperature, or heated to 100° F., the carbonate of lime is deposited as in the previous experiments, carrying with it only traces of the magnesian carbonate, which is afterwards separated by elevating the temperature nearly to the boiling-point, or by farther evaporation.

The addition of chlorid of calcium suffices to decompose the magnesian bi-carbonate and to precipitate carbonate of lime even at ordinary temperatures; but when the solution of the two bi-carbonates is boiled, even in the presence of chlorid of calcium, a portion of the magnesian carbonate falls down with the carbonate of lime, as in Forchammer's experiments. In none of these conditions however do we obtain that double carbonate of lime and magnesia, insoluble in acetic acid, which forms the base of the magnesian limestones, and Mr. J. D. Whitney, in commenting upon Morlot's investigations which we have already cited, has well remarked that we have no evidence in these of the formation of a true dolomite.

I have found in the course of my experiments that the introduction of a soluble sulphate modifies in an unsuspected manner the results already described. Mitscherlich found gypsum to be incompatible at ordinary temperatures with carbonate of magnesia, but it is no longer so in the presence of an excess of carbonic acid; in fact, gypsum may be crystallized from a solution of bi-carbonate of magnesia. If to a solution of bi-carbonate of lime, we add a sufficient quantity of sulphate of magnesia, and allow the liquid to evaporate at the ordinary temperature, or by a gentle heat, to a small volume, the whole of the lime is deposited in the form of crystalline gypsum. The same result is obtained when bi-carbonate of lime is added to a solution containing sea-salt, chlorid of magnesium and sulphates. By evaporation at a temperature of from 90° to 100° F. the gypsum is entirely deposited before the separation of the sea-salt commences, while the bi-carbonate of magnesia remains in solution, and is only separated by evaporation to complete dryness or by ebullition. This reaction may help to explain the frequent association of gypsum and dolomite, as well as the frequent occurrence of both of these in freshwater formations.

It is evident that with the facts as yet before us, we are not able to determine with certainty the manner in which dolomites have been formed. Bi-carbonate of magnesia may however be produced in two ways: first, by the action of bi-carbonate of lime upon waters containing both sulphates and magnesian salts, gypsum being generated at the same time; and secondly, by the action of bi-carbonate of soda upon magnesian waters from which the lime has previously been separated, either as carbonate by the previous action of bi-carbonate of soda, or by evaporation in the form of sulphate, as takes place during the concentration of seawater. From these solutions beds of carbonate of magnesia may readily be formed by evaporation in limited basins, precisely as we conceive gypsum and rock-salt to have been deposited; and if we suppose an admixture of carbonate of lime deposited from the alkaline waters or any other source, we have all the elements of dolomite, although not chemically combined as a double salt. H. Ste. Claire Deville, in his beautiful researches on the double carbonates, found that when a mixture of basic carbonate of magnesia with bi-carbonate of soda and water is exposed to a gentle heat, a slow combination ensues, and the mixture is transformed into a mass of small transparent crystals, which are an anhydrous double carbonate of soda and magnesia, insoluble in water,—in fact, a soda-dolomite. (*Ann. de Chim. et Phys.* [3] vol. xxxiii. p. 89).

A similar reaction between the mingled carbonates of lime and magnesia, under conditions not yet understood, may probably result in their gradual transformation into dolomite.

FISH MANURES.

Before describing the results of some enquiries into the value of these manures, and the practicability of introducing their manufacture into Canada, it may be well to explain briefly certain principles which may serve to guide us in the appreciation of the subject. Modern investigations of the chemistry of vegêtation have led to a more or less correct understanding of the laws of vegetable nutrition and the theory of manures, and we are all aware how many natural and artificial matters have been proposed as substitutes for the manure of the stable and farm-yard. Foremost among these ranks the Peruvian guano, composed for the most part of the exuviæ of sea-birds, and employed for centuries by the Peruvians as a powerful stimulant to vegetation. This substance owes its value to the phosphoric acid and ammonia which it is capable of affording to the growing plant; the former element being indispensable to the healthy development of vegetation and entering in large proportion into the mineral matter of the cereals, while ammonia furnishes, in a form capable of assimilation, the nitrogen, which with the elements of water and carbonic acid, makes up the organic tissues of plants. Besides these essential principles, plants require sulphuric acid, chlorine, potash, soda, lime, magnesia and oxyd of iron, all of which elements are found in their ashes, and are required for their healthy growth. In a fertile soil all of these ingredients are present, as well as phosphoric acid and ammonia, which last substance is constantly produced by the decay of animal and vegetable matters, and is either at once retained by the soil, which has the power of absorbing a certain portion of it, or is evolved into the air and afterwards dissolved and brought down by the rains to the earth.

Many of the mineral elements of a soil are present in it in an insoluble form, and are only set free by the slow chemical re-actions constantly going on under the influence of air and water. Such is the case with the alkalies, potash and soda, and to a certain extent with the phosphates. Now although there is probably no soil which does not yield by analysis quantities of all the mineral elements sufficient for many crops, yet by long and uninterrupted tillage the more soluble combinations of these elements may be all taken up, and the land will then require a certain time of repose in order that a store of more soluble matters may be formed. Hence the utility of fallows.

In my analyses of the soils of the Richelieu valley, in the Report for 1850, pp. 79–90, I have shown, by comparing the virgin soils with those exhausted by continued crops of wheat during fifty years, that the proportions of phosphoric acid and magnesia, elements which are contained in large quantities in this grain, have been greatly diminished, but the soil still contains as much phosphate as it has lost, and this only requires to be rendered soluble in order to be available to vegetation.

In forests and untilled lands the conditions of a healthy vegetable growth are seldom wanting; the soil affords in sufficient quantity all the chemical elements required, while the leaves and seeds which annually fall and decay, give back to the earth a great proportion of the elements which it has yielded. In this way the only loss of mineral matter is that which remains stored up in the growing wood or is removed by waters from the soil. Far different is the case in cultivated fields, since in the shape of corn, of fat cattle, and the products of the dairy, we remove from the soil its phosphates, alkalies and nitrogen, and send them to foreign markets. The effect of tillage becomes doubly exhaustive when by artificial means we stimulate vegetation without furnishing all the materials required for the growing plants. Such is the effect of many special manures, which while they supply certain elements, enable the plants to remove the others more rapidly from the soil. A partial exhaustion of the soil results likewise from repeated crops of the same kind; for the elements of which the cereals require the largest quantity are taken in smaller proportions by green crops, and reciprocally, so that by judicious alternations the balance between the different mineral ingredients of the soil is preserved.

One of the great problems in scientific agriculture is to supply to the soil the ammonia and the mineral matters necessary to support an abundant vegetation, and to obtain from various sources these different elements at prices which will permit of their being economically made use of. Nowhere but in the manure of the stable and farm-yard can we find combined all the fertilizing elements required, but several of them may be very cheaply procured. Thus lime and magnesia are abundant in the shape of marl and limestones; soda is readily obtained, together with chlorine, in common salt; while gypsum or plaster of Paris supplies at a low price both sulphuric acid and lime. Potash when wanting may be supplied to the soil by wood-ashes, but phosphoric acid and ammonia are less easily obtained and command higher prices.

An abundant supply of phosphate of lime is found in bones, which when dried contain from 50·0 to 60·0 p. c. of mineral matter, consisting of phosphate of lime, with a little carbonate, and small portions of salts of magnesia and soda. The remainder is organic matter, which is destroyed when the bones are burned. This phosphate of lime of bones contains 46·0 per cent of phosphoric acid, and the refuse bone-black of the sugar-refiners usually affords about 32·0 per cent. of the acid. The different guanos also contain large amounts of phosphoric acid, and that known as Columbian guano is principally phosphate of lime. Various deposits of mineral phosphate of lime have of late attracted the attention of scientific agriculturists. I may mention in this connection the crystalline phosphate of lime or apatite of our Laurentian limestones, and the phosphatic nodules found in different parts of the Lower Silurian strata of Canada and described in previous Reports.

These mineral phosphates are in such a state of aggregation, that it is necessary to decompose them by sulphuric acid before applying them to the soil. The same process is also very often applied to bones; for this end the phosphate of lime in powder is to be mingled with nearly two-thirds its weight of sulphuric acid, which converts two-thirds of the lime into sulphate, and leaves the remainder combined with the phosphoric acid as a soluble super-phosphate. In this way, the phosphoric acid may be applied to the soil in a much more divided state, and its efficiency is thereby greatly increased.

Even in its soluble form however, the phosphoric acid is at once neutralized by the basic oxyds in the soil, and Mr. Paul Thenard has lately shown that ordinary phosphate of lime, when dissolved in carbonic-acid water, is decomposed by digestion with earth, insoluble phosphates of iron and alumina being formed, which are again slowly decomposed by the somewhat soluble silicate of lime present in the soil, and transformed into silicates with formation of phosphate of lime. It is probable that alkaline silicates may also play a similar part in the soil. These considerations show that the superior value of soluble phosphate of lime as a manure, depends solely upon its greater subdivision. A portion of the phosphoric acid in Peruvian guano exists in a soluble condition as phosphate of ammonia.

With regard to the nitrogen in manures, it may exist in the form of ammoniacal salts, or combined in organic matters which evolve ammonia by their slow decay. The ammonia which the latter are capable of thus yielding, is designated as potential or possible ammonia, as distinguished from the ammonia of the ammoniacal salts, which is generally soluble in water, and is at once disengaged when these matters are mingled with potash or quick-lime. Such is the sulphate of ammonia, which is prepared on a large scale from the alkaline liquid condensed in the manufacture of coal-gas. In Peruvian guano a large amount of the nitrogen is present as a salt of ammonia, and the remainder chiefly as uric acid, a substance which readily decomposes, and produces a great deal of ammonia. In fact, this decomposition takes place spontaneously, with so much rapidity, that the best guanos may, it is said, lose more than one-fifth of their nitrogen in the form of ammonia in a few months' time, if exposed to a moist atmosphere.

Other manures, however, contain nitrogen in combinations which undergo decomposition less readily than uric acid. Thus unburned bones yield from six to seven per cent. of ammonia, and dried blood, fifteen or sixteen per cent., while woolen rags and leather yield about as large a quantity. In estimating the value of such matters as manures, the difference in the facility with which they enter into decomposition, must be taken into account. Thus if too large quantities of guano are applied to the soil, a portion of the ammonia may be volatilized and lost, while with leather and wool the decay is so slow, that these materials have but little immediate effect as manures. The nitrogen of blood and flesh is converted into ammonia with so much ease, that it may be considered almost as available for the purpose of a manure as that which is contained in ammoniacal salts.

Attempts have been made to fix the money value of the ammonia and the phosphates in manures, and thus to enable us from the results of analysis, to estimate the value of any fertilizer containing these elements. This was I believe first suggested a few years since, by an eminent agricultural chemist of Saxony, Dr. Stöckhardt, and has been adopted by the scientific agriculturists of Great Britain, France, and the United States. These values vary of course very much for different countries; but I shall avail myself of the calculations made by Prof. S. W. Johnson of New Haven, Connecticut, which are based on the prices of manures in the United States in 1857. In order to fix the value of phosphoric acid in its insoluble combinations, he has taken the market prices of Columbian guano, and the refuse bone-ash of the sugar refiners, which contain respectively about 40 and 32 per cent. of phosphoric acid, and from these he deduces as a mean 4½ cents the pound as the value of phosphoric acid when present in the form of phosphate of lime. This would give $1.44 as the value of 100 pounds of bone-ash, and $1.60 for the same amount of the guano, while they are sold for $30 and $35 the ton.

The value of soluble phosphoric acid has been fixed by Dr. Völcker in England, and by Stöckhardt in Saxony, at 12½ cents the pound. This evaluation is based upon the market price of the commercial super-phosphates of lime. Mr. Way, of the Royal Agricultural Society, however, estimates the value of phosphoric acid in its soluble combination at only 10½ cents the pound; and Mr. Johnson, although adopting the higher price, regards it as above the true value.

In order to fix the real value of ammonia, Prof. Johnson deducts from the price of Peruvian guano, at $65 the ton, the value of the phosphoric acid which it contains, and thus arrives at 14 cents the pound for the price of the available ammonia present. This kind of guano, however, now commands a price conderably above that which serves for the basis of the above calculation; and both Völcker and Stöckhardt fix the value of ammonia at 20 cents the pound. The price of potash as a manure is estimated by Mr. Johnson at 4 cents the pound; but this alkali rarely enters to any considerable extent into any concentrated manures, and may therefore be neglected in estimates of their value.

The use of fish as a manure has long been known; on the shores of Scotland, Cornwall, Brittany, some parts of the United States, and on our own sea-coasts, the offal from fisheries, as well as certain bony fishes of little value for food, are applied to the soil with great benefit. The idea of converting these materials into a portable manure was however I believe first carried into effect in France by Mr. Démolon, who seven or eight years since, erected establishments for this object on the coast of Brittany and in Newfoundland. For the details of this manufacture I am indebted to the *Chimie Industrielle* of Payen. Concarneau, in the department of Finisterre, is a small town whose inhabitants are employed in fishing for sardines, and it is the refuse of this fishery which is employed in the manufacture of manure. The offal is placed in large coppers and heated by steam until thoroughly cooked, after which it is submitted to pressure, which extracts the water and oil. The pressed mass is then rasped, dried in a current of hot air, and ground to powder. 100 parts of the recent offal yield on an average 22 parts of the powder, besides from 2 to 2½ parts of oil. The manufactory of Concarneau employs six men and ten boys, and is able to work up daily eighteen or twenty tons of fish, and produce from four to five tons of the powdered manure.

This manure contains, according to an average of several analyses, 80·0 per cent. of organic matters, and 14·1 per cent. of phosphates of lime and magnesia, besides some common salt, a little carbonate of lime, small portions of sulphate and carbonate of ammonia, and only 1·0 per cent of water. The nitrogen of this manure, which is almost wholly in the form of organic matters, corresponds to 14·5 per cent of ammonia, and we may estimate the phosporic acid, which is here present in an insoluble form, at 7·0 per cent. If we calculate the value of this manure according to the rules above laid down, we shall have as follows for 100 pounds :—

Ammonia,—14½ pounds, at 14 cents,.........	$2.03
Phosphoric Acid,—7 pounds, at 4½ cents,.....	0.31½
	$2.34½

This is equal to $47 the ton of 2000 pounds ; the manufactured product of Concarneau, however, according to Payen, is sold in the nearest shipping ports at 20 francs the 100 kilogrammes, (equal to 220 pounds), which, counting the franc at $0.20, is equivalent only to $1.81 the 100 pounds, or a little over $37 the ton. This however was in 1854, since which time the price of manures has probably increased.

Mr. Démolon in company with his brother, has also according to Payen, erected a large establishment for the manufacture of this manure on the coast of Newfoundland, at Kerpon, near the eastern entrance of the Strait of Bellisle, in a harbor which is greatly resorted to by the vessels engaged in the cod-fishery. This manufactory, now in successful operatiod, is able to produce 8,000 or 10,000 tons of manure annually. Payen estimates the total yearly produce of the cod-fisheries of the North American coast to be equal to about 1,500,000 tons of fresh fish ; of this, one-half is refuse, and is thrown into the sea or left to decay on the shore, while if treated by the process of Démolon, it would yield more than 150,000 tons of a manure nearly equal in value to the guano of the Peruvian islands, which now furnish annually from 300,000 to 400,000 tons. If to the manure which might be obtained from the cod-fisheries of the Lower Provinces, we add that of many other great fisheries, we are surprised at the immense resources for agriculture now neglected, which may be drawn at a little expense from the sea, and even from the otherwise worthless refuse of another industry. To this may be added vast quantities of other fish, which at certain seasons and on some coasts are so abundant that they are even taken for the express purpose of spreading upon the adjacent lands, and which would greatly extend the resources of this new manufacture. The oil, whose extraction is made an object of economic importance in the fabrication of manure from sardines in France, exists in but very small quantities in the cod, but in the herring it equals 10 per cent. of the recent fish, and in some other species rises to 3·0 and 4·0 per cent.

Mr. Duncan Bruce of Gaspé has lately been endeavoring to introduce the manufacture of fish-manure into Canada; but he has conceived the idea of combining the fish-offal with a large amount of calcined shale, under the impression that the manure thus prepared will have the effect of driving away insects from the plants to which it is applied. He employs a black bituminous shale from Port Daniel, and distilling this at a red heat, passes the disengaged vapours into a vat containing the fish, which by a gentle and continued heat, have been reduced to a pulpy mass. The calcined shale is then ground to powder and mingled with the fish, and the whole dried. Experiments made with this manure appear to have given very satisfactory results, and it is said to have had the effect of driving away insects when applied to growing crops, a result which may be due to the small amount of bituminous matter in the products of the distillation of the shale, rather than to the admixture of the calcined residue. Coal-tar is known to be an efficient agent for the destruction of insects, and in a recent number of the journal, *Le Cosmos*, it is stated that simply painting the wood-work of the inside of green-houses with coal-tar has the effect of expelling from them all noxious insects. Mr. Bruce caused several analyses of this shale to be made by Dr. Reid of New York, from which it appears that different specimens contain from 2·0 to 26·0 per cent. of carbonate of lime, besides from 1·4 to 2·0 per cent. of gypsum, 2·0 per cent. of iron pyrites, and from 4·5 to 6·7 per cent. of carbon remaining after distillation. The amount of volatile matter, described by Dr. Reid as consisting of water, naphtha and ammonia, was found by him in two different samples to equal only 3·5 per cent., of which a large proportion is probably water.

I have examined two specimens of manure prepared by Mr. Bruce from the fish commonly known as the menhadden (*Alosa menhadden*). No. 1 was made with the Port Daniel shale, as before described; while for No. 2, this was replaced by a mixture of clay and saw-dust, which was distilled like the shale, the volatile products being added to the decomposing fish. The oil which rose to the surface of the liquid mass had been separated from the second preparation, but remained mingled with the first. Both of these specimens were in the form of a black granular mass, moist, cohering under pressure, and having a very fishy odour. A proximate analysis of these manures was first effected by exposing a weighed portion to a temperature of 200° F. till it no longer lost weight, and then calcining the residue, from which the carbonaceous residue very readily burned away. The oil in the first specimen was obtained by digesting a second portion, previously dried, with ether, so long as anything was taken up. The solution by evaporation left the oil, whose weight was deducted from the loss by ignition. The portion of oil remaining in the second sample was not determined.

	I.	II.
Animal matters and carbon,	23·7	21·0
Oil,	6·6	
Water,	13·5	21·8
Earthy matters,	56·2	57·2
	100·0	100·0

The residue of the calcination was digested with hydrochloric acid, which dissolved the phosphate of lime from the fish-bones, together with portions of lime, magnesia, alumina, and oxyd of iron, derived from the shale and clay. The solution from No. 1 contained, moreover, a considerable portion of sulphate from the gypsum of the shale. Small quantities of common salt were also removed by water from the calcined residues. The dissolved phosphoric acid, lime, and magnesia were separated by precipitating the phosphoric acid in combination with peroxyd of iron, from a boiling acetic solution, and were determined according to the method of Fresenius. The nitrogen of the organic matter was estimated by the direct method of burning a portion of the dried substance with soda-lime, and weighing the disengaged ammonia as ammonio-chlorid of platinum. The results were as follows for a hundred parts:—

	I.	II.
Phosphoric acid,	3·40	3·99
Sulphuric acid,	2·16	·15
Lime,	5·90	4·44
Magnesia,	1·20	1·15
Ammonia,	3·76	2·60

If we calculate the value of the first specimen according to the rules already laid down, we have as follows for 100 pounds:—

Phosphoric acid, $3\frac{4}{10}$ pounds at $4\frac{1}{2}$ cents,	$0·153
Ammonia, $3\frac{3}{4}$ pounds at 14 cents,	0·525
	$0·678

At 68 cents the 100 pounds, this manure would be worth $13.60 the ton. The sulphuric acid is of small value, corresponding to 80 pounds of plaster of Paris to the ton, and we do not take it into the calculation. The somewhat larger amount of phosphoric acid in the second specimen, is probably derived in part from the ashes of the saw-dust, and in part from the clay. The value of this manure would be $10·88 the ton.

In order to arrive at the real value of the animal portion of this manure after the removal of the oil, we may suppose, since Dr. Reid obtained from the shales from 4·5 to 7·6 per cent. of fixed carbon, that with the 56·2 parts of calcined residue, there were originally 3.7 parts of carbon derived from the shales. This deducted from 23·7 parts leaves 20·0 of nitrogenized animal matter in 100 parts of the manure, yielding 3·76 parts, or 18·8 per cent. of ammonia. This matter consists chiefly of muscular and gelatinous tissues, and Payen obtained from the dried muscle of the codfish, 16·8 per cent. of nitrogen, equal to 20·4 of ammonia. The 3·4 parts of phosphoric acid in the manure will correspond to 7·4 of bone-phosphate, and if to this we add for moisture, impurities, etc., 2·6 parts, = 30·0 in all, we should have for 100 pounds of the fish when freed from oil and dried, the following quantities of ammonia and phosphoric acid :—

Ammonia,—12½ pounds at 14 cents, ...	$1·75
Phosphoric acid,—11⅓ pounds at 4½ cents, ...	0·51
	$2·26

The matter thus prepared would have a value of $45.20 the ton, agreeing closely with that which we have calculated for the manure manufactured from sardines in France, in which the quantity of ammonia is somewhat greater, and the phosphoric acid less, giving it a value of $47 the ton.

Prof. George H. Cook of New Jersey, in an analysis of the menhadden, obtained from 100 parts of the dried fish, 16·7 parts of oil, besides 61·6 of azotized matters yielding 9·28 parts of ammonia, and 21·7 of inorganic matters, etc., containing 7·78 of phosphoric acid.* If we deduct the oil, we shall have for 100 parts of the fish, according to this analysis, 11·2 of ammonia, and 9·3 of phosphoric acid.

By comparing these figures with the results calculated for the animal portion of Mr. Bruce's manures, we find :—

	Ammonia.	Phosphoric acid.
Manure from sardines (Payen), ...	14·5	7·0
Dried menhadden (Cooke), ...	11·2	9·3
Manure by Mr. Bruce.	3·75	3·4
" " (excluding shale), ...	12·5	11·3

The proportion of phosphates is of course greater in the more bony fishes. In the manure of Mr. Bruce there are doubtless small amounts of phosphoric acid and ammonia, derived from the shale and the products of its distillation; but these do not however warrant the introduction of an inert material which reduces more than two-thirds the commercial value

* Report of the Geological Survey of New Jersey for 1856, p. 63.

of the manure. The results which we have given clearly show that by the application of a process similar to that now applied in France and in Newfoundland, which consists in cooking the fish, pressing it to extract the oil and water, drying by artificial heat, and grinding it to powder, it is easy to prepare a concentrated portable manure, whose value, as a source of phosphoric acid and ammonia, will be in round numbers, about $40 the ton.

We can scarcely doubt that by the application of this process a new source of profit may be found in the fisheries of the Gulf, which will not only render us independent of foreign guano, now brought into the Province to some extent, but will enable us to export large quantities of a most valuable concentrated manure, at prices which will be found remunerative.

I have the honor to be,

Sir,

Your most obedient servant,

T. STERRY HUNT.

REPORT,

FOR THE YEAR 1857,

OF

LIEUT. E. D. ASHE, R.N., F.R.A.S.,

ADDRESSED TO

SIR W. E. LOGAN, F.R.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

ON THE LONGITUDE OF SOME OF THE PRINCIPAL PLACES IN CANADA, AS DETERMINED BY ELECTRIC TELEGRAPH IN THE YEARS 1856-57.

QUEBEC, 20th January, 1858.

SIR,

In the month of October, 1856, at your request I left Quebec for Montreal, in order to determine by electric telegraph the longitude of that city. On my arrival, the first object was to procure a suitable place, not far from the telegraph wire, and permission was given to make use of the top of the Exchange.

The transit instrument was placed upon a stack of chimnies, and a temporary canvas cover erected to protect the instrument from the wind. On the 28th October the transit instrument was in the meridian, the telegraph wire was led up to the top of the house, and a message sent to Quebec to be ready at 7 P.M. The night was fine and clear, and we commenced by giving a signal to look out when a star entered the field of the telescope, and as it passed each wire a single dot was sent along the line to Quebec. The assistant, Mr. Heatley, on the signal being given to look out, listened attentively to these dots and to the tick of the sidereal clock, and registered the fraction of a second; by these means the observations at Montreal were noted down with all the ease and facility that could have been attained in a properly fitted observatory, instead of the temporary arrangement we had on the top of a house.

From the operators not understanding some technical expressions, and from the novelty of the transaction, many stars were lost; but considering that it was a first trial we had every reason to expect that we should finally succeed.

On the following night we were again connected by the telegraph wire, but after sending a few stars a great disagreement was found to exist between this and the preceding night's work. On my taking observations to determine the errors of the instrument, I found that it had moved considerably out of the meridian; and subsequently I discovered that the passing of a cart, even at the distance of two streets, put the whole chimney in motion; for this there was no remedy, and the idea of succeeding with the present arrangement was hopeless.

Having to return to Quebec, I left on the 2nd November, with the knowledge taught by experience that a transit instrument placed on the top of a house could only give doubtful observations, which were worse than useless.

On the 29th December I left Quebec for Toronto, and on my arrival took up my quarters with my friend Professor Kingston of the Magnetic Observatory. Here there was every convenience, a small transit instrument in position, and a sidereal clock. The observations for time were under the superintendence of Professor Kingston. The distance of the Observatory from the Telegraph Office is, I should think, about two miles, and the work of leading the wire through the town and into the Observatory presented many difficulties—one, the ground being frozen hard could not be opened for sinking the posts, and another, the interference with private property; but by the hearty co-operation of the

Superintendent of the Telegraph Office, Mr. Dwight, and by some contrivance, these difficulties were surmounted.

The cloudy state of the atmosphere prevented our working until the 17th January, which was fair for observations. As our object was to determine the time by the face of our respective clocks at the same instant, thirty dots were sent at intervals of a second in each minute, so that if the clocks were not beating together, the fraction of a second that one clock was after the other might be guessed at. The fraction being known, the second, minute, and hour are sent, and consequently the readings of the two clocks are known at the same moment.

The errors of the clocks were obtained by observations of many stars on the same night, and the errors applied to the respective clocks ; the true difference of time between Quebec and Toronto was thus known, and hence the longitude. *See Table.*

On the 5th February I left Quebec for Kingston, and on my arrival was offered a home and every assistance by Dr. Yates. The site which I selected for the temporary Observatory is situated in a cross street between Earl street and Barrie street. Two large blocks of limestone were brought and placed in the corner of a yard, and some planks about six feet long were fixed around them, covering in a space about eight feet square. This was also some distance from the Telegraph Office, but by taking advantage of an old fence and of an occasional tree, the wire was brought to the Observatory without much difficulty.

My past experience had taught me to avoid the tops of houses, and to select the solid earth and solid rock for the support of my transit instrument. Still I had another lesson to learn. This neighborhood was infested with boys, who when they saw a light shining through the cracks of the boards, commenced throwing stones with a determination and precision worthy of a better cause ; and some of the few clear nights that occurred in this month were lost in consequence of boys' love of mischief. I first tried mild entreaties and then severe threatenings ; they laughed at the former, and made faces at the latter. I then procured the service of the police, who partly succeeded in keeping the boys from further interference with my duties.

On the night of the 20th February, all being ready, and the weather favorable, we made arrangements for sending signals to Quebec. I found that the method adopted at Montreal, of sending a signal to the Observatory at Quebec each time a star passed the wire of the telescope, involved the necessity of employing a telegraph operator for some hours; but by merely exchanging the time, the operator was not required for a longer period than half-an-hour; consequently, in this case, we sent thirteen taps, at intervals of twenty seconds, from Kingston to Quebec, from a mean solar chronometer. As a sidereal clock gains one second on the mean solar chronometer in six minutes, Quebec listened for and marked down the second of the sidereal clock which was co-incident with the signal sent from Kingston, and consequently without any guess-work, had the fraction of a second. Quebec then sent similar signals from the sidereal clock, and Kingston listened for and marked down the second which was co-incident with the signal sent from Quebec; in this way was the difference between the two places ascertained to the hundredth part of a second. I conceive that signals sent from one end of the line by *mean time* and from the other end by *sidereal time* ensure the most satisfactory results. Although the observations for time were not very satisfactory, still from the severity of the weather, and the nuisance above alluded to, I resolved not to stay any longer for further trials, but left for Montreal on the 30th. On my arrival, I accompanied you, and we reconnoitred in the neighbourhood of Viger square, where we were glad to find that there appeared to be a scarcity of boys, and those that did heave in sight were perfectly tame. The gardener's tool-house, in Viger square, appeared well suited to our purpose, and by placing a large block of limestone, on a solid basis built beneath it, we had in perfection the principal requisite for the support of a transit instrument—that of fixity.

In order that I might avail myself of every opportunity of taking observations, I took up my residence there, and although great cold was experienced, nevertheless the advantage of being close to my work, far more than compensated for the severity of the weather.

The night of the 12th March was clear, the instrument firmly fixed and well adjusted, and signals were sent to and from Quebec. Although the electric current was weak, and the signals at the Montreal end of the line difficult to be heard, still the results were most satisfactory, and I left on the following morning for Quebec.

Chicago being placed on some charts, in a longitude differing by upwards of forty miles from that on another, it was of the greatest consequence before making a map of Canada, that the right position of Chicago should be ascertained. I therefore with that view, left Quebec early in the month of April, for this renowned city, and on my arrival, called on Lieut.-Col. Graham, U. S. A., and stated the object of my visit. He offered and gave me his valuable assistance, and obliged me by taking charge of the operations at one end of the line; after an observatory was erected, my transit instrument in position, and the telegraph authorities spoken to, I hurried back to Quebec, and found that they had succeeded on one night in sending signals; but in consequence of the weather not being very favorable at Chicago, we were again in communication on the night of the 15th May.

The electric current was transmtted *via* Toledo, Cleveland, Buffalo, Toronto and Montreal, a distance of 1210 miles, by one entire connection between the two extreme stations, and without any intermediate repetition, and yet all the signals were heard distinctly at either end of the line; the signal occupied only ·08 of a second in passing along that distance.

On the 24th July, I left Quebec for Windsor, and my past experience enabled me soon to select a spot suitable for the transit instrument, around which a covering of boards was put up; on the night of the 15th August, we succeeded in sending signals to Quebec; but unfortunately the sky became cloudy, and I was unable to get satisfactory observations for the local time. However, on the 18th, the signals and observations for time were most complete.

On the 19th, I left Windsor for Collingwood, and on my arrival, I found rock and quietness in the yard of Mr. Armstrong's house, where I was stopping, The instrument was in position and the night favorable, on the 1st September, and satisfactory signals were exchanged. I left on the following day for Quebec.

It was now most important that the longitude of Quebec should be determined with the utmost possible accuracy. I had formerly by electric signals on one night from Fredericton, N. B., obtained, by the kindness and assistance of Doctors Toldervy and Jack, the position of the Quebec Observatory, but on that night observations for our local time could not be taken, and we had to trust to the observations taken on the previous night and to the good character of the sidereal clock.

If we had been able to get the difference of longitude between Fredericton and Quebec, the position of the Quebec Observatory would have been quite certain, as the longitude of the former had been obtained by frequent signals on many nights with Cambridge, which by interchange of several hundred chronometers with Greenwich, is supposed to have its meridional difference of longitude ascertained with all the accuracy possible short of that to be arrived at by the transatlantic cable.

We were unable to again get telegraphic communication with Fredericton on account of the submerged cable at Cape Rouge being broken; but Professor W. C. Bond, of Cambridge Observatory, offered in the kindest manner possible to send and receive signals to and from Quebec; on the 21st September and 9th October, the communications between the Observatories of Cambridge and Quebec, were completely successful, and the longitude of Quebec, as well as those places already referred to, finally settled.

The longitude of this Observatory as obtained by telegraphic signals, and the longitude published on the Admiralty Charts, differ by no less than fourteen seconds of time, and the other places whose positions have been determined in a similar manner have a still greater difference.

On the 29th October, I left Quebec for Ottawa, and on my arrival put up at Mr. Doran's boarding house and went in quest of a site for the transit instrument. On Barrack Hill there were several blocks of limestone, around one of which I built a little Observatory and had the telegraph wire brought there. The night of the 14th November was beautifully clear, and the result of our night's work most satisfactory.

In conclusion I may say that the ease and accuracy with which the position of a place can now be fixed by means of the electric telegraph renders it imperative that all those places which can avail themselves of the use of the telegraph line, should have their longitudes determined at once, in order that a correct map of Canada may be produced.

Subjoined I send you an abstract of the observations made.

I have the honor to be,

Sir,

Your most obedient servant,

E. D. ASHE.

Abstract of the Telegraphic Observations determining the Longitudes of several places in North America, by LIEUT. E. D. ASHE, R. N.

QUEBEC, 21st Sept., 1857.

The place of observation was the Observatory in Mann's Bastion, Citadel.

	H.	m.	s.
By the signals sent from Quebec to Cambridge, the difference of longitude is shown to be..........................	0	0	18·27
And by the signals from Cambridge to Quebec	0	0	18·25
Mean difference of longitude by the work of the 21st September,	0	0	18·26
Again on the 9th October :—			
By the signals sent from Quebec to Cambridge, &c.	0	0	18·44
By the signals from Cambridge to Quebec	0	0	18·33
Mean difference of longitude by the work of the 9th October ..	0	0	18·38
Mean of both nights' work :—			
Quebec Observatory west of Cambridge Observatory,.........	0	0	18·32
Longitude of Cambridge west of Greenwich, as communicated by Professor W. C. Bond.....................	4	44	30·70
Longitude of Quebec Observatory..........................	4	44	49·02

TORONTO, 21st January, 1857.

The place of observation was the Magnetic Observatory.

	H.	m.	s.
By the signals sent from Quebec, Toronto is west of Quebec...	0	32	44·51
By the signals from Toronto, " " " ...	0	32	44·31
Mean difference of longitude	0	32	44·41
Longitude of Quebec	4	44	49.02
Longitude of Toronto Magnetic Observatory.................	5	17	33·43

KINGSTON, 28th February, 1857.

The place of observation was the new Court-house.

	H.	m.	s.
By the signals sent from Quebec, Kingston is west of Quebec..	0	21	05·60
By the signals from Kingston, " " " ..	0	21	05·39
Mean difference of longitude	0	21	05·50
Longitude of Quebec..	4	44	49·02
Longitude of Kingston..	5	5	54·52

MONTREAL, 12th March, 1857.

The place of observation was in Viger Square, 650 feet west of Capt. Bayfield's station on Gate Island.

	H.	m.	s.
By the signals sent from Quebec, Montreal is west of Quebec ..	0	9	23·01
By the signals sent from Montreal, " " " ..	0	9	22·38
Mean difference of longitude	0	9	22·70
Longitude of Quebec	4	44	49·02
Longitude of Montreal..	4	54	11·72

CHICAGO, 15th May, 1857.

The place of observation was in the play-ground of the School situated to the northward of the Roman Catholic Church, Huron Street.

	H.	m.	s.
By the signals sent from Quebec, Chicago is west of Quebec ..	1	5	41·44
By the signals sent from Chicago, " " " ..	1	5	41·60
Mean difference of longitude..............................	1	5	41·52
Longitude of Quebec	4	44	49·02
Longitude of Chicago	5	50	30·54

WINDSOR, 18th August, 1857.

The place of observation was in the yard of Mr. Sholand in Goyeau Street, about fifty yards to the westward of the new English Church, and twenty yards to the westward of the Court-house.

	H. m. s.
By the signals sent from Quebec, Windsor is west of Quebec..	0 47 19·04
By the signals sent from Windsor, " " " ..	0 47 18·97
Mean difference of longitude..............................	0 47 19·00
Longitude of Quebec..............................	4 44 49·02
Longitude of Windsor..............................	5 32 08.02

COLLINGWOOD, 1st September, 1857.

The place of observation was the Railway terminus.

	H. m. s.
By the signals sent from Quebec, Collingwood is west of Quebec	0 36 01·43
By the signals sent from Collingwood, " " "	0 36 01·59
Mean difference of longitude..............................	0 36 01·51
Longitude of Quebec..............................	4 44 49·02
Longitude of Collingwood..............................	5 20 50.53

OTTAWA, 14th November, 1857.

The place of observation was 120 yards east of the Flag-staff on Barrack Hill.

	H. m. s.
By the signals sent from Quebec, Ottawa is west of Quebec...	0 17 59·24
By the signals sent from Ottawa, " " " ...	0 17 59·30
Mean difference of longitude..............................	0 17 59·27
Longitude of Quebec..............................	4 44 49·02
Longitude of Ottawa..............................	5 2 48·29

J. B. Tyrrell

GEOLOGICAL SURVEY

OF

CANADA.

REPORT OF PROGRESS

For the Year 1858.

Montreal:
PRINTED BY JOHN LOVELL, AT THE CANADA DIRECTORY OFFICE
ST. NICHOLAS STREET.

1859.

GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 1st *May*, 1859.

SIR,

I have the honor to request that you will do me the favor to present to His Excellency the Governor-General, the accompanying Report, shewing the progress made in the Geological Survey in the year 1858.

I have the honor to be,

Sir,

Your most obedient servant,

W. E. LOGAN,

Provincial Geologist.

To the Hon. C. Alleyn, M.P.P.,
Provincial Secretary,
&c., &c., &c.

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REPORT OF PROGRESS OF THE GEOLOGICAL SURVEY OF CANADA

For 1858.

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APPENDIX.

This volume contains the following maps and diagram :—

ERRATA.

Page 55, 10th line from the top, for *ten* miles read *two* miles.
Page 148, last line, for 1017 read 417.
Page 157, 8th line from the bottom, for *Anderson's* Brook read *Andrew's* Brook.
Page 178, 18th line from top, for *dolerite* read *diorite*.

TO HIS EXCELLENCY

SIR EDMUND WALKER HEAD, BART.,

ONE OF HER MAJESTY'S MOST HONORABLE PRIVY COUNCIL,

Governor-General of British North America,

AND

GOVERNOR-GENERAL AND GOVERNOR-IN-CHIEF

IN AND OVER

THE PROVINCES OF CANADA, NOVA SCOTIA, NEW BRUNSWICK, AND THE ISLAND OF PRINCE EDWARD,

AND VICE-ADMIRAL OF THE SAME.

MONTREAL, 1*st* *May*, 1859.

MAY IT PLEASE YOUR EXCELLENCY:

I have the honor to present to Your Excellency a Report of the progress made in the Geological Survey of the Province during the year 1858, and I accompany it with Reports from those associated with me in the investigation.

From these it will be observed, that the time of Mr. Murray was occupied in a farther examination of the physical structure of the copper-bearing rocks on the north shore of Lake Huron; and that of Mr. Richardson in a continuation of his previous season's investigation, on the south side of the St. Lawrence, in the vicinity of the Shickshock Mountains, as well as higher up the river, between Matanne and Rivière du Loup, extending in one part as far south as the Ristigouche.

One of the recommendations embraced in the Report of the Select Committee on the Geological Survey appointed by the House of Assembly in 1854, was the publication of figures and descriptions of such new organic forms as might be discovered in the rocks of Canada. In compliance with this, it was determined that the publication of those descriptions should appear in parts, each of which, consisting of about ten plates, with accompanying text, should be a monograph on the subject to which it related.

Before the appointment of Mr. Billings as palæontologist to the Survey, the first of these decades was confided to Mr. Salter, palæontologist to the Geological Survey of the United Kingdom, and the second to Professor James Hall of Albany, so well known for his researches in American palæontology. The preparation and publication of a third number, in the earlier part of the year, constituted a part of the labors of Mr. Billings, who subsequently devoted his attention to the study of the corals of the Devonian series of rocks, descriptions of which were so much required for the proper understanding of the geology of Western Canada. The results of this part of his investigations having already been published in the Canadian Journal, and the attention of Mr. Billings being engaged in the examination of the remaining fossils of the same series of rocks, his Report on the subject is reserved until the whole of the species known to characterise the Canadian portion of the series can be described together.

Mr. Hunt's Report contains a series of descriptions and analyses of the intrusive rocks of the district of Montreal, including various trachytes, dolerites, diorites and porphyries. To these succeed analyses of some of the metamorphic Silurian rocks and their associated minerals, followed by an account of his researches on the origin and formation of dolomite, commenced in the Report of the previous year and now brought to a conclusion. This investigation I may here remark, while explaining in a new and simple manner the origin of magnesian rocks, also throws light upon the formation of gypsums and many limestones.

The personal explorations which I have to report to Your Excellency relate to a farther examination of the physical structure of the Laurentian series of rocks, prosecuted chiefly on the River Rouge, which joins the Ottawa in the township of Grenville. In farther following the outcrop of one of the bands of crystalline limestone in this series, (the distribution of which bands was partially described in the Report of 1856,) it was found to strike upon the Rouge, and an ascent of the river beyond the range of present settlement became necessary in continuing the investigation. That part of the stream which is above the area at present laid out in townships was measured, the bearings being determined by a theodolite worked by the limb, and the distances by a micrometer telescope. The length thus measured on the main stream did not exceed about twenty miles, but I now regret that I did not measure the river all the way from its mouth, for the purpose of ascertaining the relation of the range lines in the townships of Harrington and Grenville. Some of these lines, though all represented on the original plans as nearly equidistant, are in reality so irregular as to render it very difficult to represent the distribution of the rocks with truth without such measurement.*

In addition to the twenty miles on the main stream, the position and form of thirty-two tributary lakes of various sizes were determined, the largest of them being upward of six miles in length.

The highest point attained on the river was the Iroquois Chute, about fifty miles from the mouth, and five above a farm cleared by Messrs. Hamilton Brothers, for the convenience of their operations on the river connected with their trade in timber. The farm consists of about 300 acres of land of good quality, producing excellent oats and potatoes, and is the lowest of three of a similar character possessed by the firm, at intervals of twenty miles from one another, on the river. To Mr. Houston, the agent in charge of the farm, I was kindly favored by Messrs. Hamilton Brothers with a letter authorising him to supply my party with whatever provisions we might require, at the same time requesting him to aid us in our objects in whatever way he could, and I have to express my obligations to both the firm and their agent, for the ready attention with which our wants were met.

In my explorations of the Rouge and the neighbouring country, I have been aided by Mr. James Lowe, formerly an artizan, and now settled as a farmer in the township of Grenville, who possessing great skill as a woodsman, has shewn much aptitude in geological field-work; to his zeal I am indebted

* A re-survey of four of the ranges of Grenville having some years ago been made by order of the Crown Land Department, it is chiefly in Harrington that the difficulties exist.

for a considerable portion of the detailed results which I have now to present in regard to the distribution of the crystalline limestones.

Considering that the exploration would afford an opportunity to a properly qualified person to collect objects of recent natural history without interfering with the main purposes in view, I induced my friend Mr. W. M. S. D'Urban to accompany me. His attainments in natural history are well known, and to his industry we are indebted for a very illustrative collection of the fauna and flora of the district examined. Mr. R. Bell, who accompanied Mr. Richardson, was instructed to attend to a similar collection over the ground investigated by the latter, and classified catalogues of the specimens obtained over both areas, prepared by Mr. D'Urban and Mr. Bell, are introduced into the Report as an Appendix. Of Coleoptera upwards of 500 species have now been procured in the two areas in question, and in the neighbourhood of Ottawa and Montreal, and constituting the first known Canadian collection of this order, that has been properly named, they will form a nucleus around which to arrange such additions as may be hereafter obtained. In naming the Coleoptera, we are indebted to Dr. J. L. Leconte of Philadelphia, who is considered the first authority on the subject in America ; while we have to express our obligations to Dr. Isaac Lea and Mr. W. G. Binney, both of Philadelphia, for their assistance, the former in naming the fresh-water and the latter the land shells.

We are also indebted to Dr. J. W. Dawson, Principal of M'Gill College, for his aid in determining many of the fishes and reptiles ; to Col. Munro, of the 39th Regiment, in naming the grasses ; and to Mr. G. Barnston, of the Hudson Bay Company, in determining several other species of plants.

LAURENTIAN LIMESTONES.

In the Report of Progress for 1856, a description was given of the distribution of certain bands of crystalline limestone, belonging to the Laurentian formation, in the townships of Grenville, Harrington, Wentworth, Chatham, Chatham Gore, and Morin, and the seigniories of Argenteuil and Mille Isles. The number of these bands was supposed to be three. The lowest one was traced from the Ottawa, near the village of Grenville, to the vicinity of Lachute, the two points being distant from one another about eighteen miles in a straight line, while the linear outcrop of the band, followed in all its windings, was eighty miles. What was supposed to be the middle band, was traced from the fifth lot of the fifth range of Chatham Gore to the first lot of the fourth range of Wentworth, a distance of two miles; and the highest band, from the fourteenth lot of the south-east range of the St. Gabriel concession of Mille Isles to the fortieth lot of the first range of Morin, a distance of about four and a half miles.

As will be presently explained, the first and second bands mentioned have been found to join one another, and thus to be only parts of the same sheet; so that the calcareous exposures described in the Report of 1856, would appear to belong in reality to no more than two bands, the Morin and Mille Isles band being considered the upper one.

In the Report of 1856, it was stated as a probability, that the Morin exposures, and certain others at St. Jérôme and in the township of Rawdon, would be found to belong to one calcareous sheet. Nothing has been ascertained to contradict this supposition, but it cannot yet be proved that the Morin and St. Jérôme exposures will have any continuous outcrop connection. In tracing out the Morin band, Mr. Lowe has ascertained that from the fortieth it attains the middle of the fifty-eighth lot of the first range, where it turns upon a synclinal axis with a bearing nearly coincident with that of the range, and that at the exit of a lake in the thirty-sixth lot of the S. W. range of the Ste. Angélique concession of Mille Isles, it makes a similar turn on a parallel synclinal axis, about a mile to the southward; where the sheet folds over the intermediate anticlinal, the calcareous rock shews a wide exposure in the south-west end of the St. Gabriel concession, and it is there accompanied with an equal spread of fine agricultural surface. From the south or lower end of the lake just mentioned, the band pursues a nearly due east course and crosses both ranges of the Ste. Angélique concession obliquely, traversing the concession road on the twenty-eighth and twenty-ninth lots, and following a branch of the Gagnon River into the Ste. Marguerite concession. This concession also it crosses obliquely, in the range of two small lakes lying between the eighteenth and fifth lots, but upon the fourth lot it presents a synclinal spur extending to the westward of south nearly across the concession upon the River Gagnon. It ascends this river and passing out of Ste. Marguerite on the second lot, it enters into the Ste. Elmire concession, and runs across seven of its lots from the fifty-fourth to the forty-eighth, touching the north range of St. Godefroy and reaching Lake Godefroy. It has not yet been traced farther, but another lake occurs a little farther on in St. Godefroy, and two smaller sheets of water still beyond; the more eastern of which, from the south end of the lake of Ste. Angélique, is nine miles; all of these lakes lie in the due east bearing of the limestone, and it appears probable the band will pass through the whole. Including St. Godefroy, the unexamined part to the most eastern lake is about three miles, and beyond this it cannot yet be suggested what course the band may assume.

From the easternmost exposures of the supposed middle band of 1856, in the fifth lot of the fifth range of Chatham Gore, the outcrop has been found to make a turn southward, and crossing into the fourth range on the same lot, to join the band traced from Grenville about the middle of the lot. From the westernmost exposures in the first lot of the fourth range of Wentworth, the outcrop proceeds obliquely into the second lot, whence it passes into the second and third lots of the third range, in the latter of which, the property of Mr. Mann, it joins the Grenville band at the western end of a small lake to which allusion was made. Thus it appears that the supposed middle band is only a part of the Grenville band, deriving its position from an undulation.

In describing the distribution of the Grenville band in the Report of 1856, it was stated (p. 22) that though no continuous exposures were met with between the fourteenth lot of the tenth range and the twenty-second and twenty-third lots near the line between the tenth and eleventh ranges of Chatham, a probability existed of an outcrop connection between the two positions. It has since been ascertained that between them two synclinal spurs point to one another, but that they do not join. From the thirteenth and fourteenth lots of the tenth range, the outcrop proceeds by the thirteenth lot across the eleventh range, and gaining the fourteenth lot in the twelfth range, it crosses the town line from that lot, and enters Wentworth upon the twelfth lot of the first range. It here supports a small lake which receives the waters of Lake Louisa, and following the upward direction of the channel connecting them, it enters Lake Louisa in the east bay. By this bay it proceeds northward, forming a point on the west side in the thirteenth lot, and farther on it underlies an area composing the point which divides the east and west bays, on which point Mr. Robertson has cleared a farm. The connected distribution under the waters of the lake is not quite certain; but on the one hand a calcareous spur appears to lie under the west bay, coming partially on the south-eastern side of the bay in the sixteenth lot of the first range, and from this lot crossing into Chatham and terminating near the front of the nineteenth lot of the twelfth range; while on the other hand, the whole of an island which appears to be at the rear of the twelfth lot of the second range of Wentworth, and part of another to the eastward, consist of limestone. Both the spur and the islands are supposed to be in one and the same synclinal form, and calcareous exposures which are met with along the margin of the lake, running obliquely across the lots from the residence of Mr. Case on the sixteenth, to the thirteenth lot of the second range, are probably on the north-west side of another synclinal. It is not yet ascertained how the band leaves the lake, but it may be by the valley of the main inlet on the north side, the mouth of which is in the thirteenth lot of the third range.

From the marginal exposures on the sixteenth lot of the second range, near the residence of Mr. Case, a valley runs obliquely across the lots to the calcareous area which was described in the Report of 1856, as extending along the West Branch of the North River, from the twenty-second lot of the second range of Wentworth to the twenty-third lot of the tenth range of Chatham. On the line between the two townships this area occupies the breadth of two lots, which is wider than was supposed, and in Chatham it presents a synclinal form around a mass of gneiss, which overlies the limestone on the line between the twenty-second and twenty-third lots. On the eastern rim it displays a spur which runs eastward nearly across the middle of the twenty-first lot, and it is this spur which points to the corresponding one, as already mentioned, on the fourteenth lot of the tenth range. In the valley between the West Branch and Lake Louisa, the east rim presents another spur projected eastward from the main area at least half a mile, and this spur appears to correspond with that including the calcareous exposures near the house of Mr. Case. Whether a synclinal calcareous belt is continuous beneath the valley is uncertain; the interval between the nearest known exposures is over three-quarters of a mile.

The calcareous area on this part of the West Branch is the extremity of a trough, one side of which has been found to run along the front of the second range of Wentworth, from the twenty-second to about the twenty-fifth lot, underlying two small lakes in the distance; it then appears to turn northward through a great marsh across this range into the next, entering it on the twenty-sixth lot, and though no calcareous exposures were here seen, the gneiss bounding the marsh which it is supposed to underlie is conspicuously displayed. From this the band seems to sweep north-westward, and touching three small lakes in the distance of about a mile, it reaches a larger one, called from its shape Spectacles Lake, on the town line between Wentworth and Harrington. The southern end of this lake is divided into two deep bays, the eastern of which is on the third range of Wentworth, and the western on the second and third ranges of Harrington. The point between the bays is composed of limestone, and so is an opposite point between two deep bays in the north or lower end of the lake, in the eastward one of which is the discharging stream, very near the town line, on the twenty-eighth lot of the fourth range of Wentworth. The eastern side of the band follows the course of the out-flowing stream, running obliquely across the fifth range, and on the line between the fifth and sixth ranges it passes close by the post between the twenty-fifth and twenty-sixth lots; it then passes eastward of a small sheet of water to the eastern extremity of Gate Lake. At the exit from Spectacles Lake the band has a breadth of about one-eighth of a mile, and the western side passes between fifty and sixty yards to the eastward of the post between the third and fourth ranges of Harrington on the town line. Before reaching the fifth range of Wentworth, which is about twelve chains farther northward, the west side begins to diverge. It enters a small lake on the town line, leaving it near the same line on the north side, and turning northwestward into Harrington, where it approaches to within ten chains of the fifth range on the line between the first and second lots.

On the other side of the trough the calcareous band proceeding from the West Branch River on the twenty-third lot of the tenth range of Wentworth, appears to come in a short distance against the intrusive syenite of that part, and masses of the limestone confusedly associated with gneiss and trap are met with, entangled in the syenite and surrounded by it, on the twenty-fourth lot in the rear of the eleventh and front of the twelfth ranges. The band becomes freed from the syenite in a small lake in the rear of the eleventh range, on the line between the twenty-sixth and twenty-seventh lots ; and from this position it runs obliquely across the twenty-seventh lot and the one beyond, the south or under side of the band, with massive coarse grained porphyroid gneiss beneath, presenting a synclinal point towards the front of the latter lot. From this lot the band passes into the township of Grenville, and joins the exposures which were described in the Report of 1856 as existing near Mr. Dolan's, in the first, second and third lots of the tenth range. In this range the band still farther crosses the lots south of and parallel with Long Lake, which is in the rear of the range. It passes into the twelfth range on the eighth and ninth lots, and leaves it on the tenth, entering Harrington on the sixth lot of the first range. On this numbered lot it traverses three of the Harrington ranges, displaying on each side of it, a bold hill of porphyroid gneiss, that on the west being called Slavery Mountain. In this part the band appears to have a pretty uniform breadth of between 800 and 900 yards, and it is interstratified with a bed of gneiss nearer the top than the bottom, which presents a prominent ridge nearly the whole way. A stream, issuing from a small lake in the front of the eleventh range of Grenville, finds a channel on the band to the middle of the seventh lot of the fourth range of Harrington ; here it joins the brook issuing from Gate Lake, but it is not quite certain how near the confluence of the streams the west or under side of the limestone band we have been following, joins the calcareous mass described in the Report of 1856 as passing eastward to Gate Lake ; there is some reason to think it will be on the east side of the sixth lot. The upper side of the band, on reaching the fourth range bends to the eastward, and then proceeds in a moderate curve to within ten chains of the fifth range on the line between the first and second lots, the position to which it was traced from the other side of the trough.

By this modification of the distribution of the limestone as given in the Report of 1856, a great addition is made to that part lying in Harrington and Wentworth in the neighbourhood of Gate, and Sixteen Island Lakes, a large portion of which supports a surface well adapted for the purposes of agriculture. The best present access to this agricultural tract is by the road which runs along the east margin of the calcareous outcrop on the west side of the trough. The site of this road is judiciously chosen, for while the calcareous valley affords a pretty even grade, it gives also much land capable of settlement along the line, and will thus facilitate the keeping of the road in repair. Some years since a road was opened by the Government to the limestone land in the north-west part of Wentworth, from the settlement on the West Branch River in the front of the township. But a line having been chosen as near to a straight one as practicable over the rugged surface of the gneiss, it happens that while the grades are difficult, there is little land fit for settlement along the road. The road, in consequence, is little used ; a second growth of timber will very probably be allowed to spring up on it, and the expense of opening it will be entirely thrown away. If a road is required on the west side of Wentworth, it is probable that a better line might be obtained along the limestone on the east side of the trough ; in general throughout the Laurentian region, the bands of limstone will be found to afford the best guide for the lines of roads.

The calcareous area which lies between the Big Lake of Harrington (Lac Erable or Maple Lake as it is called on the map of the Crown Land Office) was described in the Report of 1856 as having the form of a trough, and it has just been shewn that the area south of this, from the fourth range of Harrington to the north-west corner of Chatham is of the same geological shape. The limestone running across the lots from east to west, must therefore be an anticlinal, with an axis bearing east and west nearly. In conformity with this the underlying gneiss presents a spur running in upon the east end of Gate Lake, and were it not for an accumulation of drift, the gneiss of Slavery Mountain would probably shew a similar opposite spur in the fourth range of Harrington.

Immediately west of Gate Lake, the breadth of the limestone is little short of two miles, and it presents an equal breadth approaching Sixteen Island Lake ; but between these two positions the anticlinal spur of gneiss on Gate Lake reduces the breadth to less than a mile. On the north side of this spur the base of the limestone, leaving Gate Lake, sweeps along in a sinuous line from the twenty-sixth to the twentieth lot of Wentworth, passing at the same time from the front to the rear of the seventh range. A stream, tributary to Gate Lake, accompanies it at a moderate but variable distance the whole way. This issues from a small lake, which is one of a chain of lakes that with their connecting streams occupy a valley running to the rear of Wentworth on the twentieth lot, but trenching a little occasionally on the adjacent lots on each side. Entering Montcalm near the south-east corner, the valley crosses the first range of the township, gradually bearing more to the westward of north, and in the second range it comes upon the head of Sixteen Island Lake, to which lake that portion of its waters flowing in the most southern range of Montcalm and the most northern one of Wentworth, is tributary.

Crossing the line between Harrington and Wentworth, about the middle of the seventh range of the latter, the summit of the limestone proceeds in a curve to the middle of the eighth range on the line between the twenty-fifth and twenty-sixth lots. It here reaches the exit of a lake tributary to Gate Lake. The lake is about a mile in length, and by short channels receives on the east the waters of Long or Eagle Nest Lake, lying chiefly in the twenty-second lot; and on the north those of Sixteen Island Lake, which extends upwards of three miles in a direction east of north to the second range of Montcalm, where its head has already been indicated. These three lakes lie in one geographical depression, which narrows considerably at the foot of Sixteen Island Lake, and is separated from the eastern valley, previously mentioned, by a bold mountain mass of hornblendic gneiss, of which the lamination is so seldom apparent, that it might be mistaken for an intrusive rock. The southern limit of this mass of gneiss is at the rear of the seventh range of Wentworth, where it divides the limestone into two parts; one of which, with an average breadth of about 200 yards, paves the bottom of the eastern valley, while the other from a breadth of about a mile and a half between the southern extremity of Eagle Nest Lake and of that to which it is tributary, gradually tapers to a breadth of about 250 yards where it enters the southern end of Sixteen Island Lake.

From this distribution it is plain that the gneiss between the valleys is of a synclinal form, and that the limestone on its west side folds over an anticlinal axis, which runs through the length of Sixteen Island Lake. The widest part of this lake, occurring about the middle of the eleventh range of Wentworth, measures about a mile; and from the distribution of the calcareous exposures on various islands, and on two localities on the eastern shore, it appears probable that the limestone either spreads out very much on the bottom of the lake, or splits into two bands, which re-unite before reaching the upper extremity. Approaching this extremity the calcareous rock is seen crossing a point projecting from the eastern shore in the first range of Montcalm, and on this shore, in the rear of the range, it finally enters upon the land, and proceeds to the front of the next range, there joining the limestone of the eastern valley.

In the first range of Montcalm, the eastern valley shews some good agricultural land, which is continued for some distance in a prolongation of the depression across the second range. In the rear of the range the waters are still tributary to Sixteen

Island Lake, but on the third range they fall northward, and the valley comes upon Balsam Lake. Between these lakes, the calcareous rock was traced with great difficulty; several exposures however, occurring at intervals the whole way, were ultimately met with, and these seemed to indicate that the band, before entering Balsam Lake, diminishes considerably in thickness. In an exposure about two-thirds of the way across the second range, where the dip was *N. 80 W. > 45°, and gneiss, belonging apparently to the mountain masses bounding the valley, was visible close on the opposite sides of the band, the breadth did not exceed twenty yards, which would give a thickness of little more than forty feet. In different parts of the valley, however, much pyroxenic rock was observed on the east side, and garnet-studded gneiss on the west; these may perhaps replace a part of the limestone.

Balsam Lake, with a length exceeding two miles and a bearing somewhat west of north, presents a large island in the middle, which nearly fills its breadth. The limestone, in addition to being observed at the opposite ends of the lake in the third and fifth ranges, was found composing opposite points in two of the narrowest straits in the fourth range, and these indicated an increase of breadth in this range to about 130 yards. But it leaves the lake with apparently about half that measure, and enters a marsh; through this the stream discharging the lake gradually turns to the west, and then to the south of west after reaching the middle of the fifth range; and no calcareous exposures were observed for about a mile and a quarter, until reaching the twenty-second lot, where the marsh terminates. The limestone quits the marsh with about the same breadth it shewed on entering it; but in its continuation down the valley, obliquely across the ranges for the next three miles and a half, it gradually widens, and on reaching Round or Sugar-Bush Lake, a breadth exceeding 1000 yards is displayed, embracing the chief part of the northern and eastern shores. In these three and a half miles, the exposures are numerous, and the band is conspicuously bounded by mountain masses of gneiss on each

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* The bearings in this Report are magnetic, the variation being 10° west of true north.

side. One of these masses rises on the south side of Round Lake and stops the farther progress of the limestone in that direction, only a few yards of calcareous rock having been found there skirting the margin of the lake ; and as the gneiss appears also for some distance down the west side, the north-west corner would seem to be the only part by which the calcareous band can continue its course. Beyond the lake however in that direction, a considerable space is covered by drift or marsh, and for three miles and a half the outcrop connection of the band will have to be proved without the aid of any exposures of the rock composing it.

Round Lake, with a length of about 1600 yards, and a breadth of between 700 and 800, stretches across nearly five lots from the fifth to the ninth of the second range. It is about half a mile to the north-east of Bevan's Lake, from which it is separated by the mass of gneiss on its south and west sides. Bevan's Lake is underlaid by limestone, and it will be convenient here to shew the relation which this limestone bears to that of Round Lake.

It was explained in the Report of 1856, that the limestone which issues northward from Slavery Lake valley, and turns on the one hand eastward to Gate Lake, proceeds on the other a little eastward of north by the east side of Big Lake to its exit, displaying a breadth of nearly a mile and half, which is partly covered by the lake. From the north end of Big Lake, turning a little to the westward of north, the limestone accompanies the discharging stream in a deep valley to Bevan's Lake, crossing the town line between Harrington and Montcalm, with a breadth of nearly half a mile on the ninth and tenth lots of the former, and the fourth, fifth, sixth and seventh of the latter. A synclinal spur however returns to the town line on the second lot of Montcalm, shewing two minute undulations.

Bevan's Lake, with a length of about two miles and half, and an average breadth of less than half a mile, lies diagonally across the town line of Montcalm and Arundel, in a bearing nearly north and south, and stretches from the first range of the former to the third of the latter. The limestone which constitutes its bottom, occupies probably about three-fourths of its length. Whether it has any immediate outcrop connection with the limestone of Round Lake is uncertain; but from the outcrop connection traced the other way by the circuit of Gate, Sixteen Island and Balsam Lakes, it is plain that in Bevan's Lake and Round Lake those sides of the calcareous area which approach nearest to one another, are equivalent, being in each case the summit of the band, and that the two areas are on the opposite sides of a synclinal form. But should they join, it will be seen that they must again immediately separate; for the gneiss underlying the limestone comes in an anticlinal spur to the shore of Bevan's Lake, on the left side, towards the southern end, and is again flanked by the limestone to the westward. Thus the calcareous band, leaving Bevan's Lake on the adjoining parts of the first and second ranges of Arundel, runs south across the former and the last range of Harrington, enclosing a small lake on the town line and another called Crooked Lake farther on near the house of Mr. Bigros, where exposures are seen on the road to Fitzallan. Matilda brook, discharging Crooked Lake into Bevan's Lake, runs on the limestone all the way. South of Crooked Lake, towards the rear of the tenth range of Harrington, the band turns with a sharp point on a synclinal axis, and enters a valley which runs westward on the eleventh range, and which in the distance of about three miles comes upon the River Rouge immediately below the Dog Rapid. The valley is well bounded on both sides by mountains of gneiss, but it has not yet been sufficiently examined to determine its sinuosities with accuracy, except on the north side; nor have any exposures of the calcareous rock been met with in it, being apparently deeply covered with drift. At the Dog Rapid, however, an exposure occurs, which there is little doubt belongs to the band, and the strike would appear to indicate that it takes a turn northward.

Round Lake is discharged from its north-west corner into the lower half of Bevan's Lake, and the waters of this lake, issuing from its northern extremity, are conveyed to the Rouge, near Fitzallan, by a brook which meanders along the third range of Arundel. Not far from the exit of Bevan's Lake a tributary stream joins the north side. This tributary issues from Bark Lake, the upper end of which is on the line between the sixth and seventh ranges of Montcalm, and the lower on the sixth range of Arundel. The extremes are about three miles and a half apart in a straight line, but a deep sinus in the general form, carries the most southern part to the front of the sixth range of Arundel, and gives to the lake a length of six miles. The shores are conspicuously indented with bays; one of which, about a mile in depth, terminates in the fifth range of Arundel. From the east side of this bay, a range of gneiss extends in a nearly straight line to the calcareous exposures within 200 yards of the north shore of Round Lake. The same rock constitutes the promontory which lies between this bay and the exit of Bark Lake, and it is seen in long stretches of the shore in so many other parts, as to leave little doubt that the lake is altogether surrounded by it. From the exit of Bark Lake it extends westward along the front of the sixth range of Arundel to within three-quarters of a mile of the River Rouge, and southward in the rear of the eastern river lots to the front of the fifth range. It is thus evident the limestone of Round Lake cannot pass north of the sixth range of Arundel before approaching pretty near to the Rouge.

From the range of gneiss between Bark and Round Lakes, there extends to the Rouge a horizontal area which occupies nearly the full breadth of the third and fourth ranges. Much of it is occupied by swamp, and the general uniformity of its level is indicated by the fact that the waters of the Rouge, during the freshets of the spring, are poured up into Bevan's Lake and Round Lake, and for some distance up the brook discharging Bark Lake; so that occasionally saw-logs sent down the Rouge by Messrs. Hamilton Brothers have been floated into the two first-mentioned lakes. The first and second ranges of Arundel, from the Matilda brook limestone to the Rouge, are largely occupied by gneiss, and the only probable direction for the course of the limestone of Round Lake is therefore through the flat land of the third and fourth ranges. No evidence has been obtained to prove what sinuosities the outcrop may assume under this area; but where the line between the two ranges in question, comes upon the Rouge, a calcareous exposure is met with which must belong to the band. This occurs at the Island Chute, where there exists a great bend in the river about half a mile above the house of Mr. Thompson, the postmaster. The limestone is flanked, immediately on the west, by a mass of gneiss, which occupies the left bank of the Rouge for about six hundred yards, and extending into the bed of the stream, produces the rapid which succeeds the Chute. Gneiss occurs also on the opposite side of the river, about three hundred yards removed from the margin, shewing a breadth of about two hundred yards across the measures. It occurs again about half a mile more westward on the west side of the brook discharging Otter Lake, and then gradually rises into the mountain range which flanks the Rouge at a variable distance in this neighbourhood. Otter Lake is situated on the west side of the Rouge, in the fourth and fifth ranges of the township. It is wholly surrounded by mountain masses of gneiss; that on the east side coming close on the Rouge, where its strike is south for a considerable distance, bearing exactly for the gneiss flanking the limestone at the Island Chute. I am thus inclined to think this calcareous exposure exhibits the base of the band.

What the distribution of the outcrop may be between the Island Chute and the Dog Rapid, which are about four miles apart, has yet to be determined; but it is probable that some where below the mouth of Bevan's brook the band will, by the effect of undulation, cross to the west side of the Rouge, and pass southward on that side by the valley in which a winter road has been established by Messrs. Hamilton Brothers. To the west of this road the gneiss rises up boldly, and near the town line between Arundel and Harrington, presents a bare, bluff point of rock, about three-quarters of a mile from the river. From this bluff a ridge runs to the south-eastward, approaching the river to about half a mile opposite the Dog Rapid. But between this ridge and the river there is a great accumulation of drift, with a rapidly sloping surface, which wholly covers up the limestone.

A deep covering of drift prevails also above the Island Chute, extending along the valley of the river up to the Devil's Rapids the distance between the two places being about three and a half miles. On the east side this detrital matter forms a plain about three-quarters of a mile wide nearly the whole way, but upon the west, as has already been stated, the mountain flank running north comes close upon the stream for about a mile along the valley above the Island Chute. Beyond this the river gradually separates from the mountain flank, which still runs northward for about another mile. The slope of the higher ground then turns more eastward and gradually approaches the river, and in this way the plain on the west side assumes a rude triangular shape, the apex of the triangle being about three quarters of a mile distant from the river on the line between the fifth and sixth ranges of the township. In this triangle a synclinal spur may project northward from the limestone, the west side of which would come close upon the mountain flank in the fourth and fifth ranges. No calcareous rock was met with in a position to prove this, but the probability of it is supported by the fact that in the rear of the river lots, on the west side, toward the south part of the seventh range, the extremity of a calcareous trough opening northward occurs, which would correspond with such a structural form, and to this more northern calcareous area I shall now proceed to draw attention.

The rocky ridge on the west side of the Rouge in this part, called by the Indians *Kokoko Pikwatina* or Cuckoo Mountain, separates the sources of several small streams which flow down the eastern slope between the Island Chute and the Devil's Rapids from those of others which join the river below the former and above the latter. One of the eastern rills however has its origin in a small lake, which is situated at a pretty high level in the hills on the west side of the crest. The lower end of the lake occurs on the twenty-third lot of the seventh range precisely on the line of the crest, a deep notch in which permits the escape of the water. An exposure of calcareous rock occurs immediately at the exit, and while the bottom of the lake is composed of limestone, the shore on three sides consists chiefly of the more rugged gneiss. The edge of the limestone turns south-westward from the south-west side of the lake, and immediately beyond the lake this end of the trough, to which the limestone belongs, has a breadth of about 600 yards. Proceeding northward, the trough gradually widens, presenting on the west side a low smooth rim from which waters tributary to the Rouge, flow south on one hand and north on the other. While the sides separate the surface gradually falls, and about two miles and a half from the extremity, the trough meets with the Rouge, which in the upward bearing of the valley, makes a sweep to the north-westward, on reaching the town line between Arundel and Desalaberry, at the clearing of Mr. McIntyre, about a mile and a half above the Devil's Rapids. In this sweep the river passes through a breach in the strata of Cuckoo Mountain, the continuation of which on the left side of the river, separates the valley of the Rouge from that in which its tributary, the Devil's River, winds its very tortuous course. As we ascend the Rouge, the eastern limit of the limestone occurs just above a smooth ice-rounded bluff of gneiss on the left bank, called the Dog Rock, while the western one is seen in a range of hills whose flank runs for some distance along the line bounding the west side of Arundel and Desalaberry, the breadth between the limits being about a mile, which the river crosses obliquely, attaining the western side of the trough in the vicinity of the Huckleberry Chute.

At the Huckleberry Chute, the Rouge, which from the Island Chute upwards has a breadth of from one hundred to one hundred and fifty yards, becomes compressed into the space of twenty yards; but after making its leap, in which there is a descent of fifteen feet, it immediately expands into a pool three hundred yards wide, and on the upper side of this there is a considerable exposure of rock. In this it is perceived that the limestone is interstratified with bands consisting chiefly of quartz, but mixed or studded in various proportions with feldspar, pyroxene, hornblende, and occasionally with garnets, and a mass of this description, with a gneissoid character and a thickness of some importance, runs obliquely across the channel, where the water is precipitated from the higher level into the pool. The limestone is much charged with graphite, and from this mineral is derived the Indian name of the place—*Aboujnoumeneci*

Pawitik—or Blacklead Fall. The same Indian appellation, derived from the name of the fall, is given to the mountain of gneiss which bounds the limestone on the right bank below the pool, though there is little or no graphite in the strata composing it.

From the extremity, in the seventh range of Arundel, the general bearing of this calcareous trough for eight miles is very nearly north. It makes however a slight bend to the eastward, at the distance of two miles, where it crosses the line between Arundel and Desalaberry; and a slight bend to the westward, at the distance of six miles, where it leaves the western boundary of Desalaberry. In these eight miles the average breadth is about one mile; but through the influence of small longitudinal undulations, aided by transverse depressions and elevations of the strata, it in one place widens to the breadth of two miles, and in another narrows to one of half a mile. The longitudinal plications occur on both sides of the trough as well as in the centre, and the number and intensity of them shew a wonderfully corrugated condition of the strata.

The expansion to the breadth of two miles occurs immediately opposite to Huckleberry Chute, by a sudden turn to the west of the rim on the west side, which in its progress presents two small projections to the south, resulting from two small parallel undulations. About a mile farther north the rim returns by a corresponding opposite course round the extremity of the more western of these small synclinal forms, and the normal breadth is here restored by a fold which occurs farther south over an anticlinal axis on the east side. Beyond this northward another anticlinal fold on the east side narrows the calcareous area to half a mile; but the area immediately expands again to the average breadth by opposite turns of the rim over the same anticlinals. Where the gneiss comes from beneath the limestoneon the anticlinal axes, there is in every instance, a bold mountain mass of the rock. From the position where the trough leaves the western town line of Desalaberry to the Silver Mountain, which is two miles farther up on the eastern side, the breadth of the trough is very uniform; but a ridge of the subjacent gneiss rises boldly up through the limestone towards the western side, and continuing the whole distance, presents several conical peaks ; one of these standing on a base of a little over 250 yards across the measures, attains a height of about 700 feet above the river. The first view of this hill was obtained at Mr. McIntyre's farm at a distance of about five miles, and from its shape it went among us by the name of the Cone.

In the next mile northward the east side of the trough bends a little to the eastward, and the breadth increases to a mile and a half, but is immediately diminished again to less than a mile by a sudden turn on the west side, which shews two parallel anticlinal axes over which in succession the limestone folds, sending corresponding synclinal spurs northward. The more western of the anticlinals is a continuation of the form in which the gneiss penetrates through the limestone farther south, and as in that case it displays a ridge, but not of so marked a character. On the more eastern axis however a conspicuous mountain mass of gneiss presents a height nearly equal to that of the Cone.

This hill, as seen endwise from the summit of Silver Mountain, presents a bold and striking figure in the landscape. The calcareous plain stretching across the picture in front, running up the synclinal valley on the west, and occupying the banks of the Rouge for many miles up, gives to the hill an isolated aspect. It rises like a gigantic bee-hive from the horizontal surface of the plain, and this would suggest for it an appropriate name.

The Silver Mountain, which consists of porphyroid gneiss, has two summits, divided from one another by a shallow valley in which there is a small lake. The more eastern top, which is at the same time the more southern, has a height about equal to that of the Hive. Each of these summits appears to be on an anticlinal axis. At the base of the mountain there is a portage, occasionally resorted to by those ascending and descending the river in light canoes, for the purpose of saving the time that would be spent in navigating a great bend in the Rouge. It is from the upper end of this portage that the eastern side of the calcareous trough begins to assume a little more easting in its course. This easting it maintains for about two miles and a half, and the effect of the Silver Mountain anticlinals on the calcareous rim is very distinctly seen as we proceed along, as well as the effect of three additional forms of the same character occurring in the distance. The breadth across the whole of these five anticlinals in a straight east line would scarcely exceed a mile and a quarter, which would give a quarter of a mile as the average distance between each two.

Towards the east side of the calcareous area in this part there is a small crescent-shaped lake, deriving its form from the influence of the undulations on the distribution of the strata, and the breadth of the general trough on a line crossing this lake and running west to the flank of the ridge connected with the Hive, is about a mile and three-quarters. The whole length of the trough, in a straight line from its southern extremity up to this point, is a little over ten miles; in these ten miles there appears to be no superior rock resting on the limestone. But here the point of a synclinal mass of gneiss presents itself in about the middle of the trough, and immediately rises into a hill which rather exceeds the Hive and the Cone in height, and reposing on the limestone divides it into two bands. Of these, the one on the right, looking towards the gneiss, continues to run northward, in which bearing it has been traced for two miles from Crescent lake, while that on the left gradually rounds to the west.

In the first two miles the westing is but slight, and the band is confined to the valley of the main river; but in the succeeding two, turning up the valley of a tributary called George's Creek, the bearing becomes nearly due west. In these two miles the limestone encloses a small expansion of George's Creek called Lake Simon, and strikes the outlet of another small lake beyond. The outlet of this lake occurs at its north-eastern extremity; the main inlet is at the opposite end, where it contributes the waters of a considerable sheet, called the Lake of Three Mountains, by a short channel running across the stratification. Within about 150 yards of the outlet of the small lake, there is a tributary on the north-west side, through which run the waters of another small lake not quite half a mile to the north, and it is up the valley of this tributary that the limestone proceeds in its farther progress. This latter small lake presents two straight diverging limbs, the one bearing a little east of north from the outlet for about three hundred yards with the stratification, and the other east, at right angles across the measures nearly. The limestone underlies the northward-bearing limb, and at the north end of it enters the valley of a small brook, up which it has been traced running N. 20 E. for nearly a mile.

The breadth of the band at this point cannot be made out to be greater than one hundred yards; the dip is eastward at an angle of between seventy and eighty degrees, giving a thickness of nearly 300 feet. At Lake Simon the breadth is about two hundred yards, and it gradually increases descending George's Creek; but where the band leaves the valley of the creek and enters on that of the main river, the upper part of the limestone and the base of the gneiss are concealed by drift. On George's Creek and its tributary lakes the limestone is immediately overlaid by garnet-studded gneiss, which occasionally holds much hornblende, and near the outlet of the small lake between the Lake of Three Mountains and Lake Simon, this mineral, in a considerable thickness of the strata, is in sufficient abundance to entitle the mass to the name of hornblende rock. The eastern band of the limestone, north of Crescent lake, displays a breadth of about 500 yards, and garnet-studded gneiss is exhibited resting on it as conspicuously as on the western band.

A portion of the breadth of the eastern band is perhaps due to undulations in the strata. The effect of some of those, which have already been alluded to, is easily discernable in the modifications they produce in the distribution of that part of the base of the overlying gneiss which is north-west of Crescent lake; and the effect produced on the west band by the Hive anticlinal, and the one immediately west of it is conspicuous, while the courses of the axes are somewhat remarkable. These axes, running north-west for a considerable distance and then north, are traceable to that part of the band which includes Lake Simon, each producing a northern projection in the band, the one above and the other below the lake. On the more western one the limestone, after plunging beneath the gneiss, breaks through it again about 850 yards farther north, and there displays a lenticular area on the crown of the anticlinal, running for nearly a mile and three-quarters to the north-east; thus shewing a change of ninety degrees in the bearing of the axis, with but a short radius to the sweep. The lenticular area is surrounded by a rim composed in general of gneiss and quartzite studded with garnets, but on the north-west side, the garnets, of a pink color, are disseminated in a pure white, crystalline orthoclase feldspar, producing a rock of striking beauty. A strip of garnet-studded rock runs for some distance along the middle of the lenticular area. The more eastern axis takes a similar turn, but the limestone, after sinking beneath the gneiss near Lake Simon, does not give so sure an indication of the bearing farther to the north-westward. There is an isolated calcareous exposure at the distance of about three quarters of a mile; another at the distance of about two miles, and a third at three miles and a half. It is not certain, however, that they are all on the same anticlinal axis. In the third there is a mere trace of the limestone, but a very distinct exposure of the garnet-studded rock, and a very beautiful display of the anticlinal fold in a low cliff at the spot, in which the north-western side shews an overturn dip.

Between these exposures and the Rouge there rises a mountain ridge of hornblendic gneiss, running north-east and south-west with the strike for about two miles; it is divided into three conspicuous tops, and has in consequence received from the Indians the name of *Kan Soutana,* or the Three Mountains. The south-eastern flank of the ridge slopes sharply down to a triangular drift-covered plain, in which the Rouge meanders in a very serpentining course. The side of the plain which runs along the flank of the Three Mountains, extends across the Rouge to the north-east, and reaches Lake Simon on the south-west, the distance from one end of the line to the other being about four miles and a half. On the east side it is bounded by a continuation of the range of hills, which limits, in that direction, the eastern band of limestone, the length of the line being two miles; and on the south its measure, from the eastern limit of the eastern band of limestone to Lake Simon, is four miles. The most prominent part of the southern boundary is the mountain of gneiss which lies between the east and west bands of limestone near their junction; I have called it the Portage Mountain. Its summit stands nearly west of the exit of Crescent Lake, and the ridge running north dies in the plain at about the distance of a mile, where the stream which empties Crescent Lake, after flowing northward along the eastern limestone valley, turns west and and then south for a short distance to meet the Rouge.

The exit of the brook is close by the south end of what is called the Horse-Shoe Portage, a part of Messrs. Hamilton Brothers' winter road, by which several great bends in the river (on the ice covering which the road chiefly runs,) are avoided. The portage is upwards of a mile and a quarter long, and derives its name from the occurrence on it of a narrow horse-shoe lake, which indicates an ancient channel of the river; similar ancient channels are indicated in many parts of the plain by long, narrow, winding swamps, with high, precipitous banks of clay, sand and gravel.

The plain extends from the south side of the triangle over the surface of the bands of limestone in two spurs, and including as much of these as can be seen at once from the higher parts of the Three Mountains, the whole area comprehends about five square miles. It is upon this plain that Messrs. Hamilton Brothers have their lowest farm, the chief part of it being on the right bank of the river. Excepting close upon the boundaries of the plain, no exposure of rock was met with in any part, and we were not able, in consequence, to determine with precision the unbroken outcrop continuance of the eastern band of limestone farther than has been indicated, while the want of time prevented the farther pursuit of the western one.

The calcareous exposures, which are supposed to indicate the north-western prolongation of the Hive anticlinal, are met with in a valley which runs parallel with the ridge of the Three Mountains on its north-west side, and with the exception of the garnet-studded rock, the hornblendic gneiss of this ridge appears to be the first great mass that rests upon the limestone. The strike of the ridge seems to be regular, and the dip, which is pretty uniform, is S. 45 E. $< 55^{\circ}$. The breadth from the valley behind to the front is about 600 yards, which would give a thickness of about 1500 feet. The rock which succeeds is a mass of nearly pure quartz, in some parts obscurely granular, and in others almost vitreous; a large portion of it is white. It was met with in two positions, at the distance of two miles from one another, and appeared to have a thickness of about 600 feet. One of the exposures was in front of the highest top of the Three Mountains, where the quartz was overlaid by about one thousand feet of gneiss, and the other an isolated hill to the north-eastward, to which we gave the name of the Quartz Mountain. The strike in the latter locality indicates a turn more northward in the stratification, and the gneiss beneath, where seen near what is called the upper clearing, runs parallel with the altered strike, and crosses the Rouge about a mile above Quartz Mountain. Where it does so, the distance between the beds exposed and the nearest exhibition of the gneiss which underlies the eastern band of limestone, is about half a mile, and the space displays a flat-surfaced accumulation of drift.

According to the stratigraphical position above given to the band of quartz and the gneiss beneath it, the strata of the synclinal gneiss in Portage Mountain, would be equivalent to those of the Three Mountains, and the distribution of the quartz band under the drift would conform in some degree with the triangular shape of the plain. But the quartz band where seen, being on the west side of the main synclinal axis, if it passed northward on that side through the half-mile drift-covered space, would have to return again on the east side of the axis under the same space. In this space however there is not room for the limestone, the garnet-studded rock, the gneiss, and the double band of quartz; the quartz therefore must come to a synclinal point before reaching this space. The bearing of the axis of the synclinal gneiss in Portage Mountain is west of north for upwards of a mile and a half, and to reach the position where the quartz band must turn on it, it must assume a north-east bearing for some distance, and in doing so would preserve in some degree a parallelism with the minor synclinals on the west side of the general trough.

From the position where the strata of the Three Mountains cross the Rouge, the upward course of the river, with the exception of one serpentine curve in the first mile, is nearly straight to the Iroquois Chute, the distance above the curve being about two miles and a half. The strike of the gneiss supposed to underlie the limestone, would bring it near the left bank of the river just above the curve, from which it appears to run parallel with the course of the stream up to the Chute, the gneiss in many places touching the bank. About 600 yards below the Chute a tributary joins the river on the left side, from the mouth of which there is a portage to Trembling Lake. Below the mouth of this brook there is a considerable exposure of gneiss on the left bank, and limestone is seen touching it at the margin of the stream for some distance down. This there is not much doubt is the base of the eastern band, which probably occupies the bed and the left bank of the river in the straight part.

On the portage to Trembling Lake there are several small sheets of water. The general bearing of the path to the first of these is about east, and almost exactly across the measures, and the distance in a straight line is a little under three-quarters of a mile. The rock which is exposed on or near the path for the chief part of the distance is gneiss, but about half-way there is a thick bed of white quartzite studded with garnets. The dip appears to be regular and the angle high, and the total thickness on the portage would be about 3500 feet. The first lake is a small one, being but three-quarters of a mile in length and between 200 and 300 yards wide; the bearing is very nearly parallel with the nearest part of the Rouge. The second lake, the Indian name for which is *Kasagawigamog*, or Long Lake, has exactly the same general bearing as the first one. The sides are straight and parallel with one another; they are about four hundred yards apart, and run very nearly in the strike of the strata, while the length of the lake is a mile and three-quarters. A small tributary lake falls in on the north by a connecting channel which is only a few yards long; this small lake is in the strike of the first lake, with an interval of less than a mile between them. Between the proximate sides of the first and second lakes, the shortest distance is not over 150 yards, and between the two lakes there is a water-shed, the first falling into the Rouge, while the second is a tributary of Trembling Lake, its waters passing however through an intermediate lake. On the east side of Long Lake, towards the south end, there is a narrow entrance to a long bay which is parallel with the main body of the lake, and on the west side of this, towards the south end, is the outlet. Through the first and second lakes there runs a group of three bands of limestone, the middle one being much the largest and occupying nearly the breadth of Long Lake. Of the two bands of gneiss which divide the calcareous bands, the western one is the larger. The position of the gneiss is indicated by the separation between the first and second lakes, and between the main body of the second lake and the south-eastern bay. Other beds of gneiss are interstratified in the limestone, but they are not of much importance. The total breadth of this belt of strata is about half a mile, and the thickness is supposed to be about 2500 feet.

The lake into which Long Lake is discharged, stands at a short distance to the south-east. Its Indian name is *Misámiko Sákaigan*, or Great Beaver Lake. It has an irregular form, but may be compared to a rude triangle with the apex to the north, the base on the south side being about three-quarters of a mile, and the altitude over half a mile. From the base a deep bay runs southward, and from the vicinity of the apex a long, narrow bay runs eastward to the outlet. A small stream falls in at the apex of the triangle, which is about a quarter of a mile eastward of the main inlet. This small stream appears to mark the eastern limit of the calcareous belt, which is farther traceable by an island of gneiss standing about half way along the eastern side of the triangle and the east side of the southern bay. This is composed of gneiss, while limestone appears in the bight of the bay. The western limit of the belt appears to reach a bold precipice of gneiss, terminating northward in a bluff point. This bluff is situated south of the western corner of the lake, and as it stands exactly in the bearing of Long Lake, it is probable that the calcareous belt, after leaving Long Lake and before reaching Great Beaver Lake, turns on an anticlinal, the axis of which would run through the bluff. The width of the whole belt still continues to be nearly half a mile.

Great Beaver Lake flows into Trembling Lake on the west side, not quite half a mile from its northern extremity, by a stream which is under a quarter of a mile in length, running across the measures. Trembling Lake has a length of six miles and a quarter, with a bearing a little south of east, and a breadth of between a half and three quarters of a mile. It runs very nearly with the stratification, and in a general way parallel with the Rouge. On the west side it has several promontories and bays, the most conspicuous of the promontories being about two miles and a half down the lake. The east side of the lake is nearly straight, but displays a sudden turn about a mile from the northern end, by which the breadth is reduced from its average measure to about a quarter of a mile. At this turn the main tributary stream comes in from the north. The outlet is close to the southern extremity of the lake on the west side, where the water is precipitated immediately from the surface of the lake, over garnet-studded gneiss, in a fall of twenty-nine feet.

A band of limestone, with a breadth of about 600 yards comes upon the east side of the lake from the north by the valley of the main tributary, of which the position has just been given. In its progress southward the limestone composes several islands, one of them being the largest in the lake, and it is displayed, below this island, in a white rock which comes above the surface of the lake, and from its shape, has been called by the Indians *Kikalána Gwábik*, or Lizard Rock. A little lower down it composes also the chief part of the most conspicuous promontory on the west side, but it is not seen again until reaching the outlet of the lake, where it occurs in a precipice facing the fall, its strike being southward and down the river. Garnet-studded rock occurs along the eastern side of the band, on one or two points of the main shore, and on several islands, and not having been observed immediately on the western side, the garnet-studded rock of the fall is supposed to indicate that the whole breadth of the band must be to the west of it. But no examination having yet been made at the outlet, beyond the immediate border of the lake, this must for the present remain conjectural.

On the eastern side of the lake there rises up a vast mass of coarse-grained porphyroid orthoclase gneiss, constituting what is called the Trembling Mountain. Its Indian name is *Manitouge Sootana*, the translation of which would be the Spirits' Mountain, or Devil's Mountain. The Indians assert that low, rumbling noises frequently proceed from it, and that it has sometimes been felt to shake by those who have been accidentally upon it. If this were true, it would in that respect resemble the country in the neighbourhood of Cromarty, in Scotland; but whether it be true or not, the belief of the Indians in the fact has established for it its English name. While I was in its neighbourhood, it seemed to me to be perfectly quiet and steady. The base of the mountain occupies a large portion of the township of Grandison. The highest point seen from the lake, as measured trigonometrically, is 1713 feet over its surface, or about 2061 feet above Lake St. Peter, between Montreal and Quebec, and it appears to be the loftiest summit for a considerable distance in the surrounding country.

The eastern limit of Grandison crosses Trembling Lake obliquely at the distance of about two miles from the southern extremity, and an old timber road, which is used as a portage, starts from the vicinity of the position where the town line intersects the western margin of the lake. The road leads to the Rouge in the plain of the Three Mountains, the distance in a straight line being about four miles. Less than half-way there occurs a sheet of water, known to the lumberers under the name of Lake Sam. It has a length of about a mile and three-quarters, with the average breadth of about one-quarter of a mile. Its longitudinal bearing is S. 30 E., and it is very nearly parallel with Trembling Lake. The strike of the strata on its banks however appears to be about S. 20 W., and a band of white quartzite about 150 feet thick, interstratified with hornblendic gneiss, was traced with this bearing for three-quarters of a mile into Lake Sam, crossing it very near the town line. A band of limestone comes upon the lake at its north-west corner; the exposures ascertained were not sufficient to determine its exact breadth, but nothing was found to contradict the supposition that it might equal that of the band of Long Lake and Great Beaver Lake. No calcareous exposures were met with on the western side of the lake, but from the relative positions of the bed of quartzite and the limestone, which were separated by about thirty chains of gneiss, it is probable that the east side of the calcareous band would strike the western bank about midway between its extremes.

The interval between the supposed west side of this Sam Lake band, and the gneiss bounding the eastern side of the Grenville limestone on the plain of the Three Mountains, is about the same as that between the Great Beaver Lake band and the Rouge, while the distance between the lakes is not much more than four miles. It would thus appear almost certain that there is a direct outcrop connection between the calcareous rocks of the two lakes, and that the band would pass by the western foot of a sharp-pointed hill, to which we gave the name of the Hay Stack, the summit of which is removed nearly a mile from the Trembling Lake limestone, where it forms the conspicuous promontory below the Lizard Rock.

Allusion has been made to a lake deriving its name from the Three Mountains, which is situated on the west side of the Rouge, and discharges into Lake Simon through another small lake. The outlet of the Lake of Three Mountains is on its north-eastern side, about midway from its extremes, which are a little over three miles apart in the bearing N. 55 W. and S. 55 E. At its north-eastern extremity it is joined by a brook, which brings it the tribute of two small lakes in the same general bearing. Into the upper one of these flow the waters of three small lakes, lying in a valley nearly transverse to the previous bearing. Looking to the westward, one of these is on the right hand and the other two on the left. The brook, which issues from the lowest and largest of these five lakes, is joined on the left bank, about half way to the Lake of Three Mountains, by a tributary which comes from the eastward of north from a long, narrow marsh. On the south-westward side of the Lake of Three Mountains, about half a mile eastward of a small bay which is opposite the outlet, the lake is joined by a brook, which issues from Green Lake. This lake is upwards of two miles in length, and the lower half runs parallel with the lake of Three Mountains, while the upper half, which extends beyond that lake, takes a turn upwards of twenty degrees more to the south. At the upper end Green Lake is joined by a tributary which empties a small lake in the same valley, about half a mile further southward.

From this small lake a calcareous belt, interstratified with two heavy bands of garnet-studded quartzite and hornblende slate, has been traced to the western end of Green Lake, occupying a considerable portion of the ground between the lower half of this lake and the lake of the Three Mountains. Farther on the belt embraces two small lakes, in the same valley as Green Lake, which partially overlap one another, the waters of one of them flowing eastward to join the discharging stream of Green Lake, and the other northward to join the lake of Three Mountains. On the Lake of Three Mountains the valley is represented by the channel which lies between the main shore, on the south-west side, and the only large island of the lake. The limestone is seen in this part of the lake, and exposures are met with a few hundred yards inland from the lake. The belt occupies nearly all the space between the north-western end of the Lake of Three Mountains and the next lake to the westward, and turns up the valley of the tributary which falls in on the left side of the connecting stream. In this valley the heaviest bed of limestone of the belt keeps in the channel of the brook, which is pretty straight, and reaches the long, narrow marsh which has been mentioned, the upward bearing of which is N. 30 E.

At the north-western head of the Lake of Three Mountains, about ten chains up the brook which falls in there, a rock occurs on the east side of the calcareous belt, composed of masses of pure white albite, several feet in diameter, and shewing large striated cleavage surfaces; inclosed in it are masses of translucent quartz, some of them a foot in diameter, and large crystals of greenish-brown and black mica. The rock may be intrusive, but it is in contact with micaceous gneiss, and there may be limestone on the east of it, as there certainly is on the west, beyond which garnet-studded gneiss is seen, the feldspar of some of which is albite. The gneiss forms a pretty thick band; limestone occurs on the west side of it; garnet-studded quartzite follows, interstratified with one or two thin calcareous beds, and hornblendic gneiss limits the whole, the breadth of the belt being about 450 yards; it will be observed that as far as traced, about eight miles, the band maintains a course parallel in a general way to the curves presented by the Grenville band, on the west side of the trough, from a position opposite the Silver Mountain to that at which its investigation ceased.

The valley in which occur the two lakes next west of the Lake of Three Mountains, lies across the measures, and displays bold hills of gneiss on each side. The three small lakes farther on, which supply these two, occupy a valley coinciding with the strike. In it another band of limestone occurs, running parallel with the previous one as far as traced, the distance however scarcely exceeding two miles. The band appears to be interstratified with one or two layers of gneiss, and the breadth including these, is about three hundred and fifty yards.

The two outside calcareous zones on the western side of the general trough, are of course considered to be equivalent to those on the eastern, and the bearing presented by the whole three bands on the opposite sides, as the investigation now stands, are such as would bring each pair of equivalents to a junction northwards, unless they become deflected by the influence of undulations. There appears to be some probability that the opposite sides of the uppermost deposit will meet somewhere in the vicinity of the Iroquois Chute, but nothing can be said in respect to the farther distribution of the inferior two without additional exploration.

Within the trough, connected with that part of the distribution of the Grenville band which runs from Sixteen-Island Lake, and passing through Balsam Lake follows its discharging stream to Round Lake, there are three small lakes that require to be noticed. One of these, called Proctor's Lake, is situated on the thirty-first lot of Montcalm, on the line between the second and third ranges. The stream discharging it is at the southern end, and it has been traced to the front of the thirty-second lot of the second range, whence it is supposed to run into Sixteen-Island Lake. Another of the lakes crosses about the middle of the twenty-sixth, twenty-seventh and twenty-eighth lots of the fourth range. A stream flows into it on the south side, on the twenty-eighth lot, and the upward bearing of the valley points towards Proctor's Lake. The outlet is at the west end, and the discharging stream flows into Little Black Lake, which is on the twenty-first and twenty-second lots of the same range, and constitutes the last of the three lakes. Its discharging stream joins a small expansion of the Balsam Lake brook, in the same range.

A band of calcareous rock, varying in thickness from ten to fifteen feet, was traced through the three lakes mentioned, from a position on the discharging stream of Proctor's Lake, about a quarter of a mile from the front of the thirty-second lot of the second range. Its course, as far as traced, bears a general parallelism with that of the neighbouring main calcareous band, from which its nearest transverse distance is between thirty and forty chains, giving a vertical thickness of about 1500 feet. The difficulty of following so small a bed through the tangled forest induced us to relinquish the search for it at the outlet of Little Balsam Lake; but the existence of two or three lakes, further south than Proctor's Lake, in nearly the same relation with respect to Sixteen-Island Lake that Proctor's Lake bears to Balsam Lake, makes them probable positions in which to meet with it.

Though this bed overlies the main Grenville band, it is not supposed to be equivalent to that of Morin, but to be a deposit intermediate between the two, and a great way beneath the Morin rock. If this be the true sequence, it will follow that the Grenville band, with the Proctor's Lake bed above it, should be repeated between Montcalm and Morin, on the east side of an anticlinal axis that must run in a direct line east of north through Howard. There is not much doubt that the repetition of the Grenville band will be found in a northern continuation of the limestone of Lake Louisa; one traverse, however, which has been made between Montcalm and Morin, by the town line common to Howard and Wentworth, has not been successful in detecting any calcareous exposures; but several drift-covered gaps were met with sufficiently wide to permit the outcrop to pass without being observed.

From what has been said, it will be observed that in the present state of the investigation, without counting the Proctor's Lake bed, which is too small for separate consideration, there appears to be a sequence of four important bands of crystalline limestone in the Laurentian area examined. The wrinkled condition of the strata however is such that in a space of not more than fifty miles by twenty, one of the bands exhibits an outcrop exceeding 200 miles in length, and this renders it very difficult to determine with precision the volume of rock in which the four calcareous bands are enclosed; but according to the best estimate I have been able to make, it appears to me that the following would be an approximation to the thickness of the various constituent parts of the mass, arranged in ascending order:—

1. Gneiss composing the Trembling Mountain. Though the mass has not been especially examined, nor any geographical position shewing its inferior limit ascertained, yet the general aspect of the mountain induces the supposition that it must be of great thickness, and it is presumed that it will exceed the volume here given........	5000
2. Crystalline limestone of Trembling Lake........	1500
3. Gneiss between the limestone of Trembling Lake and that of Great Beaver Lake........	4000
4. Crystalline limestone of Great Beaver Lake and Green Lake, including two bands of interstratified garnet-studded rock and hornblendic gneiss, which may equal half the amount........	2500
5. Gneiss intermediate between the limestone of Great Beaver Lake and Long Lake, and the Grenville limestone on the Rouge at the Iroquois portage, the lower part having several bands of garnet-studded gneiss and quartzite, and the upper part much coarse grained porphyroid gneiss........	3500
6. Crystalline limestone of Grenville, in some parts interstratified with a band of gneiss. The thickness appears to vary from about 1500 feet to 60 feet, and may be estimated at about........	750

8. Gneiss intermediate between the limestone of Grenville and that of Morin. This would include the rock of the Three Mountains, the limestone of Proctor's Lake, the quartzite of Quartz Mountain, and the gneiss which overlies it. The nearest geographical approach of the two bands that has been ascertained is about two miles, and the present estimate of their stratigraphical separation is not perhaps extravagant....................................	5000
8. Crystalline limestone of Morin....................................	500
	22750

DRIFT.

The more recent deposits observed on the banks of the Rouge, where they were undisturbed by fluviatile action, were clay in the lower part of the river, and sand and gravel in the higher. An undisturbed deposit of clay is seen on the left bank of the river, on the fourth range of Grenville, in a high cliff, where the clay fills up the inequalities of the round-backed gneiss rocks on which it rests. The height of the cliff was not measured, but it may be abont 125 feet. The clay appears to reach from the top of the cliff to the level of the river, which is here about 280 feet above Lake St. Peter, while the smooth worn gneiss protrudes through it in different parts.

In the rear of Grenville and front of Harrington, not very far removed to the eastward of the Rouge, there spreads out a flat surface of several hundred acres in extent, which is underlaid by clay. A brook, called the Big Gulley Creek, runs though it on the twenty-sixth lot of the eleventh range of Grenville. The ravine in which it makes its way is in different parts probably from 140 to 150 feet in depth, and it shews on each side an evenly stratified argillaceous mass of a blue color, which would be an excellent material for the manufacture of common bricks. Between the western margin of this plain and the river there is interposed a low ridge of Laurentian strata, so that a comparison of levels does not immediately strike the eye; but judging from the relation of the brook and the river, it appears probable that the height of the plain would be about 500 feet over Lake St. Peter.

The Devil's River winds in a very tortuous course through a narrow drift-plain, which occupies about three miles of the lowest part of its valley. The banks of the river are from ten to twenty feet in height, and where these have been broken down by the recent erosion of the stream, they uniformly display a yellow sand, sometimes deeply stained with peroxyd of iron. The height of the plain over Lake St. Peter would be about 550 feet.

The plain of the Three Mountains has been much broken up and modified by the action of the Rouge. Many facts exist to shew that the river has very frequently changed its course, and has mixed up with the debris of the original plain, material brought from a distance by the stream. Some parts however of the ancient plain still remain; these shew an elevation of about thirty feet above the ordinary summer level of the river, which would give them a height of about 585 feet over Lake St. Peter. They consist in general of sand or fine gravel at the top, with clay interstratified towards the lower part, but the sand greatly predominates. The coarser material of the drift appeared to be all derived from Laurentian rocks.

The surface of these rocks, in almost all the parts examined, presented rounded forms, and parallel grooves resulting from glacial action, were observed in several places. The following is a list of the positions and of the bearings of the grooves :—

1. On the left side of the Rouge, at a very sharp turn, about three-quarters of a mile in a straight line down the east side of the valley from the lower end of the Horse-shoe portage, and about half a mile above the position where the limestone divides into two bands between the Crescent Lake and the Hive ridge .... S. 12 E.
2. On the right bank of the Rouge, a mile and a quarter up the valley in a straight line above Huckleberry Fall.. S. 5 W. & S.
3. On the left bank of the Rouge at the Dog Rock, lot 31, range 1, of Desalaberry .... S. 30 E.
4. On the left bank of the Rouge, lot 13, range 3, of Arundel.. S. 10 W.
5. On the left bank of the Rouge, just below the Island Chute, lot 18, range 3, of Arundel............... S. 20 E.
6. On the right bank of the Rouge, at the head of the Dog Rapid, lot 22, range 10, of Harrington........ S. 25 W.
7. On the left bank of the Rouge, at the head of the Mountain Chute, north half of lot 17, range 4, of Harrington .... S. 7 W.

8. On the left bank of the Rouge, about thirteen chains below the mouth of a brook near the town line between Harrington and Grenville................ S. 15 W.
9. On the east side of Trembling Lake, half a mile below the east town line of Grandison................. S. 25 E.
10. On the front of lot 8, range 6, of Grenville......... S. 10 W., S. 20 W.
11. On the road between lots 2 and 3, middle of range 6, of Grenville.................................. S. 7 W.
12. On the road between lots 2 and 3, middle of range 5, of Grenville.................................. S. 5 W.
13. On the middle of lot 9, range 4, of Grenville....... S. 13 E.
14. On a promontory, east side of Lake Louisa, about middle of lot 12, range 2, of Wentworth.............. S. 20 W.

The bearing of the grooves in the first position coincides with that preserved by the valley on the side of which they occur, for a mile above and a mile below them. Between it and the second position there are three gentle turns in the valley of the river, in the upper two of which, the one south and the other east of south, no grooves were observed, while the remaining one was marked by the grooves of the second locality.

The rock prevailing at the second locality is crystalline limestone, but it is interstratified with beds and irregular masses of quartzite, and the strata are tilted up to an angle of sixty degrees. The general surfaces of the exposures have rounded forms, coming down to the margin of the river and sinking beneath the water, but the parallel groves appear only on the upturned edges of the quartzite, which stands out boldly and sharply from the limestone, six or nine inches. No doubt when the grooves were formed, the limestone and the quartzite presented a uniformly smooth surface, but the softer and more soluble material has since been worn or dissolved away, while the other remains without apparent change. If any estimate could be made, shewing the rate at which the limestone has been destroyed, it would be a means of establishing the time at which the groves were formed. The effect of the water of the river on the limestone might perhaps be ascertained by experiments, but it would be difficult to determine how long or how much the surface may have been protected from solution by a covering of drift before the river ran over the beds. The bearings of the grooves coincide with the course of the valley for two miles and a half, partly above and partly below the locality.

The third locality occurs where the valley of the Rouge, after having followed the bearing of the calcareous trough in which it flows from the Hive Mountain to the Huckleberry Chute, breaks through the gneiss hills bounding the limestone eastward, to assume again a bearing west of south farther on ; the grooves at the third locality in some measure coincide in direction with the change in the valley, as they do farther on at the fourth locality, where the valley changes again. The valley maintains the bearing of the grooves of the fourth locality for between two and three miles, and is then deflected to the south and a little to the east of it, though not so much to the east as the bearing of the grooves at the fifth position, which would be a continuation and augmentation of the deflection. The grooves however here coincide with the strike of the limestone and the gneiss on the west of it, and it is difficult to say how deep a valley may be worn in the limestone farther on, as it becomes immediately covered up with drift.

The bearings of the grooves in the sixth and seventh localities accord in a general way with the direction of the valley. At the spot where the seventh occurs however the flow of the water is nearly at a right angle to the grooves; for at this spot the river makes a sudden turn to the west, toward a deep narrow gorge in the gneiss through which it rushes to form the Mountain Rapids; while a depression continues on to the southward in the bearing of the grooves over a limestone trough bounded on each side by bold ridges of gneiss; the ridge on the west being a continuation of the gneiss of the gorge and the Mountain Rapids. The grooves of the eighth locality are in the direction of the valley which the river attains after leaving the Mountain Rapids.

The grooves on Trembling Lake, in the ninth position, coincide with the direction of the valley of the lake and the flank of the Trembling Mountain which limits it on the east.

The tenth locality is in a valley of limestone, the bearing of which, coming from the north, coincides with that of the grooves, though the valley assumes more westing a little farther on while crossing a mass of intrusive syenite, but no grooves were observed where the change occurs. The eleventh locality is also in a valley of limestone, forming the termination of a trough, and shewing a depression out towards the Silurian plain to the southward. The bearing of the grooves agrees with that of the valley.

The twelfth and thirteenth positions are on surfaces of intrusive syenite, where the bottom of a depression gradually descends to the Silurian plain to the southward. The bearing of the depression coincides with that of the grooves.

In the fourteenth locality, that of Lake Louisa, the bearing of the grooves coincides with that of the depression containing the lake, and particularly with the direction of the east bay and the limestone valley running southward from the exit.

It would thus appear that in every one of the above instances, which are all that were observed, the grooves have such a relation to the valleys in which they occur, that the limits of the valleys appear to have guided the direction of the moving masses producing them.

The Rouge appears to bring to the Ottawa a considerable supply of sand, and it is probable that the great sand bank which occurs in the bay above the village of Grenville derives a large portion of its material from that source. In the navigable parts of the tributary great banks of sand appear above the surface of the water when the stream is at its lowest level, and these are known to be considerably modified in shape after every freshet, the sand being gradually shifted farther and farther down the valley. The sands are no doubt derived from the deposits accumulated in the upper part of the drift, and the instances met with of newly broken banks and ancient river channels afford numerous proofs of the erosive forces in operation.

The remains of ancient channels sometimes appeared in the shape of narrow crescent or horse-shoe lakes, close upon the margin of the existing stream. These are formed by the curves at the upper and lower extremities of a circular sweep in the river gradually wearing into one another and producing a shorter and therefore more sloping channel for the water. The stream flowing through this new channel leaves still water in the previous circular sweep, and the eddies formed at the extremities of this permit an accumulation of sand or silt, which ultimately closes them up and converts the part thus cut off into a lake of the form in question.

One of these was observed near the mouth of the Devil's River. The breadth clearly indicated that it was once a part of this tributary which had been cut off by a change in the channel of the main stream. Another was the Horse-Shoe Lake, giving a name to the portage in the plain of the Three Mountains. This lake, in the line of the curve, is three-quarters of a mile long, and from sixty to ninety yards wide, which is about the breadth of the present sweep in the neighbourhood. The lake shews an interference with an older channel, now filled up by a serpentining tamarack swamp of several miles in length. This also presents a breadth of about the same measure as that of the river, and in some places it lies between banks of thirty feet in height, composed of the original drift, while in others it has cut through still more ancient channels by which the original drift had been broken down. The best part of the farm of the Three Mountains appear to be a portion of the plain which has been modified by the action of the river. It consists of an area on each side of the stream of considerable breadth, on a level some fifteen feet lower than the original drift-plain by which it is bounded. Pines of large dimensions appear to have been abundant on the surface of the original drift-plain of the Three Mountains, much of which has been destroyed by fire ; but, on the parts modified by fluviatile action, maple and trees of other descriptions occur indicating a better soil.

Economic Materials.

The minerals of economic value to be sought for as belonging to the Laurentian series of rocks, have been alluded to in different previous Reports. Most of these minerals are associated with the crystalline limestones of the series, and several of the localities in which some of them were met with in the more southern part of the area to which the geological description in this Report refers, were noticed in the Report of 1856. In the more northern part, the limestone itself constitutes the mineral of chief importance, more particularly in respect to its relation to the land capable of settlement which almost always accompanies it, but the localities in w ich it is to be met with in the area in question have already been noticed in sufficient detail in what precedes. A few more localities of Laurentian economic minerals, however, have been ascertained in some parts of the country heretofore partially examined, and the practical test of mining has been applied in others to deposits which have been mentioned in former Reports. To these, as well as to minerals connected with the area of my personal explorations, it may be proper to draw attention.

Magnetic oxyd of iron.—One of the economic minerals associated with the Laurentian limestones is magnetic oxyd of iron, but the number and sequence of these calcareous bands being still a subject of investigation, it may be for some time doubtful whether the iron ore characterises one or several of them, and how those holding the ore may be related in sequence to the rest. Of the four bands of which the sequence has been ascertained, the upper and the two lower ones have not been followed sufficiently far to give much significance to the fact that they have not afforded any indications of the ore. But the Grenville band, of which the examination has been so much more extended, cannot as yet be said to give much promise of the mineral. Indications of it however were observed by Mr. Lowe, on the south side of Gate Lake, in the twenty-sixth lot, of the sixth range of Wentworth. Here according to his description two sets of beds, about a hundred yards apart, were traced for half a mile on the strike, which was N. 20 E. The ore ran in straggling layers of an inch or so in thickness, of which several in each set continued for short and irregular distances parallel to one another, often breaking into a succession of bunches or lumps of the size of musket balls. The ore was held in gneiss interstratified in the limestone, and many spots and crystals of the oxyd of iron marked the whole of the rock. In some parts of the farther extension of this band of limestone, the ore may possibly increase in quantity sufficiently to become available.

The great difference in bulk between the articles which in the course of trade are brought down the valley of the St. Lawrence, and those returned, produces a competition for back freight, which reduces it to a minimum rate ; and one of the results is a growing inquiry for various crude materials to be obtained on the route, which can with advantage be applied to useful purposes at certain distant places ; but the required value of the materials is so low that they cannot bear a heavy charge for carriage. Among these materials is to be enumerated the magnetic oxyd of iron. When this ore, with a produce of between sixty and seventy per cent. of pure metal, can be laid down at the smelting establishments of Pittsburgh, and other places at a price not exceeding about five or six dollars the ton, a ready sale may be found for a considerable quantity ; and a trade is in consequence gradually springing up between some of the iron-smelting localities of Pennsylvania, and shipping ports on the route which are favorably situated in respect to deposits of the mineral. The ore has been sent to Pennsylvania from Lake Champlain, but a more convenient position for export is Kingston on Lake Ontario, to which there is an easy access by the Rideau Canal, from some of the most important of the Canadian deposits. The first Canadian exports of the ore from Kingston, were the produce of the great deposit in Hull, from which since 1855, about 8000 tons have been forwarded ; but during the last season about 2000 tons were mined and exported from the still more favorably situated deposit of South Crosby near Newboro, on the Rideau Canal. A stock of the ore is held constantly ready at Kingston, and the price at which it is placed on board of lake craft there, is I am informed $2¼ the ton.*

* The Newboro iron-ore bed, which has a breadth of about 200 feet and is situated in the twenty-sixth and twenty-seventh lots of the sixth range of South Crosby, on Mud Lake on the Rideau Canal, has been described in a previous Report. The trade in the ore has naturally excited a keen search for other

Galena.—This ore of lead is another of the minerals that are to be looked for in connection with the limestones of the Laurentian series; but as in the case of the magnetic oxyd of iron, it is not yet determined whether it specially characterises one or more of the bands. None of it was met with in the calcareous exposures in the district of the Rouge, but I have been informed by Mr. McFarlane, formerly connected with the smelting forges of St. Maurice, that several veins holding galena have recently been discovered in the township of Bedford, not very far removed from those lodes which have already been described by Mr. Murray, in the twenty-first lot and near the line between the eighteenth and nineteenth lots of the eighth range of the township.*

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deposits in favorable positions, and Messrs. G. Chaffey and Brothers, who mine the South Crosby ore, have informed me that this search has been rewarded by the discovery of the continuation of the ore bed across the first and second lots of the sixth range of North Crosby. They have also informed me that a deposit of ore has been met with on Black Lake in the eighth lot of the fourth range of Bedford, and another one on the sixth lot of the third range. These may be a continuation of the bed which has been described by Mr. Murray in a previous Report as existing on the twenty-first lot of the ninth range of the same township.

The ore bed of Hull was opened and mined by Messrs. Forsyth and Co., iron smelters of Pittsburgh. Their chief object in the enterprise appears to have been the supply of the ores to their own smelting works. The ore was transported from Hull through the Rideau Canal to Kingston, and stocked there ready for shipment by lake craft to Cleveland. But the Newboro bed being much nearer to Kingston, and more favorably situated for loading into canal barges, the ore from it can be placed at the shipping port at a lower cost; and Messrs. Forsyth & Co., now taking their supply from Messrs. G. Chaffey and Brothers, have ceased for the present their operations at Hull. Messrs. G. Chaffey and Brothers, I understand have this season exported about 4000 tons of the Newboro ore, making with last year's export 6000 tons, and from this deposit and that of Hull, I am informed that there have been shipped from Kingston, up to the present time (December 1859,) about 15,000 tons.

* Mr. Weston Hunt of Quebec, who is the proprietor of the lodes described by Mr. Murray, and I believe of the newly discovered lodes, has favored me with specimens from the latter. He informs me that there appear to be five new lodes, running nearly parallel to one another in a bearing approaching N.W. and S.E. and all comprehended in a breadth of a little over a quarter of a mile. According to his information they are upon the nineteenth lot of the seventh range of the township, and would be less than the length of a lot to the westward

In the Report of 1851–2, Mr. Murray makes mention of the occurrence on the second lot of the eighth range of Lansdowne of a vein composed of galena disseminated in a gangue of heavy spar and calc spar, which had been unsuccessfully tried as a lead mine. Subsequent to his visit to the locality a lode was discovered on the third lot of the same range, from which specimens were obtained in 1855 for the Paris Exhibition. A trial shaft had been sunk on it to the depth it was said of fifty feet, and a sufficient quantity of ore obtained to pay the expense of sinking. The specimens procured by me, and the mass of ore exhibited to me, shewed a thickness of between two and three inches of pure galena associated with calc-spar. I was informed that other lodes existed in the neighbourhood, but their position was kept secret. The two which had been tested are parallel to one another, with a bearing approaching to N.W. and S.E.

The bearings given by Mr. Murray to the three lodes examined by him in Bedford are N. 15 W., N. 32 W., and N. 85 W., the last being the course of the lode traced and tested farthest. The distance between the Bedford and Lansdowne lodes is not much over twenty miles, and considering the differences that may be allowed for the gentle windings which usually exist in the courses of metalliferous veins, it appears not at all improbable that the lodes of the two localities may be identical, or belong to one group, the bearing of the two positions being about N. 68 W. and S. 68 E. of one another. If a line from the Bedford to the Lansdowne lodes were continued twenty-five miles farther it would cross the St. Lawrence and strike Rossie in Lawrence County, New York, where a group of well known veins of lead ore exists, some of which, though just now abandoned, are not supposed to be exhausted, and two of which are known at one period to have yielded a great quantity of ore.

The rock cut by the lodes at Rossie is of the Laurentian series, but a line between Rossie and Lansdowne would intersect the outcrop of the Potsdam sandstone which lies between Rossie and the St. Lawrence. It has been ascertained

of the lodes in the same numbered lot mentioned by Mr. Murray. One of the masses presented to me by Mr. Hunt, weighs twenty-eight pounds, and shews a breadth across the vein of five inches of pure galena, which is associated with sulphate of barytes or heavy spar and calc spar.

that a vein of lead ore cuts through this sandstone at Redwood, which would not be far from the position of the line to Lansdowne. It is thus not improbable that there is a group of lead lodes running from Rossie to Bedford, and this metalliferous line appears well worthy the attention of explorers in search of lead ores. The dislocations in which the lodes exist are of course thus proved to be of a more recent age than the Potsdam sandstone, but this by no means establishes that the older rock may not be the source of the metal.

In 1853 Mr. Richardson ascertained the existence of a vein of galena on the third lot of the sixth range of Ramsay belonging to Mr. J. McLean; an analysis of the ore was reported by the chemist of the Survey, and specimens of it were shewn in Montreal as part of the contribution intended for the Paris Exhibition in 1855. The subsequent exhibition of specimens from the same locality in the Museum of the Survey has led to a practical trial of the vein during the last summer. A shaft of five fathoms in depth has been sunk on the lode, and about seventy-five fathoms in the plane of it having been excavated, they have yielded about twenty-six tons of galena containing eighty per cent. of pure lead. The bearing of the lode is from N. 45 W. to N. 50 W., its underlie being to the north-east. The breadth varies from two and a-half to five feet, and the ore-bearing part from eight inches to occasionally two feet. Judging by the eye, the produce of the lode in galena of eighty per cent. may vary from nearly dead ground in some places to as much as nearly two tons to the fathom in others. The rock which the vein intersects is an arenaceous limestone, the fossils of which prove it to belong to that division of the Lower Silurian series which is known as the Calciferous sandrock. In the bearing of the lode the base of this formation crops out about a mile from the shaft, and it is succeeded by the Potsdam sandstone, which prevails for three quarters of a mile farther, beyond which the gneiss and limestone of the Laurentian series present themselves.*

* Founding his opinion on lithological characters and stratigraphical sequence Professor Hall is I believe disposed to regard the lead-bearing rock of Missouri as of the age of the Calciferous formation, but the want of fossils in the Missouri rock must of course render the identification somewhat uncertain.

Sulphurets of Copper.—In the Report of 1851–2 the pyritous sulphuret of copper was mentioned by Mr. Murray as occurring in the Laurentian series in small quantity in a vein of calc spar, on which an unsuccessful trial shaft was sunk on the twenty-fourth lot of the tenth range of Bastard. He alludes also to its occurrence in loose masses of several pounds weight on Gananoque Lake in the same neighbourhood. One of the masses brought to the Museum weighs between seven and eight pounds. It is of great purity and contains upwards of

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The Ramsay rock is undoubtedly the Calciferous, but whether the Missouri be so or not, the masses of galena which occur in it as well as those of Wisconsin, the rock of which from fossil evidence is considered to be of the Hudson River formation, are not the same in their mode of occurrence as those of Ramsay. The Wisconsin and Missouri masses, though considerable, never run deep. As described by Mr. Whitney, they do not occur in true veins, but fill up fissures, druses or vertical and horizontal caverns, which do not owe their existence to dislocations, and are confined in vertical range to a certain set of strata of no very great thickness. The Ramsay ore on the contrary occurs in a true vein, filling a crack connected with a dislocation, and on a late visit to the mine, I had an opportunity of observing a clear evidence of this in one of the walls of the lode, (both of which are well defined,) in the parallel grooves occasioned by the grinding of the terminal edges of the strata on the opposite sides of the crack when the displacement happened. Whatever quantity of ore the lode may carry with it there is little doubt of its great depth, a depth to which indeed no certain limit can be placed. In addition to the Calciferous sandrock the lode will intersect the Potsdam sandstone and the Laurentian series beneath, and in this respect resemble the Rossie lodes. Little hesitation can be felt in pronouncing it to be a lode of the same age as these, and the interesting fact is now for the first time shewn that not only these lodes, but probably all the yet known lead veins of the Laurentian rocks, are newer than at least the Calciferous formation, and possibly than some of the formations above it, thus extending considerably the area in which such veins may be looked for.

There appear to be indications of other lodes with nearly the same bearing as the one opened at Ramsay, not far removed from it, and it may belong to a group, which running parallel with the Bedford and Rossie group, would be about forty miles distant from it to the north-east.—Additional excavations have been made on the Ramsay lode during the last summer (1859) and the company who have mined it have erected a smelting furnace and reduced a large portion of the ore obtained. A ten horse-power engine is used to give blast to the furnace and pump the water from the mine. The shaft has been sunk to the depth of seven and a-half fathoms, but a considerable spring of water having been struck, it will require a much more powerful engine to make an effectual trial on the lode, of which it appears to me well worthy.

thirty per cent. of copper. No rock is attached to it, and the only foreign substance associated with it is hydrated peroxyd of iron in leaves as thin as paper, which run in what appear to be natural joints, while the masses are quite free from green carbonate. The source of the masses was not discovered.

In the same Report Mr. Murray mentions the occurrence of specks of copper pyrites as characterising a six-inch bed of magnetic oxyd of iron interstratified in gneiss on the seventh lot of the second range of Escott, the property of Mr. W. Way. Subsequent to Mr. Murray's visit a cutting having been made for the convenience of the Grand Trunk Railroad at the spot, the bed became more exposed. The sub-contractors engaged in the excavation collected the iron ore as they proceeded in their work, with the view of selling it, but threw aside considerable masses of another mineral which they conceived to be iron pyrites. On presenting some of the specimens however to the Museum of the Survey in 1857, they were made aware that the rejected mineral was copper pyrites. The masses obtained so strongly resemble those from Lake Gananoque that it appears probable the two come from similarly characterised deposits. In the Escott bed six or eight inches in thickness were nearly pure copper pyrites, in which thin leaves of hydrated peroxyd of iron ran in cracks or joints, while green carbonate was absent. In some parts calc spar was present in short thin veins and small specks, and iron pyrites was disseminated in others, increasing in quantity as it approached the north-west side, into which the copper ore appeared occasionally to run in small strings for short distances. The magnetic oxyd of iron occupied about six inches of what was considered the under part of the bed, while the greatest width of the cupriferous portion was about ten inches. This portion appeared to be of a lenticular form, extending not much more than twelve feet continuously in the run of the bed. I understand that between eighteen and twenty tons of the copper ore were obtained, but after this bunch became exhausted I believe no excavation was made through the dead ground in search of a farther quantity. On testing the iron pyrites, Mr. Hunt has detected in it traces of cobalt, and as cobalt and nickel very generally accompany one another, the latter may very reasonably be expected in this deposit.

By British practical miners, copper ore when occuring in beds seems generally to be considered less certain than when found in well defined lodes. Yet it is in the stratification that the ore is obtained in the copper slates of Germany, which have been profitably worked for a great length of time; and the copper deposit of Fahlun in Sweden, which has been mined for hundreds of years, is supposed to be subordinate to the strata. The prodigious mounds of copper slag accumulated by the Romans at Rio Tinto in Andalusia in Spain, from the smelting of the ore of that neighbourhood, show that its mines must have been productive for many centuries, and I believe they still continue to yield a profitable result; the copper ores there, are disseminated in a thick bed of iron pyrites. Interstratified deposits have yielded the copper ores which have for many years been shipped in such abundance from Cuba to Swansea; and from Sir Roderick Murchison's description of the copper mines of the Ural Mountains, it is evident that the ores there occur in deposits of a similar character.

In the Reports of the explorations made by the Survey on the south side of the St. Lawrence in 1847 and 1849 it was stated that indications of the pyritous and variegated sulphurets of copper were observed in many localities, usually in the vicinity of certain bands of dolomite, serpentine, soapstone and other magnesian rocks, which in various forms characterise a group of strata lying at the top of the Hudson River formation, and intermediate between what have occasionally been called the Richelieu shales, and the Sillery sandstones. They are equivalent to the rocks of Quebec and Point Levi, and affected by undulations, range through the country between Cape Rosier and Lake Champlain in a very irregular manner, being distributed in long narrow synclinal forms, which carry their outcrops in stretches backward and forward in a general north-east and south-west direction, bending however in some parts towards north and south, and in others towards east and west. Proceeding from the St. Lawrence in a south-east direction the formation is thus found to be repeated a great many times in a transverse distance, which opposite to Quebec would equal nearly fifty miles, whilst at each repetition, the strata, which on the north-east are of a sedimentary nature and show characteristic fossils, become more and more crystalline, and ultimately lose all traces of their organic contents.

When the indications of copper ore in these rocks could be traced continuously to any distance, they in every instance that came under my observation, preserved a direction coinciding with the stratification. In three instances the quantity of ore appeared sufficient to justify the recommendation of crop trials, one being in Upton, another in Ascott, and a third in Inverness. In the first, which occurred on the fifty-first lot of the twenty-first range of the township mentioned, the copper ore, consisting of pure pyrites, was in a mass of greyish-white, and reddish-grey, compact, sub-crystalline, yellowish-weathering limestone, which it intersected in reticulating veins of from one quarter of an inch to an inch in thickness, always inclosed between walls of highly crystalline calc spar, associated occasionally with a little quartz. These reticulating veins constituted bunches, and several of these bunches could be traced in succession in the strike of the limestone. These reticulating veins of copper pyrites did not differ essentially in their arrangement from the thin veins of quartz, which very frequently, and thin veins of titaniferous, specular and magnetic iron ores which less often have been found intersecting the magnesian limestones of this formation in various places, and I presume must be regarded as veins of segregation, filling up fissures which do not pass beyond the limits of the limestone.

A bed of breccia or conglomerate, of which both the fragments and the matrix are calcareous, appears to overlie the greyish-white limestone, and like it is marked by copper pyrites. A reddish-grey limestone quarried in the neighbourhood is supposed to underlie the greyish-white rock, though not seen in contact with it. This towards the top was interstratified with yellowish-white beds, and towards the bottom with red shale; no copper ore was observed in the reddish-grey limestone. The breadth across the whole of the beds may be about a quarter of a mile. The general dip is toward the south-east, and the inclination varies from ten to twenty-seven degrees, but the data are not sufficiently clear to establish the total thickness.

In one of the Reports in question it was indicated that this band of limestone appeared to hold a course from its position in Upton, through the northern portion of Acton, into Wickham, where on the twenty-sixth lot of the last range of the township, it was again marked by the occurrence of copper ore. The bearing of the band in this course would approach to north-east, and about ten miles south-eastward from it another range of calcareous exposures exists in a nearly parallel course, one of the exposures occurring on the thirty-eighth lot of the seventh range of Acton, and another on the eighteenth lot of the ninth range of Wickham, where additional indications of copper ore exist. A third north-eastward run of the same description of limestone extends from the thirty-second lot of the third range of Acton to the fourteenth lot of the tenth range of Wickham, and on both these lots the rock is again marked by copper ore, as well as on the thirty-second lot of the fifth range of Acton, which is intermediate between the other two positions. All these calcareous ranges it was there explained, most probably belong to one and the same band, the first and third being on the opposite sides of a trough-like form which stretches from the neighbourhood of the St. Francis River to Farnham, while the second is due to an anticlinal axis which divides this general trough into two subordinate synclinal parts. Other synclinals present themselves further to the south-eastward, a general description of which was given in the Reports.

The existence of the copper ore on the thirty-second lot of the third range of Acton was I believe, discovered by Mr. H. P. Merrill, and at the request of Mr. Cushing, the proprietor of the land, Mr. Hunt visited the locality in August last. As then seen, before any excavation had been made, the surface presented an accumulation of blocks of copper ore, evidently in place, and covering an area of about sixteen paces in length by ten paces in width. These masses consisted of variegated sulphuret of copper, intermingled with limestone and a silicious matter, without any thing like vein-stone, and evidently constituted a bed subordinate to the limestone, whose strike was about N. E., with a dip to the north-west at an angle of about forty degrees. In continuation of this bed for about seventy paces in either direction, the limestone was observed to hold little patches and seams of variegated ore and yellow pyrites, with stains of the blue and green carbonates of copper. The limestones in the immediate vicinity presented several veins of quartz crossing the strike, but containing only traces of copper.

During Mr. Hunt's visit, a small amount of excavation was made with pick and shovel, and a farther extent of work has been done since, but though this has not added materially to the information at first obtained, there can be no doubt, even should the limits of the deposit extend no farther than those above indicated, that there is here an unusually rich bunch of copper ore*.

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* During the present year (1859,) Mr. Cushing has made an arrangement for the working of the copper ore on his property, and under it Mr. Louis Sleeper of Quebec, (who has heretofore been engaged in mineral explorations in the county of Megantic, and in testing for different mining companies by trial-shafts and other excavations, various quartz courses marked by copper ore in the townships of Inverness and Leeds,) commenced mining the Acton copper ore on the 23rd of September last. After several weeks had been spent in the excavations, I had an opportunity of visiting the mine and of spending several days in the examination of the facts observable in the natural exposures of rock in the neighbourhood, as well as those brought to light by the excavations.

The mine is just half a mile to the south of the Acton station of the Grand Trunk Railway. The road to it is over a marshy piece of ground, and it is crossed by one or two low mounds of yellow sand. At the end of the road, a hill rises to the height of about 105 feet above the marsh, and descends to a marsh on the other side. It stands on a base of a quarter of a mile in width, and for nearly one half the distance is composed of a sub-crystalline magnesian limestone dipping to the N.W. with an inclination varying from thirty to forty degrees. The limestone is light grey in fresh fractures, and weathers to a dull pale yellowish tint on the exterior. It is in some parts studded with concretionary nodules consisting of concentric layers of carbonate of lime with a transverse fibrous structure. The exterior of these is of a botryoidal form, and the layers are in some places partially replaced by chert preserving the fibrous structure. These nodules very much resemble corals, but they also resemble some concretionary forms of travertine, and the occasional intercalation of magnesian layers in the nodules makes it probable they are the latter. As stated by Mr. Hunt the

In the other two instances in which crop trials were recommended the gangue was opaque white quartz from one to two feet in thickness, in which was disseminated the pyritous sulphuret in Ascott and the variegated sulphuret in Inverness. The rock in both cases was described as chloritic and talcose slate.

Subsequent explorations in the townships of Inverness and Leeds by different individuals have led to the disclosure of

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limestone of the hill is intersected by several small veins of quartz, and one of them, more conspicuous than the rest, carries traces of the yellow sulphuret of copper and of galena. The mass of limestone visible, extending a short distance beyond the summit of the hill, has a thickness of about 270 feet. It is divided into heavy beds, in which irregular masses of chert are disseminated in unequal quantities in different places, being most abundant towards the bottom.

The summit of the limestone from the north-eastern corner of the lot proceeds south-westward for about thirty chains, and in the succeeding 300 yards turns gradually south and ultimately a little to the east of south, before becoming concealed. In the other direction, after running some distance, it sinks beneath a marsh on the thirty-first lot of the third range, and again makes its appearance on the rail road, which it crosses about three-quarters of a mile to the east of the Acton station, meeting and crossing the Black River about 220 yards north of it.

The rock underlying the limestone is concealed, but that which immediately overlies it at the mine, appears from partial exposures to be a lavender-grey shale or slate with a cleavage independent of the bedding. In this slate there appear to be irregularly distributed large masses of a harder rock, which is internally of a light olive-green, uniformly and finely speckled with darker green spots, looking like serpentine, many of which are surrounded with a bluish-grey film. The rock under atmospheric influences becomes light yellowish-brown on the surface, and in its weathering strongly resembles some of the serpentines of the Eastern Townships. Some of the masses measure fifty yards in length by twenty in breadth, and on the north side of the rail road there is one of twice those dimensions, apparently sunk into the top of the limestone. Thin layers of the rock occasionally appear to be interstratified evenly among the slates. In thick masses spots of calc spar are sometimes disseminated, giving the rock a cellular and somewhat trappean aspect, but there is no evidence that it is intrusive, and it occasionally assumes the character of a sandstone with small quartz pebbles running in the direction of the beds. In the speckled part of the rock very thin partitions of the same color and hardness as the darker green spots run in several directions. These partitions on analysis prove to be a ferruginous chlorite, and the whole rock may be described as a hydrous silicate of alumina with much iron and magnesia.

These slates and harder masses have a thickness of about eighty-five feet. They are succeeded by isolated masses of limestone of various sizes and somewhat rounded or lenticular forms, some of them attaining magnitudes of thirty yards a considerable number of localities marked by cupriferous indications; several of them have been tested in various degrees by the Megantic Mining Company and others, by shafts and excavations of moderate depths, and at the present time an efficient trial is in progress at Harvey's Hill in Leeds, by the English and Canadian Mining Company, who are pushing

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in length by twenty in breadth, and even eighty yards in length by ten in breadth. As seen on the surface they present a succession of protruding lumps, which run in a line parallel with the summit of the limestone, turning with it to the southward at the south-western part of the exposures. These calcareous masses consist of grey limestone made up of irregular and apparently broken beds and rounded forms, and hold irregular and ragged pieces of chert in more or less abundance, with strings and spots of calc spar. The serpentine-like rock sometimes appears to surround these calcareous masses.

The copper ore appears to occupy a position immediately near the isolated masses of limestone, and very little of it to penetrate into the serpentine-like rock or the slate. Indications of it occur on both sides of the calcareous masses and in some places can be traced as if surrounding them; but the chief part appears to be beneath them and intermediate between them and the slates and serpentine-like rock. The ore consists of the pyritous, variegated and vitreous sulphurets of copper, the second species being the most abundant and the third more abundant than the first. The green carbonate also occurs, but it must be regarded as a secondary product formed at the surface and in cracks. The chief excavation has been made in a cross-cut running S. 45 E., which is at right angles to the strike. The depth excavated is from four to eight feet, and the following is the succession of masses met with in the cross-cut, given in a descending order and reduced to vertical thickness from horizontal measurement.

		Feet.
1.	Limestone; this may be a boulder deeply sunk in the soil, but it is supposed to be in place and to belong to one of the isolated masses of the stratification..........	3
	Concealed..........	3
	Limestone in place, belonging to one of the isolated masses; small irregular spots of the pyritous sulphuret of copper occur in the rock; this is probably part of the same mass as the first three feet, and the concealed three feet would also be a part, making the whole 8 feet..	2
2.	Variegated sulphuret of copper enclosing numerous angular fragments of limestone in irregular aggregations; this mass dipped with the stratification, but thinned out and terminated downwards.........	2
4.	Limestone broken into various sized angular fragments by a number of reticulating cracks of from one quarter of an inch to three inches in width, and filled with variegated sulphuret of copper, with spots of white crystalline calc spar and occasional crystals of transparent quartz..........	15

their work with considerable vigor, under the management of Mr. Herbert Williams. At Harvey's Hill, there occur on the seventeenth lot of the fifteenth range of the township nine courses composed chiefly of quartz with various proportions of bitter spar, chlorite and calc spar, and all holding in greater or less quantities the pyritous, variegated or vitreous sulphurets of

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4.	Breccia or conglomerate with a paste composed of variegated and vitreous sulphurets of copper mingled with fine grained silicious matter, enclosing fragments of limestone, some angular and some rounded; some of them almost wholly calcareous and others largely silicious. The sulphurets of copper run in parallel clouded streaks, the clouded character being occasioned by the presence of more or less silicious matter mingled with the steel-grey and the purple of the two sulphurets	4
5.	Limestone	2
6.	Copper breccia or conglomerate of the same characters as before	4
7.	Limestone	3
8.	Slate with traces of copper (green carbonate on the surface)	12
9.	Serpentine-like rock	14
10.	Slate with traces of copper (green carbonate on the surface)	4
11.	Concealed to the limestone	25
		93 ft.

The thickness of fifteen feet given to the brecciated limestone of No. 3 is deduced from a horizontal measurement of ten yards across the strike and a supposed slope of thirty degrees, which is about the dip of the bed and of the strata where it can be made out in the vicinity. But no clear indication of bedding is visible in the body of the breccia, and as the excavation across it is yet only two feet deep, it may hereafter be proved that by some irregularity the slope is less than thirty degrees; in that case the thickness would have to be reduced in proportion to the diminution of the slope. If the slope should be eighteen degrees the thickness will be ten feet.

The two breccia or conglomerate beds numbered 4 and 6 contain the great body of the copper ore. On the strike these beds are exposed for about eight yards to the south-west. There is then an interruption by the presence of a wall of the serpentine-like rock, which crosses the strike in the shape of a slender wedge coming to a point north-westwardly and gradually spreading out into the strata in an opposite direction. A farther quantity of copper conglomerate, however, exists on the opposite side of this wedge-shaped wall. The condition of the rock to the north-east of the cross-cut has not yet been sufficiently ascertained to give any description of it except from an excavation at the distance of about forty-five yards. Here a mass of ore has been mined for about two fathoms on the strike, commencing with a breadth of nine feet, and irregularly diminishing to the north-westward. Beyond the excavation it appears to diminish farther and probably thins out. On the north-west side this copper. The width of these courses varies from a few inches up to seven feet in the thickest part of some of them. In the trials on the surface, some of them after yielding quantities of copper ore that seemed encouraging, have gradually thinned both horizontally and vertically, and disappeared. To prove

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mass was limited by limestone belonging to the line of isolated masses, and on the south-east by a mass of the serpentine-like rock, the face of which stands in a nearly vertical attitude.

In costeening pits, which have been carried across the strike of the upper part of the ore, at distances of about eighty yards on one side of the cross-cut and 110 yards on the other, indications of ore continue to exist in the stains of green carbonate and small masses of the sulphurets, but the work done is not sufficient to give facts that bear upon the mode in which the ore is connected with the rock.

In so far as the facts ascertained by the present condition of the excavations enable an opinion to be formed, it appears to me probable that the copper ore mingled with silicious matter constitutes the paste of a breccia or conglomerate, the fragments of which have been accumulated in a depression in the surface of the argillaceous and silico-magnesian sediments forming the slates and their associated harder masses, while the sulphurets of copper have been deposited from springs bringing the metal in solution from some more ancient formation. The whole conditions of the case appears to bear a striking resemblance to those of the copper deposits of the Urals as described by Sir Roderick Murchison, except that in Russia the ores are carbonates instead of sulphurets.

However this may be, there is no doubt the mass of ore is a very important one; already, after but nine weeks work, not far from 300 tons have been housed, supposed to contain about thirty per cent. of pure metal. The value of this quantity would be about $45,000, while exclusive of lordship, the mining expenses, and those necessary to carry the ore to a market, will be comparatively small. The quantity of ore excavated appears to have produced but a moderate impression on the total mass in sight.

Whether such another bunch of copper ore will be met with associated with the limestones it is impossible to say; but even should one exist, it would perhaps be too much to expect that it would be found immediately at the surface.

Many of the facts connected with the mode in which the copper ore of the conglomerate is related to the fragments, were ascertained by slitting a slab of the rock by means of a lapidary's wheel and polishing the surface. The same test has been applied to a block of the Upton conglomerate, and it is found that there is some analogy in the two cases, except that the Upton ore is altogether pyritous sulphuret, and much more thinly distributed among the fragments. While large blocks of the Acton conglomerate give thirty per cent and upwards of pure metal, the best blocks obtained by me from the conglomerate of Upton do not yield more than five per cent. But this if the quantity of rock with such a percentage were large and the masses not too widely scattered, would constitute a valuable mine. It would, however, require a careful crop trial to determine whether the quantity is available.

their character more thoroughly in a downward direction an adit is now being driven on the north side of the hill at a level which is thirty-seven fathoms below the summit. This will intersect nearly the whole of the courses, and until it is completed it would be premature to pronounce any positive opinion upon the success of the enterprise.

The rock of the hill is such as has usually been called talcose slate; but though unctuous to the touch, analyses by Mr. Hunt of slates of a similar character in other parts in the vicinity of Harvey's Hill, have shewn that instead of magnesian they are aluminous, and that they should rather be designated micaceous, or as he has called them from their lustre nacreous slates. They are in general whitish or light grey, and are often thickly studded with chloritoid. These slates are interstratified with bands of a darker color, more resembling clay slates, and the darker appears to prevail over the lighter color at the mouth of the adit. The dip of the strata appears to be from N. 10 W. to N. 65 W. with an average slope of between fifteen and nineteen degrees. The bearings of eight of the quartz courses are from N. 15 E. to N. 35 E. while one of them runs N. 75 W. They all underlie to the westward at angles varying from fifty to nearly ninety degrees, and it would thus appear that none of them coincide with the strata either in dip or strike.*

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* On a recent visit to the Harvey's Hill mine, I was informed by Mr. Williams that after sinking on the incline N. 80 E. $<75^{\circ}$, on Fremont's lode near the top of the hill for forty-five feet, the underlie changed to S. 80 W. $<75^{\circ}$ and the shaft being then sunk vertically for seventy-five feet more, a bed of three inches, holding disseminated copper ore, was met with at the depth of twenty-five feet, and another of six inches of the same character fifteen feet farther down, the latter constituting the top of a six-feet bed of soapstone. In this an opening was made for thirty feet each way in the slope of the bed, which met Fremont's lode in the rise, and continued beyond it. At the bottom of the incline a level was driven in the bed for nearly thirty-two feet. The copper ore was continuous the whole of the distances, and may be said to have thus been proved over an area of nearly 2000 square feet in the plane of the bed.

The shaft being full of water at the time of my visit, I had not an opportunity of inspecting the work; but descending another shaft at a distance of about ten chains from the last, in a direction which is nearly in the dip of the strata, I examined what there is little doubt must be another bed. This occurs at a depth of ninety feet from the surface, and allowing for the fall in the surface

Mica.—In the area of my personal explorations, no addition were made to the three localities shewing economic quantities of this mineral, mentioned in the Report of 1856, and allusion is made to the mineral on the present occasion for the purpose of stating that the exhibition of Canadian mica at Paris in 1855,

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between the two shafts, its position would be very nearly twenty fathoms above the upper bed in Fremont's shaft. An opening has been made in the bed of about seventy feet in length by twelve feet in width, partially on the strike, but gradually turning up to the full rise of the strata. In this opening the thickness of the bed, as measured by myself, varies from nineteen to thirty inches. The rock is a nacreous slate, and the copper ore is distributed in the bed in patches generally of a lenticular form; they are usually thin, but sometimes attain from one half to three quarters of an inch in the thickest part, and occasionally present in the section, lines of six inches or even a foot in length. These patches interlock, one overlapping another, with variable distances between, while many single crystals and small spots of ore are disseminated throughout the whole thickness. In some parts the pyritous, and in others the variegated sulphuret prevails, and the quantity of metallic copper in the mass may range from about three to about five per cent, producing an average of about four per cent. The estimate however has been made by the eye and not by assays. Supposing the bed to average two feet in thickness, a cubic foot to weigh 180 pounds, the produce to be five per cent, and one fifth of the copper to be lost in dressing the ore up to twenty per cent., then each square fathom of the bed would yield 1.10 tons of dressed ore of the above produce, the value of which in Swansea would be about $110. If the produce were four per cent the value of a fathom would be $88; if three per cent $66. It is only by an experiment on a large quantity of ore in the way of dressing that the true produce of the bed can be determined.

The mode in which the copper ore is distributed in the nacreous slates of Leeds, precisely resembles that in which it occurs in the bituminous slates of Germany, and it is only the circumstance that the facts known in connection with the Canadian deposits are yet too few to give entire confidence in the persistence of similar conditions over a great area, which should moderate the expectation of an important result. As the copper in the beds is probably contemporaneous with them, it would of course be antecedent to that associated with the courses of quartz, the fissures holding which, it is unnecessary to state must have been formed subsequent to the strata in which they occur. The copper in the courses was probably derived from that in the beds, and though the former, not only in Leeds, but in other parts may in many cases prove to be economically unavailable, it may yet be serviceable as an index to the position of available beds, and materially aid in their discovery. The copper-bearing quartz courses, from contrast of color, are much more conspicuous than the copper-bearing beds, and though the latter from the undulations in the strata, might be brought to the surface in many places, they would not has induced nquiries in regard to it, on the part of Mr. E. Goddier, No. 34, Rue du Faubourg St. Martin, Paris, who has informed me by letter, that for the purpose of several applications of mica, for which he holds patents, he could use about

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readily attract the eye, unless from marks connected with the strata more prominent than the copper ore itself, which at the surface will often have disappeared from the influence of weather. At Harvey's Hill the soapstone underlying the lower cupriferous bed, might prove a serviceable mark by which to trace the copper ore on the surface. The soapstone, known to crop out at a certain distance beyond Fremont's shaft, though its accompanying ore has not been there remarked, could in all probability be followed for a considerable distance on the strike, with very little difficulty. Should the cupriferous character of the upper part prove continuous, which appears to me very likely, the existence of a valuable copper ore deposit might thus be established as probable at a very small expense. Cupriferous beds would of course be subject to the accidents of dislocation affecting the strata in which they are enclosed. One of these appears to affect the Harvey Hill bed where the lower shaft intersects it. At this spot, the copper ore suddenly ceases, and a mass of quartz presents itself, cutting a part of the stratification in a nearly vertical direction, while a little to the eastward, the inclination of the copper-bearing bed suddenly increases from nineteen to thirty-nine degrees. These circumstances combined appear to me to indicate a dislocation with a down-throw to the northward.

The discovery of copper ore, subordinate to the stratification of the magnesian group in Upton, Acton and Leeds, of which the last two instances, and perhaps the first, afford quantities economically available, invest the traces so widely spread in connection with this group in Eastern Canada, with more importance than they previously possessed. These traces are not confined to the more crystalline and altered parts of the deposit, but extend to the portion which is so far unchanged as to be marked by characteristic fossils, and the ores being found to occur mingled with the original sedimentary matter of the beds, there is no geological reason why such traces may not lead to the discovery of economical quantities of the ore at Quebec and Point Levi, as well as in other parts. There are dolomites however in a lower part of Silurian series than this group, and both these dolomitic groups are found to exist below Quebec on the St. Lawrence, the one on the north side at Mingan, and the other on the south side all the way to Cape Rosier, and in various islands near both sides ; and the fossils being the only sure guide by which the one group can be distinguished from the other, the study of these becomes an important part of the investigation.

In the Appendix is given a list of all the positions known to me, in which traces of copper have been met with in what we have sometimes termed the Quebec formation. Though most of these may lead to no available deposits, they will yet serve to shew the wide distribution of the metal.

12,000 pounds annually He could afford to pay the following prices for it according to size.*

From 10 centimeters	to 15 centimeters,	3.75 francs	per kilogram.
15 "	to 20 "	4.50 "	"
20 "		5.25 "	"
25 "		6.00 "	"

Phosphate of lime.—This mineral was met with in small crystals disseminated in the limestone in several places in the district of the Rouge, but no where in sufficient abundance to be of economic avail. Mr. J. McMullan in explorations connected with the Laurentian limestones on the south side of the Ottawa, met with larger crystals disseminated in greater abundance and associated with purple fluor spar in the limestone of Ross, on the seventh lot of the first range.†

Rensselaerite.—The application of this mineral as a refractory material and as serving other purposes was mentioned in the Report of 1856. No instances of it were met with on the Rouge, but Mr. R. Oatey of the Ramsay lead mine, has presented to the Museum specimens of it from the Laurentian limestones in the neighbourhood of that mine.‡

Shell marl.—Fresh-water shell marl was met with in the bottom of Long or Eagle Nest lake, on the twenty-second lot of the eighth range of Wentworth, and in a pond on the fifth lot of the fourth range of Harrington. The quantity in both cases was considerable.

Peat.—A swamp underlaid with peat was met with toward

* The centimeter is in round numbers, very nearly four-tenths of an inch, and the kilogram about two and one-fifth pounds avoirdupois; the franc is about nineteen cents.

† My friend Dr. J. Wilson, of Perth, has informed me, that crystals of the phosphate have been found in great abundance on the twenty-fifth lot of the eighth range of North Elmsley, the property of Mr. George Oliver.

‡ In examining the Laurentian rocks in the neighbourhood of the Ramsay mine, I found a band of Rensselaerite from which the specimens above mentioned were obtained, on the eighth lot of the sixth range of Ramsay. It is on the east side of the lot, toward the front, and runs in a general way with the length of the lot; it appears to be between a bed of quartz on the one hand, and crystalline limestone on the other, and considerable masses might be obtained from it.

the front of the first and second lots of the fifth range of Harrington. It has an area of about sixty acres, and the depth of some parts having been tried was found to be twenty-five feet.

Marble.—On the eighteenth lot of the first range of Wentworth, exposures of white limestone were met with, a somewhat coarse-grained variety of which was spotted with green serpentine, in a manner similar to the marble which has been described in a former Report as obtained on the sixteenth lot of the third range of Grenville. The green spots however seemed to be more uniformly small than those of the Grenville rock, and produced a more pleasing effect.

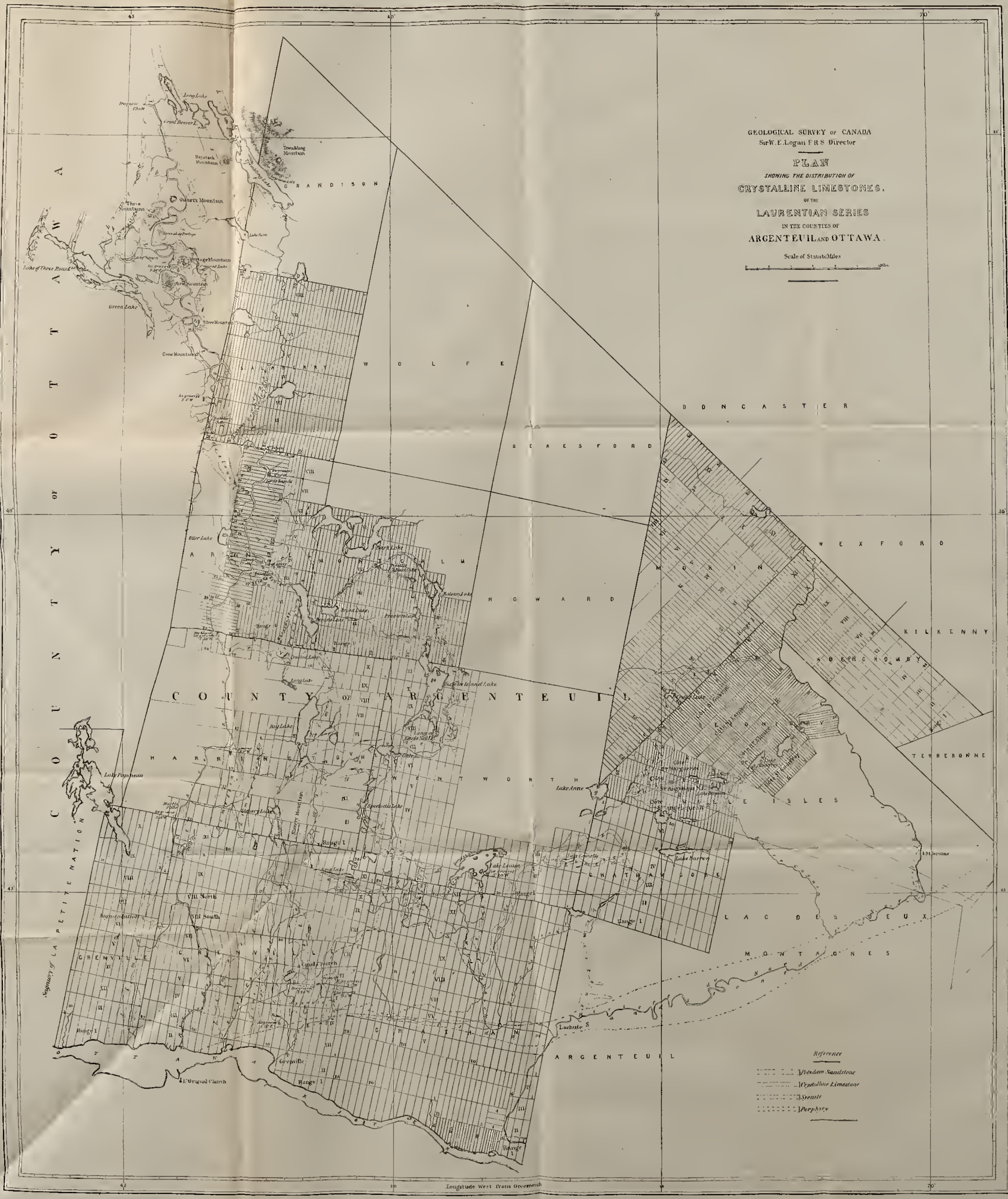
Mr. Lowe has brought me specimens of a limestone from the twelfth and thirteenth lots of the Ste. Marguerite range of Mille Isles, in which spots and streaks of a red color are mingled with spots of green ; a few thin patches of chert are present in one of the specimens. If sufficiently large blocks can be obtained free from the chert, it is probable they would yield a handsome variegated marble.

GEOLOGICAL MAP AND GENERAL REPORT.

The number of township, seigniory and railroad plans which it has been found necessary to copy and reduce in order to represent with truth the topographical features of the country as far as they have been surveyed, and the unavoidable interruptions resulting from periodically recurring new field-work presented to the draughtsman for delineation, have delayed the completion of the geological map which is in progress, much longer than was anticipated. This, however, will afford the opportunity of placing on the face of it a much more correct and connected view of the relations of the Lower Silurian series of rocks in the eastern part of the province than would otherwise have been possible. The delay has also enabled the palæontologist of the Survey to make a more extensive examination of the great accumulation of organic remains which have been collected. In the course of this examination he has published in the Reports and Decades of the Survey, and in the scientific journals of the province, descriptions of upwards of 200 new species peculiarly marking the Canadian rocks, and descriptions of half as many more will shortly appear. With the present knowledge of our materials in this branch of the subject it appears as if it would scarcely have been judicious to publish before this a Report giving a condensed view of our results, in which our own discoveries in palæontology would have necessarily been left out, and in which the student in Canadian geology, in so far as this branch is concerned, would have been made to depend upon what had been done everywhere else but in Canada.

I have the honor to he
Your Excellency's
Most obedient servant,

W. E. LOGAN


GEOLOGICAL SURVEY OF CANADA
Sir W. E. Logan F.R.S. Director
PLAN
SHOWING THE DISTRIBUTION OF
CRYSTALLINE LIMESTONES,
OF THE
LAURENTIAN SERIES
IN THE COUNTIES OF
ARGENTEUIL AND OTTAWA.
Scale of Statute Miles
COUNTY OF OTTAWA
COUNTY OF ARGENTEUIL
GRANDISON
WOLFE
DONCASTER
BERESFORD
WEXFORD
HOWARD
KILKENNY
ABERCROMBY
TERREBONNE
HARRINGTON
WENTWORTH
MORIN
GRENVILLE
CHATHAM
CHATHAM GORE
ARGENTEUIL
LAC DES DEUX MONTAGNES
Seignory of LA PETITE NATION
Lake Papineau
Lake Anne
Lake Barron
Lachute
Grenville
L'Orignal Church
Trembling Mountain
Longitude West from Greenwich
Reference
Potsdam Sandstone
Crystalline Limestone
Syenite
Porphyry

REPORT

FOR THE YEAR 1858,

OF

ALEX. MURRAY, Esq., ASSIST. PROVINCIAL GEOLOGIST,

ADDRESSED TO

SIR WILLIAM E. LOGAN, F.R.S., F.G.S.

PROVINCIAL GEOLOGIST.

MONTREAL, 1*st March*, 1859.

SIR

In continuance of the investigation commenced in 1857 I have been engaged during the last summer and autumn in following out the structure of the copper-bearing rocks on the north shore of Lake Huron, and have examined the portion of country lying between the valley of the Thessalon River and the lake coast south of it, in addition to that between the valleys of the Thessalon and the Mississagui.

Much inconvenience was experienced, especially during the early part of the season, from the difficulty of obtaining good canoe-men. This arose in consequence of the unexpected removal from that part of the country of two gentlemen to whom I had addressed communications on the subject early in the spring, and on whom I had relied to hire men for me. I was thus compelled to employ such hands as happened to be out of work at the time of my arrival, and as none of them were disposed to engage for the whole season, it became necessary to make frequent changes in my crew, and finally to pay off the whole party earlier than was originally intended.

While in the neighbourhood of the Bruce Mines, which I made my head quarters during the earlier part of the season, I re-examined the whole coast from Point Thessalon to Portlock Harbour, making several excursions to the northward between the coast and Thessalon river, and completed a measurement of Walker Creek, and Walker Lake, which is discharged by the creek into Portlock Harbor. Subsequent to this I ascended the Thessalon, a measurement of which had been made in 1848 up to Desert or Thessalon Lake, the second sheet of water from the mouth; I surveyed a third expansion called by Mr. Salter, Rock Lake, as well as the stream connecting the two. The measurement of the main stream being then continued for a few miles above Rock Lake, I left the Thessalon to make an excursion north-westward from it, and join the work with that carried on from Echo Lake the previous season. Many excursions were also made from points on Lake Thessalon, and from the lower parts of the river, both by my assistant Mr. Johnston and myself, in the endeavor to trace as far as possible any well-marked band of the formation, by the aid of which to elucidate the arrangement of the whole series of rocks.

The latter part of the season was employed in examining the country and coast between the Thessalon and Mississagui, and in continuing the measurement of the latter river above the twenty-five miles which had been completed in 1848.

Geographical Characteristics.

It has been remarked in former Reports that the north coast of Lake Huron, in many parts picturesque, appears too rocky near the margin to be suited for agricultural settlement, though likely in time to become of importance to the province by the development of the metalliferous ores, which the geological formation of the region is known to contain. But while this description is applicable to the coast line and the margin of some of the rivers and larger lakes of the interior, it is by no means so to the country in general. On the contrary there are in many parts, especially in the valleys of the Thessalon and its tributaries, extensive tracts of the finest lands, covered with a luxuriant growth of hard wood interspersed with stately pine trees, probably equal in average size to any of the same species known in the province.

In the immediate neighbourhood of the Bruce and Wellington mines and thence to Portlock Harbour, the country is for the most part broken by low rocky ridges, the flat land between which is in general densely covered with thickets of spruce, balsam, or in marshy parts with tamaracks ; but occasional patches display a stout growth of maple and white birch. In many parts the low grounds open out into extensive prairies or marshes, usually well covered with wild grass, and prettily dotted with clumps and little groves of small tamaracks or bushy spruce. The timber on the wooded flats is certainly not such as in general is supposed to indicate a very fertile soil, but much of the surface is nevertheless susceptible of cultivation, and there can be little doubt that with successful mines to produce a market for surplus produce, farming to a considerable extent might be advantageously followed. Admirably adapted for grazing, the prairies might also supply an ample stock of winter fodder for cattle, while nearly all the ordinary spring crops might be raised from the arable portions of the land.

The Thessalon River as heretofore stated empties into Lake Huron in latitude 46° 16′ 2″ N., and longitude 83° 27′ 31″ W. nearly. The upward course, independent of minor turns is a little westward of north for about nineteen miles, within which distance two lakes of considerable size are included, namely Otter-tail Lake between twelve and fourteen miles from the mouth, and Desert or Thessalon Lake at the termination of the distance formerly measured. Above Thessalon Lake the stream takes a northerly direction for about a mile and a half, and then turning easterly for another mile reaches Rock Lake. This lake stretches away to the southward until within about a mile and three quarters of the north shore of Otter-tail Lake, and between the two there is an Indian portage. The main stream falls into Rock Lake near its most northern part, and the general upward course is northerly for about a mile and a half, after which it bears north-easterly as far as we ascended.

Below Otter-tail Lake the navigation of the Thessalon is interrupted by two sets of rapids and two falls, the former severally about six and eight miles and the latter under nine and eleven miles from the mouth of the river. Excepting when the river is swollen by freshets, both of the rapids can be ascended and descended by canoes, but the falls of course require portages to be made. These rapids and falls constitute the only difficulties of navigation as far as we ascended, but I was informed by the Indians that farther up the river becomes very swift and turbulent.

The tributaries of the Thessalon are very numerous, but with the exception of the east branch, which joins the left side about three miles above the mouth, they are all very small, and navigable for only very short distances. Small trading vessels might ascend the Thessalon to the lowest rapid, and no doubt they will do so whenever the country becomes settled or the lumber trade introduced.

Much of the surrounding country is well qualified to sustain the operations of either the farmer or the lumber-man. On a line north-east from the lowest rapid there is a breadth of over four miles, which with the exception of the first fifty or sixty chains, presents either a dead level or a very gently undulating surface, all of which supports a growth of heavy hard wood mixed with white pine, some of the latter measuring from twelve to fifteen feet in circumference. South-eastward of this line, and from one to two miles from the river, a precipitous broken ridge of quartzite and red jasper conglomerate breaks the continuity of the good land, but the ridge dies down farther on and the rich flat land re-appears at the junction of the east branch. From this it appears to extend a considerable distance to the eastward in a belt parallel to the coast of Lake Huron.

The immediate shores of the surveyed lakes of the Thessalon are for the most part bold, rocky and barren, but there are many parts at no great distance from them, especially west of Thessalon Lake and north-westward of Rock Lake, where the land is of excellent quality. The country between Rock Lake and Echo Lake, is marked by a series of high and frequently precipitous parallel ridges ranging about W.N.W. and E.S.E. The valleys alternating with them are in some cases wide and extensive and in others contracted, but almost in every instance they are covered with a luxuriant vegetation of the finest maple, elm and birch, with occasional large sized white pines, and it is only in comparatively few places, where the ground is either swampy or subject to occasional inundations, that tamarack and spruce prevail, while thickets of hemlock frequently fringe the edges of the more abrupt and precipitous ground. The region is spangled with numerous ponds and lakes, some of which are extremely picturesque, and each valley has a stream of excellent water, usually well stocked with speckled trout.

One of the lakes of this part, lying rather nearer to Echo than to Rock Lake was represented in the Report of 1857 as being one of the sources of Echo River. The upward course of this river instead of turning south-eastward to this lake has been ascertained by Mr. Salter to turn north-eastward, and the outlet of the lake in question, which commences with a downward south-easterly course, is now supposed to maintain it to a junction with the stream connecting Rock and Thessalon Lakes, meeting it about a mile below the former.

The Mississagui joins Lake Huron about twenty-six miles to the eastward of the Thessalon in latitude 46° 11′ 13″ N. and longitude 82° 55′ 53″ W. nearly. At the mouth it splits into a series of channels forming a group of marshy islands. Through these channels the river is easily entered either from the east or from the west, and it is navigable up to the Hudson Bay Company's trading post for boats and small coasting vessels. The trading post stands at the union of the channels; immediately above it the current becomes pretty strong, and at the end of about a mile, in which the ascent is about north, the navigation is interrupted by a break in the river.

This sometimes assumes the character of a fall, at others that of a rapid, its condition depending upon that of the great lake below. When visited in 1848 Lake Huron was considerably below its average height, and this part of the river displayed a fall of 3·3 feet ; but on the occasion of my late visit, the lake being unusually high, the fall was reduced to a moderate rapid, and we ascended it without difficulty in our canoes by the aid of paddles. About half a mile north above the fall the upward bearing of the river turns westerly and makes a course nearly N. W. for about thirty miles, presenting however many minor turns in the distance. It then assumes a general bearing of N. N. E. for a little over fifteen miles, and afterwards N. W. for three or four miles more. Here our measurements ceased.

Many tributary streams fall into the Mississagui, but only two of them are of much importance or capable of being ascended in canoes. These are the Pakowagaming and the Little White River. The former joins on the right side about nine miles above the fall, and the latter on the left from fourteen to fifteen miles farther up. The former flows from a suit of fine lakes severally named by the Indians Wahbiquekobing, Wahbiquekobingsing and Pakowagaming. These stretch in a north-westerly direction somewhat parallel to the main stream for a distance of twelve or thirteen miles from their outlet into it, and the head of the largest of the lakes, Wahbiquekobing reaches to within four and a half miles of the Thessalon River. The Little White River is a rapid and tortuous stream flowing from N. E. to S. W. as a general course, as far as we ascended it, which did not exceed from six to seven miles in a straight line.

The navigation of the Mississagui is rendered tedious by interruptions of heavy falls and violent rapids, together with a strong current prevailing for the whole length of its course from the highest part we reached. To illustrate this character, the following estimate of the rise of its channel is given in a tabular form, but being founded on observations by a clinometer level and rough guesses at the rate of the current, it must be regarded merely as an approximation to the truth.

Levels of the Mississagui River.

	Distance. Miles.	*Rise.* Feet.	*Total Dist.* Miles.	*Height above the Sea.* Feet.	
Height of Lake Huron.....				578.00	Lake Huron.
Rise from smooth water at the Hudson Bay Company's post to the head of 1st fall or rapid	1.00	3.50			
——in current between the 1st fall and the mouth of the Pakowagaming estimated at 1.00 foot per mile.............	11.00	11.00	12.00	592.50	Pakowagaming.
——in current between the Pakowagaming and the foot of a strong rapid, estimated at 1.00 foot per mile.............	5.25	5.25			
——in rapid	0.30	5.20			
——in current above the rapid to the foot of a fall, estimated at 0.80 foot per mile, say.....	0.85	0.60			
——in 2d fall.............	0.10	19.50			
——in current above 2d fall to the foot of 3d fall, es-at 0.50 foot per mile..	2.50	1.25			
——in 3d fall............	0.10	18.50	21.10	642.80	
——in current above 3d fall to foot of 4th fall estimated at 0.50 per mile...	0.40	0.20			
——in 4th fall............	0.25	33.25			
——in current above 4th fall to the mouth of the Little White River, estimated at 1.50 feet per mile....................	4.00	6.00	25.75	682.25	Little White River.
——in current above Little White River to the foot of the rapid at the Gd. Portage; the current increasing in velocity with the ascent, estimated at 2.00 feet per mile.....	6.00	12.00	31.75	694.25	Foot of Gd. Portage.

	Distance. Miles.	*Rise.* Feet.	*Total Dist.* Miles.	*Height above the Sea.* Feet.	
Rise in 5th fall and rapids at the gorge of the Grand Portage to foot of 5th fall estimated at......	1.40	18.00			
——in 5th fall nearly vertical..................	0.05	20.00	33.20	732.25	Head of Gd. Portage.
——in current across two pools including a small rapid between, estimated at about..........	0.40	2.00			
——in 7th fall nearly vertical..................	0.03	26.00			
——in current above the 7th fall to the foot of a strong rapid, estimated at about 1.5 foot per mile say..............	2.85	4.00			
——in rapid..............	0.15	4.00	36.63	768.25	Salter's Side-line.
——in current above rapid to the foot of 8th fall estimated at 1.5 foot per mile..................	4.00	6.00			
——8th fall..............	0.20	14.00			
——in a succession of small rapids alternating with swift currents, estimated at 3.00 feet per mile	5.00	15.00	45.83	803.25	Salter's Base-line.
——in a succession of small rapids alternating with swift currents to the foot of 9th fall, estimated at 3.00 feet per mile	10.00	30.00			
——in 9th fall and rapid...	0.10	2.50			
——in current above the 9th fall to the end of the measured distance, being a succession of rapids as before.........	6.00	18.00	61.93	853.75	End of measurement.

The river scenery of the Mississagui is for the most part very beautiful, and much of it, especially above the Grand Portage, is grand and imposing. There is however but little land fit for cultivation and the timber generally is of inferior size and description. A considerable tract north of Lake Pakowagaming has a good soil, and there the Indians have opened up several small clearings ; but it is south of the Lake Wahbiquekobingsing and between it and Lake Huron that the finest land was observed. This appears to be a continuation of the belt of good land running eastward from the east branch of the Thessalon, for I was given to understand from the Indians to whom it has been reserved, that the same character of soil is maintained more or less all the way.

Character and Distribution of the Rocks.

The order of succession in which the various rock masses were found in the area examined last season corresponds with the descriptions given of them as seen around Echo Lake in the Report of 1857. The close resemblance in mineral character of individual strata in one part of the series with strata in another, all equally destitute of organic remains to constitute a distinctive guide, and the frequent large intervals of ground wholly void of exposures, occasionally produce much embarrassment in attempting to identify masses widely apart. The band of limestone which was followed the previous year from Echo Lake is undoubtedly the best characterized feature of the whole series,and were it always exposed,the difficulty of making out the structure would be comparatively small ; but its course appears usually to run in low swampy ground, in prairies or in lakes. It comes to the surface only in small irregular sections, often at long distances from one another, and it in consequence frequently becomes necessary to take what is above or below it as a guide. The position of the limestone band in the series is evidently near the base of the slate conglomerate masses. Slate conglomerate was the superior rock in every instance in which the next succeeding rock above the limestone was seen ; it was generally also the rock below it ; but the lower slate conglomerate appears sometimes to pass imperceptibly into a greenstone or to be replaced by one, and it sometimes has happened therefore, as at the Bruce Mines, that the limestone has been found resting on greenstone, without conglomerate perceptibly near. It was principally by tracing the slate conglomerates of the series, with the actual exposure of the limestone at intervals as a guide, that the conclusions stated in the present Report were arrived at, and the lines of stratigraphical division on the accompanying map were constructed.

But before proceeding to explain the distribution of the rock masses it will be proper to give an enumeration of them as they succeed one another. In the following list they are given in ascending order, with the nearest estimate I have been enable to arrive at in respect to their thicknesses on the line selected for the representation of a vertical section.

1.	Greenish chloritic red-weathering silicious slates; of these the thickness is very doubtful	2000
2.	White quartzite sometimes becoming a fine conglomerate with pebbles chiefly of white quartz; the beds are interstratified with fine silicious slate, and divided by occasional intercalated masses of greenstone	1000
3.	Slate conglomerate and greenstone, the conglomerate generally very coarse, the pebbles consisting chiefly of syenite and gneiss with occasionally some of red jasper	1280
4.	Limestone	300
5.	Slate conglomerate as before, but not so coarse, with interstratified beds of reddish or grey quartzite, and fine compact silicious slate sometimes marked by epidote, with intercalated masses of greenstone	3000
6.	Red quartzite and greenstone	2300
7.	Red jasper conglomerate, the matrix composed chiefly of white quartz sand and many of the pebbles of blood-red jasper; it is interstratified with masses of greenstone	2150
8.	White quartzite frequently of vitreous aspect, generally in massive beds, which are sometimes separated by thin silicious layers resembling chert, and interstratified with masses of greenstone	2970
9.	Yellowish chert in thin and very regular beds interstratified with layers of impure limestone, and green and pale drab very compact slaty layers, with a stratum of red and yellowish fine grained sandstone at the bottom	400
10.	White quartzite frequently of vitreous aspect, occasionally mottled with leaden-grey patches	1300
		16700

The only difference between the preceding list of rock masses and that given in the Report of 1857, in so far as the latter reached in the ascending series, consists in the accidental portion of intercalated greenstone, and the thickness given to the masses. In the present list however there are added three numbers, 8, 9 and 10. Number 9 is the limestone of the Thessalon lakes, which it was suggested in the Report of 1857 might possibly be a continuation of the Echo Lake band, represented above by number 4. It will be found however by what follows, that from the physical structure of the area now examined, the Thessalon band must be much higher in the Huronian series than that of Echo Lake, and that it is not yet quite certain whether there may not be a third partially calcareous band still higher up.

In the investigation of the structure it appears to be one of the results of the season's work, that two main troughs exist in the Huronian rocks of the area in question, divided from one another by an anticlinal axis, which seems to run up the Mississagui for over twenty miles from its mouth, then leaving it to continue a course nearly north-west. These two troughs may be distinguished as the Thessalon and Mississagui troughs, and it will be convenient to consider them separately.

The Thessalon trough may be roughly described as extending transversely from the lower part of Echo River to some point beneath the unconformable fossiliferous rocks to the south-west. The longitudinal axis extends along the valley of the Thessalon from the lowest rapid to the south-west side of Thessalon Lake, and proceeds thence toward the St. Mary River between Little and Great George Lakes. It is divided into several subordinate parallel troughs, two of them arising from an anticlinal form, the axis of which was shown in the Report of 1857 to pass a little south of Echo Lake, and two more occasioned by a similar form at the Bruce Mines, to which allusion was also made.

Resuming the work of the previous year at the Bruce Mines, the band of limestone which was used as the index to the general structure was easily traced for about two miles west of the point near the French Islands, where it emerges from the water. It skirts the shore for rather more than half the distance and then bears off in a N.W. direction for the remainder, presenting a well-marked escarpment to the N.E. Here it suddenly breaks off and the ground beyond becomes swampy ; but south of the supposed continuation of the band, the upper slate conglomerate is largely displayed. The lower part is seen resting on the limestone where the latter leaves the coast, and as it runs westward higher and higher beds come up from the lake upon the shore, until the mass assumes a breadth exceeding a mile, presenting irregular low broken but parallel ridges, generally showing small dips to the south or westward of south. Interstratified with the conglomerate are strong beds of pale reddish and grey quartzite, and layers of fine grained greenish-black and light olive-green silicious slates, some of which yield hones of a very fine description. The slates are well displayed on the eastern shore of Portlock Harbour and on the islands opposite, where it was observed that they were marked by epidote running both in streaks with the layers and in strings across them; calc spar was observed investing small fissures and rents in the rock.

Proceeding along the east side of Portlock Harbour the dip appeared gradually to assume more westing, and on reaching its north-east corner it became nearly north, in which direction, some distance inland, a ridge of greenstone showed itself, beneath which the conglomerate appeared to sink. From the north-east corner of the harbour, the conglomerate bends eastward across the Hincks location, and the distribution thus indicated results from the effect of the Bruce Mines anticlinal.

How far the summit of the upper slate conglomerate may extend westward on the axis of the anticlinal is not yet quite certain, but from the facts ascertained by yourself along the strait between St. Joseph Island and the main land in 1848, it seems probable that it will not turn before reaching the western side of the Hart location, and that its southern slope, in addition to many of the smaller islands, will include rather more than the northern half of the Island of Campment d'Ours.

On the axis of the anticlinal across the Keating location, to the eastward of the supposed position of the limestone, the ground is low and swampy, and the rocks are altogether concealed, but on reaching the neighbourhood of the Wellington mine, near the line between the Keating and Cuthbertson locations, at the distance of fifty-five chains from the margin of Lake

Huron, there is an exposure of the limestone which by its northern dip marks the north side of the anticlinal form. From this to the eastward the limestone rises to the surface in low irregular knolls, with flat and generally swampy land between, until reaching Cameron's lot on the Cuthbertson location. Here it shews itself pretty regularly for nearly a mile, striking on the average E. N. E., and dipping northerly from eighteen to twenty-five degrees. Beyond this it runs into a swamp, and in its probable course there is a succession of swamps, prairies and marshes; but the rock appears on the line separating the Belanger and Delorme locations, about ninety-five chains south from the Thessalon River, striking in the direction of the lower rapid, which is about four miles beyond.

Immediately north of the limestone band across the mining locations there appears in general to be a greater or less breadth of low swampy or prairie land without exposures; but beyond this the exposures were frequent, and wherever they were met with, they proved to be for a considerable breadth either the slate conglomerate, the quartzites and silicious slates associated with it, or masses of greenstone. On the line between the Keating and Cuthbertson locations as determined by yourself in 1848, the slate conglomerate and its associated beds occupy a breadth exceeding two miles, and their breadth appears to be undiminished farther to the east on the Starnes location, until approaching to within a short distance of the north-east corner. Here the rock displays a dip north, but following on the strike it suddenly ceases and is replaced by a white quartzite with a dip S. 20 W. $<$ 30°, from beneath which on the Thessalon about a quarter of a mile to the northward there rises a set of thin yellowish chert beds, interstratified with layers of impure limestone. These chert beds in their strike follow the bearing of the river to the immediate vicinity of the upper fall, the rock of which seems to be the white quartzite above them. The slate conglomerate, from the position where it displays the northern dip on the Starnes location, can be traced at intervals until it comes upon the river at a turn on the Belanger location below the fall, and to the position where the line between the Belanger and Delorme locations intersects the river; but in each successive exposure the rock breaks off obliquely to the strike, the dip remaining north, and the beds displayed occupy a lower and a lower place in the vertical section. At the intersection of the boundary line and the river the distance from the underlying limestone as has been said does not much exceed a mile. The same phenomena continue to the rapid below the lower fall at the eastern boundary of the Delorme location, where the distance from the underlying limestone would not exceed half a mile; while on the opposite side of the river, a succession of white quartzite beds approaches the stream with a dip to the S. W., the two different rocks on the opposite sides apparently coming up to one another in the shape of a V. The only explanation of such an arrangement is in the existence of a fault or dislocation running up the stream.

Between the exposures of limestone on the opposite sides of the anticlinal on the Keating and Cuthbertson locations, the rock seen is chiefly greenstone, and it is in cracks which occur in it on the crown of the anticlinal, that are found the copper ores of the Bruce and Wellington mines. The lower conglomerate however with which this greenstone is associated, is seen in several parts of these locations close beneath the limestone on the north side of the anticlinal, and in the same relation beneath the exposure of the limestone on the line of division between the Belanger and Delorme locations. In all of these places its breadth is inconsiderable and in all of them it is followed by great masses of greenstone. A larger exhibition of the conglomerate rock however is met with on the south side of the anticlinal in the Palladeau Islands, the whole of which with the exception of the southern half of the largest one (where we meet with quartzite,) are composed of this rock. The conglomerate of the Palladeau Islands is occasionally of very coarse material, being a mass of rounded boulders of syenite, gneiss and other crystalline rocks, among which red jaspers are not uncommon, the whole cemented together by a coarse greenish silicious paste. The Palladeau rock is no doubt an inferior part of the lower slate conglomerate, which the greenstone of the Bruce mine either replaces or overlies. In its extension to the eastward on the north side of the anticlinal the masses belonging to this division of the series are supposed to occupy the breadth of about a mile.

At a point in the bay between the Bruce mine and Eagle Point, beds of white quartzite, in parts becoming slightly conglomerate by the presence of small pebbles chiefly of white quartz, pass below the greenstone of the mine, dipping northward, and the east coast of the bay farther south displays similar measures interstratified with greenstone, shewing a moderate westerly dip on the axis of the anticlinal arch. Rocks of a similar character compose the coast opposite the Palladeau Islands with a southerly dip, as they do the rest of the coast eastward to the boundary between the two Ferrier locations, with a northerly dip, the axis of the anticlinal running between. The islands in front of those two locations consist of the same rock, and northward on the line between them exposures of the same character were met with for a mile and a half from the coast.

An island about three quarters of a mile outside of the Palladeau group is composed of the same quartzite. The dip of the strata is northward at a very moderate angle; and as the quartzite on the south side of the largest of the Palladeau islands dips northward, though at so high an angle as to seem almost perpendicular,(to which the conglomerate in contact conforms,) a synclinal axis must run through the conglomerate of this island of the Palladeau group.

Thessalon Point is composed of detrital matter up to the mouth of the river, but the coast a short distance to the east of the river consists of green chloritic slates, which weather red in some parts. The strata are so much disturbed that it is difficult to determine the dip, but the position of the rock in relation to those which have been previously described leads to the supposition that it comes from beneath them, thus constituting the lowest division of the series.

Immediately north of the upper slate conglomerate and its associated strata, on a small stream on the east side of the Desbarats location there was met with an exposure of red quartzite with a moderate dip northward, and the rock was visible at intervals for a breadth across the stratification of about a quarter of a mile. West of this on Walker Creek and the south part of Walker Lake other exposures of a similar rock occurred, which were supposed to succeed the previous beds; and these, interstratified with occasional masses of greenstone, occupied a breadth of about three quarters of a mile, the dip being much the same as before. This division of the series was not followed eastward, but between what was considered the position of the slate conglomerate and the base of the succeeding division (the red jasper conglomerates,) there always appeared to be sufficient space for the red quartzites.

The interstratified greenstone of this division near the exit of Walker Lake is intersected by a white quartz vein holding copper pyrites. The breadth of the lode is about two feet, but the copper ore is rather thinly disseminated in it; the bearing of the lode is about east. A mass of greenstone is met with towards the north termination of the dividing line between the Hincks and Keating locations, and a corresponding one on the dividing line between the Keating and Cuthbertson locations. Both masses are supposed to hold the same stratigraphical place among the red quartzites as the greenstone of Walker Lake, and a copper lode intersects the rock in each of the localities. On the west side of the Keating location the lode is about two feet wide; the vein-stone is white quartz and it holds a promising quantity of copper pyrites. On the east side of the location the lode is pretty much of the same character, and it seems probable that the three instances are exhibitions on one and the same lode, the extreme distance between them being eight miles.

The red jasper conglomerate rocks overlying the red quartzite are displayed in great force on the north side of Walker Lake. They are here interstratified with occasional beds of greenstone, and occupy a breadth of about a mile and three quarters, which is greater than their breadth to the eastward. The dips which they display are moderate, seldom exceeding ten or fifteen degrees, but as often happens, in such cases, the bearings of the dips are somewhat variable, ranging from about north in some places, to nearly west in others. This division was not traced farther westward than Walker Lake on the south side of the Thessalon;

but its full breadth was traversed on one of Mr. Salter's side-lines about four miles to the eastward. On this line the base of the division occurred in a small bay in the south-east corner of a moderately large sheet of water about three miles from Lake Thessalon, and what was considered the summit was met with not far from the outlet at the southern extremity of a smaller lake, the position being about a mile and a half from the shore of Lake Thessalon, thus giving a mile and a half as the breadth of the division in this part. The beds here, as near Walker Lake, are interstratified with occasional masses of greenstone, and the dip which is about north, shews a somewhat higher inclination than near that lake, being between twenty and thirty degrees, and in one instance towards the summit, where there was perhaps some disturbance, so much as seventy degrees were observed. The strike of the beds would carry the summit of the division, in a distance of two miles, and the base in one of four miles, to the flank of a hill overlooking Otter-tail Lake. This flank however being covered with soil shewed no exposure of rock. Coming down on the lake however, we met with a continuation of the white quartzites and cherty limestones mentioned as occurring lower down the Thessalon, dipping as before south-westward, and proving a continuance of the dislocation to which allusion has been made.

North of the red jasper conglomerates a set of white quartzites succeed. On Salter's side-line the space which they would occupy measures about fifty chains; but in this part the only exposures seen were about a mile to the west of the side-line, where an escarpment of from 100 to 200 feet rose above a prairie. The rock was very white and vitreous, with a uniformity of aspect that made it very difficult to distinguish what might be joints from beds. The dip was in consequeuce not very satisfactorily made out, but such evidences as were obtained appeared to indicate that the inclination was not less than forty-five degrees, and towards the north, the run of the escarpment shewing that the strike was a little north of west. From the escarpment exposures of the same character were met with at intervals on a north line for a distance somewhat under half a mile, when they terminated in an escarpment of thin yellowish chert beds with a dip N. 19 E. $<18^{\circ}$. The exposures on this line include the chief part of this division, but there is probably some portion wanting at the base, which was not any where seen on the south side of the Thessalon.

The yellowish chert beds were well displayed on Salter's side-line, dipping eastward of north at an angle of eighteen degrees, and maintaining this inclination across a breadth of about a quarter of a mile. The beds of chert were interstratified with hard calcareous layers and beds of silicious slate, and they formed a ridge with low ground on both sides. To the eastward the ridge died down at no great distance into the low land which limits the south side of Thessalon Lake, but to the westward it was followed two miles in a nearly due west course, after which the bearing of the band seemed gradually to turn about north-west, which it maintained for two miles more, obliquely crossing in that distance the outlet of a small lake which is tributary to Walker Lake, and including more than the southern half of the small lake itself. From this lake it turned again nearly west, in which bearing it was followed for about another mile. Along this course the dip of the beds gradually diminishes, and the breadth of the band increases until it measures about half a mile, with a dip not far removed from horizontality on the south, not over eight degrees about half-way across, but suddenly increasing to forty-five degrees where it disappears on the north, plunging beneath a mass of quartzite with the same dip. Where the examination of the chert ridge ceased there was a dingle of about two chains in width to the south of it, beyond which the underlying white quartzites rose into a pretty bold hill. This appeared to run for some distance to the westward, and from it the water of Great George Lake could be well seen about nine miles off, there occurring no land north of the white quartzite ridge high enough to interrupt the view. The intermediate ground however still remains to be investigated.

Chert beds very similar in aspect to those just described are met with on the north-east side of the small lake which is tributary to Walker Lake. Between those and the nearest approach to the previous beds there in a distance of no more than a quarter of a mile. They dip to the south-west with a slope of thirty-five degrees, and they might well be supposed to be the same beds as before on the opposite side of a synclinal axis. There is some suspicion however, as will be seen from the sequel, that they are higher strata on the north side of a great downthrow fault.

These beds in the attitude above mentioned are seen along the north-east side of the lake for a distance of a quarter of a mile; they are followed northward by a mass of greenstone, and that again by a great display of white quartzite, both running parallel with the chert beds. Three quarters of a mile south-eastward chert beds again appear, dipping to the south-west, with greenstone coming out from beneath them, and in this relation they can be traced for two miles to the south-east. Here the chert beds are within eight chains of the south-west corner of Thessalon Lake and the greenstone lies between them and the margin. This position is about half a mile from Salter's side-line, but the farther progress of the chert beds towards the side-line appears to be interrupted by a mass of white quartzite.

The low ground on Salter's side-line, mentioned as occurring to the north of the chert ridge first described, forms a hollow of a few chains in width, beyond which the mass of white quartzite just alluded to rises pretty sharply, constituting a hill which fills the space between the hollow and the lake, with the exception of a narrow mass of greenstone at the water's edge, and overlooks the low ground on the south margin of Lake Thessalon to the east.

On this low ground there is an interval of marsh, but beyond the marsh there is a point about half a mile above the outlet of the lake, where the strata make their appearance. They consist of yellowish chert interstratified with impure limestone, and they dip S. 37 W. $<19^{\circ}$. The band is about a quarter of a mile wide, and it can be traced without much difficulty in a pretty straight line for upwards of eight miles down the river to the higher fall, dipping in the same direction and nearly at the same inclination the whole way. In this course the band obliquely crosses in succession the terminal edges of all the divisions which have been described on the south-east side of the river to the middle of the upper slate conglomerate, its relation to which has already been pointed out.

At the point which has been mentioned on the south side above the exit of Thessalon Lake, the chert band proceeding north-westward enters the lake, but some uncertainty exists as to the position at which it leaves it. On the north-east side of the peninsula of Otter-tail Lake, there is at the base of the chert band a bed of a red and yellowish fine grained sandstone. A similar bed is seen at the upper end of Thessalon Lake with a bed of yellowish chert resting on it, and it is probably here that the band again enters upon the land; but the dip at the spot is irregular, and the band has not been traced beyond it. There is no doubt from the sequence of the rocks beneath the band that it is equivalent to the one overlying the white quartzite on Salter's side-line, and should it on farther investigation be found to continue westward from the upper end of Thessalon Lake, then the south-west-dipping chert band which faces the first described one, would necessarily occupy a higher stratigraphical place, and would prove the continuance of the fault which no doubt reaches Salter's side-line. The extent of this downthrow is not quite certain, but it appears to me it cannot be less than 1500 feet at this part.

The rock which would lie between these two chert bands is seen in a hill forming a point north of the south-west corner of Thessalon Lake. It occupies three quarters of a mile across the stratification and consists of white quartzite. A dip of eighteen degrees would give to this a thickness of nearly 1500 feet, to which if 200 feet be added for the upper chert band the dislocation would appear to approach even 1700 feet on Salter's side-line.

The downthrow however, if the dislocation result from a vertical movement, must be progressively much greater to the south-east, for the chert band terminating near the upper fall against the middle of the upper slate conglomerate, would there shew a displacement equal to the whole volume of strata between, which according to the thicknesses given in the list of strata would be 9,320 feet additional, or upwards of 11,000 feet.

Having thus shewn the distribution of the various divisions of the Huronian series on the south side of the Thessalon trough in ascending order, I shall now proceed to describe their distribution on the north side in an opposite order.

On the north-east side of Thessalon and Otter-tail Lakes the white quartzites underlying the lower chert band are displayed in a bold ridge which separates these two lakes with their connecting stream from Rock Lake. These quartzites are well seen on the Indian portage between the latter and Otter-tail Lake, where, as on the south side of the Thessalon, they are interstratified with greenstone. Their breadth in this neighbourhood is upwards of a mile, and their average dip nearly south-west, with a slope of about twenty-five degrees. The hills which they form continue down on the left side of the river, gradually approaching nearer to it below the upper fall, and at the lower fall the ridge occupies a breadth of about half a mile with low land on the north-east side of it. At the upper rapid the base of the white quartzites is about thirty-five chains from the stream, immediately beyond which the beds begin to shew blood-red jasper pebbles. At the lower rapid the red jaspers are a little farther back. The white quartzites in front of them shew leaden-grey patches, but farther on in the strike the ridge dies down, and the surface becoming low extends into a great cedar swamp.

This swamp is situated on the east Ferrier location, where the Thessalon begins to take a more southerly course for Lake Huron. From the river it has the breadth of about a mile, and on the north side of the swamp there rises to the height of 100 or 150 feet a well marked hill, which has a breadth of nearly a mile. The hill consists of strong beds of red jasper conglomerate interstratified with greenstone, and the dip averages S. 55 W. $<$ from 10° to 12°. The summit of the division near the lower rapid has already been mentioned, and the traverse from the river at this place did not extend beyond it. On the traverse from the lower fall, the ground north-eastward of the white quartzite was flat for a considerable distance, and showed no red jasper conglomerate in place, but where it was to be expected there occurred a great number of large angular blocks of the rock.

The next exhibition of the division examined was on Rock Lake. Here the summit of the division strikes upon the lake in its south-eastern bay, whence it runs parallel with the Thessalon, forming the promontories of the south-west side of the lake, leaving the bights of the bays for the white quartzite. From the south-western bay the trend of the summit is to that turn in the stream discharging Rock Lake, where its course changes from about west to about south. The upper part of the division is much mixed with greenstone, and an exemplification of the interstratification is seen on the island of the south-east bay, where the dip is westward of south with a slope of twenty degrees. In the middle part of the division there is a great mass of greenstone seen in conspicuous promontories on opposite sides of the lake, while the rocks on the opposite sides of the outlet present a section of the lower part. Here the beds, dipping to the south-westward, present a pretty regular slope of forty degrees, and unless some unperceived dislocation in the bed of the river occasion a repetition of strata, this part alone must measure nearly 1500 feet.

Between the exposures of red jasper conglomerate on the stream connecting Rock and Thessalon Lakes, and those met with in my exploration from Echo Lake, the distance is about three miles. From the latter lake the division comes upon a lake mentioned in the Report of 1857 as tributary to the lower part of Echo River. The rock appears to occupy upwards of a mile on the northern part of this lake, the base reaching the northern extremity. Masses of greenstone are interstratified with the other beds, and the whole seem to turn southward across the lake, probably folding over the axis of the anticlinal which was ascertained to affect the limestone band to the west of Echo Lake. The strata again turn westward and have been traced for about a mile and a half from the lake in that direction. The strike would apparently bring them out to the flat land bordering the lower half of that part of Echo River which discharges Echo Lake, but the nearest exposures seen are two or three miles from its bank.

The red quartzites which underlie the red jasper conglomerates have not been recognized as yet on Echo Lake. They might be expected on the lower part of the lake and the upper half of its discharging stream, but this space is occupied by great masses of greenstone in which copper lodes are known to exist, and perhaps it may be worthy of remark that this copper-bearing greenstone has here the same relation in stratigraphical place, as the greenstone holding copper veins on Walker Lake and in the rear of the Cuthbertson location. The red quartzites are seen on the north shore of Rock Lake, where pale brownish flesh-red and pale and dark grey beds of a somewhat granular character are interstratified with one another, and sometimes present ripple-marks on their surface. Masses of greenstone are often intercalated, those toward the summit being of considerable thickness. The dip, which is south-westward, varies from twenty eight to fifty-five degrees in inclination, and the breadth assigned to all that belongs to the division is about a mile. On the traverse from the lower fall of the Thessalon the red quartzites were met with a little under three miles from the river, near a small lake on the western Ferrier location. Some of the beds were of a light brownish flesh-red and others grey, and greenstone was interstratified with them. The dip of the strata was S. S. W.<23°. The exposures spread over a transverse distance of about half a mile, but as the land both in front and rear of them was flat and the rock was concealed, it is not probable that the whole breath of the division comes to the surface. Beyond this to the south-east this division was seen no more. It was searched for north of the red jasper conglomerate on the east Ferrier location, but the land being flat presented no exposures whatsoever.

The upper and lower slate conglomerates with the limestone band between them on the north side of the Thessalon trough, were so necessary as guides to one another in tracing them out on the surface, that it will be convenient to describe them together.

In the Report of 1857 all the facts known in respect to the distribution of the lower limestone band on the west side of Echo River were given in considerable detail. The upper slate conglomerate follows the limestone in a belt having a breadth of from one half to three quarters of a mile, and presenting nearly the same sinuosities of outline. In the upper part of this belt there is here a more than usual amount of pale and dark grey quartzite, which however is supposed to belong to the slate conglomerate group, from the occasional occurrence of beds similar to these in the lower part of this group elsewhere. In the Report of 1858 on page 26, there is a diagram representing a vertical section running north-eastward from the upper end of Great Lake George, in which under the several letters *l*, *g*, and *h* are given, upper slate conglomerate, fine grained black and grey quartzites, and whitish and grey quartzites. All these are now supposed to belong to the division No. 5 of the present Report. In the tabular list of rocks on page 24 of the Report of 1857, the division No. 6 is described from exposures on the east side of Echo River, and it was supposed that the whitish or whitish-grey quartzites there mentioned were equivalent in part to the whitish and grey quartzites, *h* of the diagram. It is now however considered that the former are higher in the series, and that the red quartzites No. 6 of the present Report come in between. These red quartzites have not yet been seen on the west side of Echo River, the only rock met with there above what is now included in No. 7 being greenstone.

The Report for 1857 gave all the details known of the limestone for ten miles south-eastward of Echo Lake, to a position about half a mile from the small lake then supposed to be the head of Echo River, but now known to be tributary to the Thessalon. The supposed position of the limestone in this part was indicated by the presence of loose angular blocks of the rock. Characteristic exposures of the slate conglomerate rock occurred both north and south of the position, with interstratified quartzite and greenstone. To the south the breadth is three quarters of a mile, which is precisely the breadth which the rock shows south of the limestone on the east shore of Echo Lake, where it is well displayed; so that the breadth may be considered pretty uniform the whole way. Between the rock on Echo Lake and the most western exposures of the red jasper conglomerates, there is a distance of two miles in a due south bearing. In this space rise up the great masses of greenstone already mentioned as holding copper lodes. One of the masses with a breadth of half a mile extends three miles and a half east and west, terminated westwardly in a great bluff; round the extremity of this the summit of the slate conglomerate appears to bend to the south-eastward, proceeding to its position southward of the small lake tributary to the Thessalon. Between the summit of the slate conglomerate at this place and the base of the red jasper conglomerates the distance is about thirty-five chains, and in this space the red quartzites are supposed to be represented by some reddish-grey and dark grey beds of this description of rock.

Two miles in a direction a little south of east from the supposed position of the limestone in this part, we meet with Mr. Salter's side-line, and about a quarter of a mile beyond it the limestone band is seen in place, dipping S. 25 E.< 37°. From this the limestone was not again seen in place to the eastward, and it became necessary to depend on the slate conglomerate in the endeavour to trace out farther its probable course.

From Mr. Salter's side-line the strike of the slate conglomerate appeared to be very regular all the way to the Thessalon, the distance being about four miles and the bearing about S.S.E. The position to which this would carry the limestone band on the river, is about a quarter of a mile below the turn which the upward course of the river takes to the eastward within a short distance from the end of my measurements. Although there was no limestone seen here, there was nothing to contradict its possible presence beneath the high clay banks between which the river makes its way. Considerable masses of greenstone rose up immediately north of the position, along the foot of which there was a clay-covered depression, and across the measures to the south-westward the slate conglomerate with its associated masses was spread out for a mile and a quarter, leaving upwards of three quarters of a mile beyond, between them and the red jasper conglomerates, for the red quartzites.

On the east side of the river, about a mile farther in about the same strike, slate conglomerate is associated with greenstone on the northward side of the place assigned to the limestone band, and the same breadth and description of rock as before extends to the southward. The same breadth is in front of it half a mile still farther on the strike, and in this place the summit of the slate conglomerate reaches to the margin of the north-eastern bay of Rock Lake where the dip, is S. 33 W$<35^{o}$. For about three miles beyond this the strike appears to turn slightly more south, but the supposed position of the limestone, which would be somewhat over two miles and a quarter east of the north-eastern bay of Rock Lake, has the same relation to the slate conglomerate as before. An east line from the bay would cross the measures obliquely, and on it the summit of the slate conglomerate was met with about thirty chains from the lake.

Between this position and the next at which the slate conglomerates were examined, there occurs an interval of six miles on the strike. The exposures connected with it were reached by the traverse from the lower rapid of the Thessalon. The distance across the measures from the nearest of these exposures to the base of the red jasper conglomerates would be about two miles. But though there appears to be a diminution in the inclination of the strata over a considerable area in this neighbourhood, the distance is considered too great to be filled up by the red quartzites alone, which as already stated are concealed in the interval. It is therefore supposed probable that a portion of the slate conglomerates is also covered up, and the place of the summit of the division might be indicated as half a mile farther south than the exposures.

From this position the slate conglomerate was traced for about five miles on the strike to the west end of Wahbiquekobing Lake. In this distance it presented low flat hills and shewed a dip somewhat to the west of south seldom exceeding ten or fifteen degrees in inclination. If the summit has been correctly indicated above, the formation would have a breadth of over two miles. At that distance it was every where limited by a great and continuous mass of greenstone, which extends in a nearly straight line from the north-west bay of lake Wahbiquekobing for six miles, while the north side of the lake presents a continuation of the same mass for seven miles more in an opposite direction. The greenstone was thus found to continue in a straight line without an interruption for thirteen miles, the bearing being about S. 20° E. At the west end of the lake this rock was found to extend two miles northward on Mr. Salter's side-line, and southward it composed nearly all the west end of the lake to the bight of the south-west bay. From the bight of the north-west bay however, a narrow valley, commencing south of the brook which enters at the corner, runs westward in front of the continuous range of greenstone. The depression at the end of a mile comes upon a small lake which discharges into the south-west bay. Towards the east end of this lake, slate conglomerate, dipping south at a small angle, was overlaid with greenstone. The depression from the north-west bay was covered with clay, which may be underlaid with slate conglomerate.

With the exception of a long tongue-like promontory about a mile below the portage to Lake Wahbiquekobingsing, and the drift-covered bays on each side of the promontory, the whole of the south side of Lake Wahbiquekobing consists of slate conglomerate, in some parts nearly flat, and in others dipping southward at an angle seldom exceeding six degrees; so also does the north-east side of Lake Wahbiquekobingsing, as far to the south-east as a promontory cutting the lake nearly in two about a mile above the portage. The promontories on both lakes are greenstone, and a ridge inland appears to connect them. Slate conglomerate probably composes also the north-eastern shore of Lake Pakowagaming for upwards of two miles above the exit, being seen at both ends of the distance, dipping to the south at the south-eastern end at an angle of five degrees. It seems probable also that it will extend over the area between this part of Lake Pakowagaming and the west end of Lake Wahbiquekobing, for it lies along the shore of the west end uninterruptedly as far as the portage to the Mississagui from the most eastern bay. The next promontory north is composed of greenstone; the next bay shews strata belonging to the slate conglomerate; while the coast from the succeeding point to the portage at the north-east corner of the lake, and for half a mile farther is greenstone;

but a narrow strip of slate conglomerate skirts the shore for half a mile farther, coming against the greenstone which has been mentioned as running along the north shore.

This greenstone in a narower mass than it presents on the north-eastern shore, seems in its continuation to outflank the slate conglomerate of the west end of the lake. It occupies the north portage all the way to the Mississagui, and the south one to within a quarter of a mile of the river. It constitutes mountain masses two miles to the east of south, and reaching Lake Pakowagaming it is seen in a wide and moderately bold promontory, the point of which is under a mile and a half above the outlet, but a cape which forms the southern horn of a cove three quarters of a mile further up the lake, consists of nearly horizontal beds of grey and pale reddish quartzite, which is supposed to belong to the slate conglomerate division, and to indicate that this is the farthest eastern extension of it belonging to the Thessalon trough.

Opposite the greenstone promontory on the north-eastern side of Pakowagaming there is a square bluff of the same rock standing conspicuously out between two bays on the other side of the lake. The next point above this is also composed of greenstone, which is the rock of the shore for a mile farther Above this, opposite a small island, the only one of the lake, the rock is again slate conglomerate; but instead of displaying the nearly horizontal attitude of the formation on the opposite side of the lake, the strata are here disturbed and corrugated, and plunge under the water with a dip N. 23 E.<from 56° to 60°. With a strike corresponding to this dip, the front of the mass gradually separates from the shore of the lake, and is traceable in a Well marked ridge for two miles, leaving between the foot of the hill and the margin to the west end of the lake, a flat land in which there are no exposures.

An attempt to separate the upper from the lower slate conglomerate in this part, and thereby fix the position of the lower limestone band, has presented great difficulties, and I have been obliged to content myself with choosing a line of division, in regard to which I have met with nothing to contradict its possibility rather than much to support its probability.

The only masses of limestone here met with were loose angular blocks, which occurred in some abundance near the west end of the north portage from Lake Wahbiquekobing to the Mississagui; but these may be derived from some more northern exposure of the band. To the south however of the greenstone promontory which cuts Lake Wahbiquekobingsing nearly in two, there is on the east side of the lake a breccia consisting of fragments of greenstone cemented together by a calcareous paste, while veins and cracks in the rocks both of quartzite and greenstone on both sides of the lake were filled with calc spar. A rock of a somewhat similar character to this breccia was observed on Lake Wahnapitaeping in 1856, and described in the Report of that year at page 177. The calcareous paste in it however bore a much larger proportion to the fragments than in the breccia of Wahbiquekobingsing. If this breccia indicates the true position of the limestone band, the band probably enters Lake Wahbiquekobing at the south-west bay and passes along the lake to the east side of the tongue-like promontory of quartzite mentioned on the south side, thence crossing the land to Lake Wahbiquekobingsing.

At the south-east end of Lake Pakowagaming there are red quartzites, slates and other rocks of the Huronian age, whose place in the series is yet uncertain, but they are all twisted, highly tilted northward or vertical, and on the south-west side of the lake for two miles up in the bights of the bays and in positions behind the greenstone points and promontories, there are exposures of well characterized massive gneiss. The same rock forms the south side of Lake Wahbiquekobingsing, and the fact that these positions are not much out of the direct line of the great dislocation of the Thessalon valley makes it very probable that we have here an exhibition of a portion of the Laurentian series, brought up against the Huronian from a great depth. On the coast of Lake Huron four miles south of Wahbiquekobingsing, there are exposures of gneiss, and these continue along the coast for twelve miles to the eastward. Great masses of intrusive greenstone are also seen along this line, and dykes emanating from them are often found cutting the gneiss. How the gneiss is related to the chloritic slates near the mouth of the Thessalon has not yet been ascertained.

From beneath the greenstone which outflanks the slate conglomerates of the east end of Lake Wahbiquekobing there appears to emerge a group of strata consisting of fine dark olive-gray or grayish-black slates weathering somewhat brown, associated with reddish-grey, brownish-grey or reddish-brown quartzites. The slates are very thin bedded and often break into rather regular rhomboidal forms. The quartzites appear to have disseminated through them in many places very minute grains or cubes of iron pyrites, and they occasionally present pebbly layers, giving them the characters of fine conglomerates. The slates and quartzites are interstratified, the slates predominating at the bottom, and the quartzites at the top. These strata come upon the Mississagui, on which exposures of them exist from a position about a mile below the mouth of the Pakowagaming to the second fall, being that immediately above the southern portage to Lake Wahbiquekobing, and from the north portage to the mouth of the Little White River. On that part of the Missisagui which is between the two portages the prevailing rock is greenstone.

The dips of these rocks present slopes in opposite directions from the general upward course of the river, as far as a turn northward occuring about half-way between the north portage above mentioned and the Little White River. The angles of inclination are usually small, shewing a rather flat anticlinal arch with a shallow saddle-shaped depression between the two portages, over which the greenstone passes from one side to the other. Near the mouth of the Pakowagaming however there are some corrugations and sharp opposite dips in the slate, but these are probably local and may not extend far on each side.

Along the crown of this anticlinal arch there were met with several veins holding more or less copper pyrites; their courses were parallel with the axis of the anticlinal. Near the mouth of the Pakowagaming they intersected the slates, and consisted of calc spar in which both copper and iron pyrites were observed. At the south portage the gangue of a vein cutting quartzite and holding copper pyrites was quartz and bitter spar. A vein of from one to two feet in width met with at the north portage intersected greenstone; the vein-stone was quartz in which both iron and copper pyrites were disseminated. Though the quantity of copper ore disseminated in these veins was small, yet as the veins occured in cracks on the crown of an anticlinal where dislocations may be expected, they are deemed worthy of notice, as they may become of more importance in their farther prolongation.

With what division the slates and quartzites which come from beneath the greenstones on the anticlinal of the Mississagui should be classed, is not yet quite certain; nor am I able in respect to the structure of the area through which the river flows, to do more than give some isolated facts to be connected at some future time after further exploration.

From the north portage the greenstone which there crosses the Mississagui runs up the valley of the river in two pretty bold flanks which separate as they proceed; that on the east side bears a few degrees west of north to the Little White River; that on the west about north-west for about two miles and a half, when it comes to the valley of a tributary joining the Mississagui on the right side near the bend half way to the Little White River. Here the flank of the hill is about half a mile west of the bend, and while greenstone composes the top, the slates and quartzites come from beneath it at the bottom, the dip being apparently W. S. W. at a very small angle. The flank continues on the north side from the valley of the tributary and comes close upon the right bank of the Mississagui under two miles above the Little White River. Here again the slate and quartzite come from beneath the greenstone. They also come from beneath the greenstone of the Little White River, about three quarters of a mile below its mouth.

Greenstone is the rock of the Little White River all the way to the first fall, which is two miles up. About four miles due east from the mouth of the Little White River a band of limestone was met with dipping S.E. $<$ from 5° to 8°; it was overlaid by slate conglomerate and underlaid by quartzite. About a mile and three quarters west of north from this on the bank of the Little White River there occurred a farther indication of the band, with a dip only a little east of north, and here it was again associated with slate conglomerate. If this band of limestone be considered equivalent to the lower one of the Thessalon trough, then the strata between it and the greenstone at the fall lower down the stream would come in the place of the lower slate conglomerate. In this part of the stream there are several good exposures of strata, and though some of them resemble the beds of the lower slate conglomerate in character, others as much resemble beds of the red jasper conglomerate. Although red jasper pebbles have been occasionally met with in the slate conglomerates of the Thessalon, white quartzite containing them never has. White quartz pebbles however, are occasionally by no means deficient, and it would not be surprising therefore that the finer part of the rock should take the form of white quartz sand. Though the dips in this part of the Little White River are irregular, none of them present higher angles of inclination than might result from gentle undulations, and from the dips prevailing near the greenstone, it is evident the conglomerates sink beneath it. It thus seems probable that the conglomerates on the one side of the greenstones of the Little White River belong to the same division as the slates and quartzites on the other. It would follow that the slates and quartzites of the Mississagui are equivalent to the lower slate conglomerates on Wahbiquekobing Lake and that both underlie the intermediate greenstones.

From the mouth of the Little White River the greenstone ridge on the left bank of the Mississagui continues its northward bearing in a pretty straight line to the vicinity of the Grand Portage. At the Grand Portage the channel of the river, whose ordinary breadth is from sixty to eighty yards, suddenly becomes contracted to eight or ten yards, with vertical banks rising to the height of seventy or eighty feet, and through this the water rushes in a torrent for nearly a mile and a half. This deep cut is through greenstone all the way. At the lower end of the portage this greenstone has a breadth of nearly a mile on the left side of the river, forming a hill of 300 or 400 feet in height; beyond the foot of this to the north-east there extends a level country, which for another mile and a quarter is underlaid with slate conglomerate, fine green slate and quartzite in a nearly horizontal attitude; the dip is northward, and does not appear to exceed three or four degrees in inclination. The greenstone probably overlies these beds.

The hill of greenstone appears to extend up the river on the left side to Salter's side-line, which is some three miles above the portage. A corresponding ridge, but not so high, extends along the opposite bank of the river. On the west side of the portage it forms a plain about 100 feet above the river for a moderate breadth and then gradually falls to the south-west; but about half a mile above the head of the portage, and not quite half a mile from the river, it presents a hill of about 300 feet high, while the part intermediate between it and the river, and a small strip on the opposite side with a height of not more than thirty feet above the river, have an even surface underlaid with slate conglomerate in a nearly horizontal attitude. Similar strips of slate conglomerate on opposite sides of the stream are seen near Salter's side-line, dipping at moderate angles in several directions, but horizontal on the average. South of the river on Salter's side-line there are two small lakes, one a mile and the other three miles distant. Between the river and the first lake, with the exception of slates and quartzite on the margin of the river, the space is filled with greenstone. Between the two lakes the rock is slate conglomerate in a horizontal attitude, and it is probable that the same horizontal slate conglomerate extends to the greenstone of Wahbiquekobing Lake as it does to the foot of the greenstone hill at the head of the Grand Portage.

The same arrangement of greenstone and slate conglomerate continues for some few miles farther on the river to the eighth fall, in latitude 46° 30′ N. Beyond this there is a change in the character of the rocks, and what appear to be red syenite, red granite and occasionally red gneiss (all associated with greenstone) prevail on the more immediate banks of the river as far as surveyed, with the exception of slate conglomerate, which comes in on the left bank about a mile in continuation of Salter's side-line beyond his base line. This conglomerate appears at intervals for two miles up the stream with a dip northward at a moderate angle. The lowest exposure seems to approach close upon the gneiss on the opposite side of the stream. The facts ascertained in regard to these apparently older rocks being wholly confined to the banks of the river, their relations are not yet understood.

At both ends of the Grand Portage and along the portage path, as well as at Salter's side-line, indications of copper ore were met with in quartz veins intersecting the greenstone and slate conglomerate. The bearings of those near the portage coincide with the bearing of the deep straight narrow chasm through which the river here makes its way. The chasm is not far removed from them and may possibly mark the position of another vein, though nothing was observed to confirm the supposition. A list is given at the end of the Report of all the localities where traces of copper ore were met with on the Mississagui, and though the quantity of the ore does not in the case of any of the veins appear very encouraging, they may become the means of leading to the discovery of veins of a more promising character in the neighbourhood.*

The examination of the area connected with the Mississagui has not yet been sufficiently extended to determine the relation between the copper-bearing veins of the Grand Portage and the physical form to which they are subordinate. The veins of the lower part of the river are evidently related to the anticlinal existing there. Those of the south part of Echo Lake also belong to an anticlinal; so do those of the Bruce and Wellington mines; and it would almost appear as if the importance of the metalliferous indications rose with the sharpness of the fold. But whatever be the cause of the dislocations in which metalliferous minerals are secreted, it would seem to be a probable supposition that in a metalliferous district the greater the dislocations the greater the chances of valuable metalliferous lodes. If this be the case, the great dislocation of the valley of the Thessalon would become invested with much importance. But though there is no doubt whatever that it is a master fault, it would I fear be a somewhat expensive affair to prove or disprove that it is a master lode,

* The list is introduced into the Appendix.

SECTION OF THESSALON TROUGH.

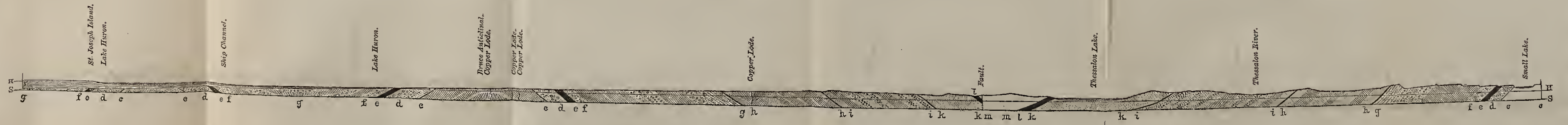
REFERENCE.

	H	*Level of Lake Huron.*
	S	*Level of the sea.*
	s′	*Lower Silurian series.*
10	m—m	*White quartzite and greenstone.*
9	l	*Chert and limestone.*
8	k—k	*White quartzite and greenstone.*
7	i—i	*Red jasper conglomerate and greenstone.*
6	h—h	*Red quartzite and greenstone.*
5	g—f	*Upper slate conglomerate and greenstone.*
4	e	*Limestone.*
3	d	*Lower slate conglomerate and greenstone.*
2	c—c	*White quartz conglomerate and greenstone.*
1		*Greenish chloritic slates. These do not come into the section.*

Equivalents in sections of Huronian Rocks, 1857 and 1858.

1858. Thessalon Trough.		1857. Echo Lake.
s′	=	i
m—m	=	*Wanting.*
l	=	*Wanting.*
k—k	=	*Wanting.*
i—i	=	*Wanting.*
h—h	=	h
g—f	=	g & f
e	=	e
d	=	d
c—c	=	c & b
Wanting.	=	a

Vertical and Horizontal Scale: One mile to one inch.



for although the proximate position of it has been more or less examined for upwards of fifty miles, never in any place have I been so fortunate as to find the rocks on the opposite sides of the fault in juxtaposition. On arriving at the spot where the junction was expected there was always a swamp, a marsh, prairie, river, lake, or some flat surface covered over with drift. The only mode of proving the matter would be by costeening, and it is probable that the thickness of the covering would cause this to be attended with much outlay.

DRIFT.

A deposit of clay usually of a brownish-drab color is spread over a large portion of the region examined. This clay occupies the lower part of the hollows and valleys, and was exposed occasionally in considerable thickness on the banks of the streams. On the Thessalon and Mississagui it was observed to be distinctly stratified, and frequently to contain calcareous concretionary nodules of various shapes and sizes. Near the top of some of the highest sections of clay, such as are seen on the Mississagui and Little White River, thin seams of yellowish sand become interstratified, and the whole mass is overlaid with sand of a similar character higher up the main stream. The sand extends far and wide over the highest table lands and a great part of the country generally, concealing the clay beneath, except in ravines and the banks of rivers, where the action of the water has made sections.

The clays on the banks of the Little White River were observed at several places to be tilted; just below the first fall on that stream the dip was N.W.< 25°. About three miles above the fall, where the bank is from seventy to eighty feet high, the lower fifty of which were clay, the strata were again tilted in the same direction as before and at about the same angle. One bed of the clay about a foot thick was observed to be curiously corrugated, while those above and below were perfectly even and regular. This corrugated bed and its associated strata were exposed for no more than thirty feet, the face of the section on each side and above being concealed by clay and sand which had fallen from above, mingled with a few small boulders. The debris presented a talus on each side of the exposed strata, the surface of which shewed a slope of about forty-five degrees. The cliff faced south-east, and the section of the folds in the corrugated bed induced the opinion that their axes were at right angles to the strike of the general mass or nearly so. In your Report for 1844–5, p. 32, you mention an analogous case in the limestone and shale of Cape Bon Ami near Cape Rosier, where the corrugated bed was traced for upward of a mile.

The clay deposits of the Mississagui and Little White River do not appear to attain a height of much more than 160 feet over Lake Huron, or 738 feet above the sea. That is the greatest height found on the banks of the tributary, whilst on the main stream above the head of the Grand Portage, the height of which I have given as 732 feet, the clay is replaced by a great accumulation of sand and gravel, the gravel becoming coarser and more prevalent as we ascend the river. On the banks and flats above Salter's base-line, where the height is 830 feet above the sea, the shingle consists of rounded masses almost all of syenite, the smallest of which is rarely under the size of a man's fist and the average as large as a twelve-pound cannon ball. Many of the masses are much larger, and in addition there are a great number of huge boulders.

Between Wahbiquekobingsing and Lake Huron there is a remarkable piece of table land, about a mile wide from north to south, which stretches to the east and west, rudely parallel with the shore of Lake Huron. It rises by abrupt banks of from eighty to one hundred feet over the flats on either side, which may be between thirty and forty feet above the lake, making the table land about 700 feet above the sea. One of the banks faces Lake Huron, which is from two to three miles distant, the other Lake Pakowagaming. The sides and upper edges of the banks expose coarse gravel at intervals, but the upper surface, which is flat, is covered with a good loamy soil, growing timber of mixed hardwood and evergreens. No running streams were observed on this table land, although there was abundance of water on either side. From these circumstances it appears probable that the whole of the upper part is of loose material such as gravel and sand, and that it is supported on clay, from above which the surface water, percolating through the looser material, issues on to the flat below.

Glacial grooves and scratches were observed on the smooth rounded faces of the solid rock at many parts of the coast of Lake Huron, in the valley of the Thessalon and in the lower part of Mississagui. The following is a list of such as were registered, with their bearings:

1. Island south side of Echo Lake.................................. S. 55 W.
2. Half a mile below island south side of Echo Lake.............. S. 70 W.
   These two bearings are in the general run of Echo Lake, on the south side of which rises a bold hill.
3. North of Walker Lake in a shallow depression on the top of a hill and from 200 to 300 feet over the lake which is very little higher than Lake Huron; the valley of Walker River discharges the lake in front of this shallow depression and has the same general bearing as the grooves.................... S. 17 W.
4. Right side of Thessalon River a short distance above Rock Lake in the general bearing of the valley of the river for several miles above,.. S. 25 W.
5. West and south sides of Rock Lake. There is high land in the direction of these grooves to the southward.................. S. 15 W.
6. East side of bay, Bruce Mines.................................. S.
7. North side and east end of the larger eastern Island of the Palladeau group, in three places .... S. 15 W.
9. Entrance of the Thessalon River, east side..................... S. 18 W.
10. North-west end of Wahbiquekobingsing Lake .... S.
11. South-east end of Wahbiquekobingsing Lake .... S. 12 W.
12. South-west shore of Pakowagaming Lake a mile from the south east end.. S. 25 W.
13. Coast of Lake Huron, nine miles west of the Mississagui....... S. 15 W.
14. North end of the large island dividing the mouths of the Mississagui River.. S. 12 W.
15. Right side of the Mississagui below the first fall.............. S. 12 W.
16. Right side of the Mississagui a mile and a half above the mouth of the Pakowagoming.. S. 10 W.

The effect of recently moving ice was noticed in a few instances on the Mississagui River north of Salter's base-line, where the coarse shingle was loosely piled up into great conical heaps. The accumulations were usually at a turn in the river where there was a strong current above. The ice brought down with violence and impinging on the side at the turn appeared to have ploughed up the shingle and pushed it forward on to the bank. One of these heaps was estimated to be about ten feet high at the apex, with a diameter at the base of from forty to fifty feet; it rested on closer packed material of the same kind, which also formed the bed and the margin of of the stream in the neighbourhood.

I have the honor to be, sir,

Your most obedient servant,

A. MURRAY.

GEOLOGICAL SURVEY OF CANADA.
Sir W. E. Logan F.R.S. Director.
PLAN
SHOWING THE DISTRIBUTION OF THE
HURONIAN ROCKS
BETWEEN
RIVERS ST MARY AND MISSISAGUE.
Scale of Statute Miles
Reference.
No 10 White quartzite
9 Chert and Limestone
8. White quartzite
7. Red jasper conglomerate
6. Red quartzite
5 Upper Slate conglomerate
4 Limestone
3. Lower Slate conglomerate
2 Quartz conglomerate, Quartzite & Greenstone
1 Chloritic slates.
Boundary of Silurian formation
Copper veins.
SUGAR ISLAND
LAKE GEORGE
NEEBISH ISLAND
MUD LAKE
ST JOSEPH ISLAND
LAKE HURON
DRUMMOND ISLAND
MINING LOCATIONS
Echo Lake
Rock Lake
Wabbiquekobing Lake
Table Land
Boundary of Silurian Formation
Longitude West from Greenwich.
84°
83°

REPORT

OF

MR. JAMES RICHARDSON, EXPLORER,

ADDRESSED TO

SIR WILLIAM E. LOGAN, F. R. AND G. S.

PROVINCIAL GEOLOGIST.

MONTREAL, 1*st March* 1859.

SIR,

In the month of May last you were pleased to direct me to prosecute a geological examination of the Gaspé peninsula in continuation of the previous season's investigation, and to carry the work to a connection with that of yourself and Mr. Murray in the years 1843-4-5 and 1849 at Cape Ste. Anne on the one hand and Rivière du Loup on the other, as well as to follow out a line of research across the peninsula from some such point on this part of the St. Lawrence as I might deem expedient, to the Restigouche and Bay of Chaleur.

Leaving Montreal on the 13th May in company with Mr. R. Bell, I reached Rivière du Loup on the 16th. We here landed our camping materials with a small quantity of provisions, and forwarded the bulk of what was intended for the work of the season, to Rimouski, to be placed under the charge of Mr. J. B. St. Laurent of that place.

The first part of our season's operations was an examination of the country between Rivière du Loup and Ste. Anne des

Monts. In this, removing forward our camping materials from point to point by means of carts, we required the aid of but one permanently hired hand. The whole distance, 176 miles, was measured by pacing, the measurements being made along the shore and along the roads running parallel with it, as well as along occasional transverse lines extending from ten to twenty miles into the interior. Being provided with Bayfield's charts of the St. Lawrence, our distances were checked by means of them, when practicable, at the end of every two or three miles, and every day's work was registered on a map in our tent at night, care being taken to introduce in its proper place every rock met with, together with its dip and strike. We reached Ste. Anne des Monts on the 23rd of June, and continued our measurements in the same manner for thirty miles more along the coast, terminating this part of our work at a point seven miles below the Marsouin River.

Hiring two Indians at Ste. Anne, we ascended the Ste. Anne River in a canoe for thirty-two miles to the junction of the north branch with the main stream. Here, leaving the canoe, a pedestrian measurement was made for twenty miles south-eastward over the Mount Albert of Mr. Murray, to within six miles of that part of the Great Cascapedia, (tributary to the Bay Chaleur,) which is south from a hill called in your Report for 1844–5, the Barn-shaped Mountain. This mountain we visited on our route back. Returning to Ste. Anne, another transverse measurement was made up the valley of the Marsouin River for twelve miles in a bearing S. 12 W. which was continued in a bearing S. 45 E. for about ten miles more to the top of the high mountains that rise between the Ste. Anne and the Magdalen Rivers. Returning from this, we kept a nearly straight line to a point on our southward line within a mile and a half of the mouth of the Marsouin, in a general bearing a few degrees west of north. On this return line, after leaving the higher ground, our route was up the valley of a stream which flows southward to the main north branch of the Ste. Anne, and then along a tributary of the Marsouin (called by us Henley's Brook) which runs in a course opposite to that of the previous stream, but in the same depression.

After this, procuring a boat at the Marsouin we ascended the coast to the Great Metis River, reaching it on the 14th August. Here, hiring a third Indian and another canoe, we made a portage to Lake Matapedia, measuring the road by pacing, and registering on our map, as in all other parts, the various bands of rock which crossed our path. We descended the Matapedia in our canoe, and from the mouth of it, made an excursion to Dalhousie for the purpose of obtaining a collection of fossils required to determine the age of the rocks in the vicinity, on both sides of the Restigouche.

At the mouth of the Matapedia, I obtained through the obliging kindness of Messrs. Daniel and Alexander Fraser, a good plan of the Restigouche for fifty-four miles from its mouth, which, in connection with the valuable information regarding the interior of the country, derived from those gentlemen, saved me much time. The distance especially examined on the Restigouche was about thirty-six miles, extending from the mouth of the Matapedia to that of the Patapedia.

Having determined to return across the Peninsula by this stream, and possessing no map of it, a measurement of the river was made for about thirty-one and a quarter miles to a tributary called the Awaganasees or Pass Brook, the bearings being determined by prismatic compass, and the distances by Rochon's micrometer telescope. The Awaganasees was measured for about nine miles and a quarter more, and from this, a portage of three-quarters of a mile brought us to the head of the lakes of the Metis. These lakes, three in number, and the River Metis were measured in the same way to the junction of their waters with the St. Lawrence, the distance being fifty-one miles and a half.

We reached the mouth of the Metis on the 28th of September, and subsequent to this various measurements and examinations were made in the townships of Macpes and Duquesne in the rear of Rimouski, and in those of Denonville, Viger, and Whitworth in the rear of Trois Pistoles, Cacouna and Rivière du Loup, as well as in various parts as far up as the Seigniory of St. Denis.

After my return to Montreal on the 14th of November, an excursion was made to the Thousand Islands in the neighbourhood of Gananoque to continue certain partial explorations made in 1855–56, but further examinations will have to be made in that neighbourhood before the facts connected with the rocks of those islands can be satisfactorily combined.

Geographical Characteristics.

Valley of the Marsouin and neighbourhood.

The Marsouin falls into the St. Lawrence nearly thirty-three miles below Cape Chat. Where it meets the highest tides, which is about half a mile up from the open gulf, the stream is about one chain wide, and there is at the mouth of the river a lagoon behind a barrier of sand which runs out from a rocky point on the west side of a not very deep bay. The lagoon forms a very good harbour for fishermen's boats and such small schooners as can effect an entrance in moderate weather, but a small rocky island, and the narrowness of the channel render the entrance dangerous at other times.

The hills near the mouth of the river are not more than from 200 to 400 feet in height, and their crests appear to run parallel with the coast; but a few miles inland, they become lofty and their run appears to be about north and south. At about six miles from the coast, between the main trunk of the Marsouin and Henley's Brook, they were estimated to rise to the height of from 2500 to 3000 feet, while east of Henley's Brook and west of the Marsouin they do not attain 2500 feet. In a shallow depression on the ridge between the Marsouin and the north branch of the Ste. Anne, the height was supposed to be about 2600 feet, and two streams belonging to this branch crossed on our south-east line in a mile and a half beyond this, were respectively about 270 and 310 feet lower.

The first of these two streams takes its rise in the depression already mentioned, which is four miles to the north-east. Its source is a pond about a quarter of a mile in diameter, which is immediately followed by two small lakes, each three-quarters of a mile long by a quarter of a mile wide. The second, which is the larger and the main stream of the north branch, takes its rise about two miles to the south-east of these lakes, in a sheet of water which is a mile and a half long by half a mile wide.

A mile and a half beyond these streams, we reached the summit, which was estimated at about 3500 feet above the sea. It displays a narrow ridge running west for two miles between the north branch and another of its tributaries, and then rapidly falling toward their junction; but in an opposite direction the ridge sweeps round to the south with a breadth not exceeding a quarter of a mile, flanked on either side by a narrow ravine sinking precipitously 800 or 1000 feet. Continuing southwardly for about a mile, the ridge widens out and meets the equally high surfaces coming from the opposite side of the ravines. This increased breadth constitutes a sort of table land of some two or three miles wide, extending southwardly for about eleven miles, to the summit over-looking the valley of what was last season called the middle branch of the Magdalen. With the exception of one point, the inequalities of this table land scarcely exceed 100 or 200 feet, and they are chiefly due to a somewhat raised rim which occupies each side of the top. The rim however is broken through by various gaps, permitting the escape of the water which collects in the central depression.

The point just referred to is situated on the eastern rim about four miles from the north end of the table, and it constitutes a peak which attains a height estimated to be about 4000 feet above the level of the sea. It is this part of the mountain to which Mr. Murray alludes in the Report of 1845 and 1846 (p. 104) as interrupting his view from Mount Albert on the west side of the Ste. Anne River. Mr. Murray ascertained by barometrical measurement that Mount Albert is 3778 feet over the sea, and this height has been taken as a standard by which to compare the heights of the various summits that could be seen from it, so that it is partly by this aid that the elevations here given have been computed.

The waters collected in the central depression are discharged partly into the Ste. Anne and partly into the Magdalen from a multitude of small lakes or ponds. The most northern group of these consists of thirteen sheets of water, none of them exceeding fifty acres in superficies. They spangle an area of about three square miles and unite in a stream, which running northward, falls into the ravine on the east side of the narrow ridge at the north end of the table top. These are tributary to the north branch of the Ste. Anne. A little south of these, there is a group of five ponds occupying an area of two square miles, of which the discharging stream flows eastward round the south side of the peak, and another group of two, whose outlet joins the previous stream at the east base of the mountain. The united waters of these brooks flow northeastward and then southward, being what in the Report of last season, was termed the northern branch of the Magdalen. About five miles southward of the peak there is a group of seven or eight more lakes and ponds scattered over an area of about the same number of square miles. The brook resulting from these flows first to the westward, but turning south within the western rim, gradually winds farther round, and flows eastward through a profound gorge as the middle branch of the Magdalen.

The western flank of this table-topped mountain stands at the distance of about four miles east of the junction of the north branch with the main stream of the Ste. Anne. The base is about four miles wide, and its eastern flank in its progress southward comes to within about four and a half or five miles of the junction of the north, south and middle branches of the Magdalen, being the point reached by the measurements of 1857.

The central depression of the top might be supposed to be continued in a pretty straight course along the line which we kept in returning to the mouth of the Marsouin, and approaching the coast to be represented by Henley's Brook ; the whole mountain being thus continued north. But as the table-topped mountain is composed of intrusive rock, while the mass between the north branch of the Ste. Anne and the coast, is sedimentary, with an east and west strike, the north and south ridge-like character of the latter must be only an accident arising from transverse valleys, the position of which give the sedimentary rocks the semblance of being a prolongation of the unstratified mass.

The bearing of the central depression on the intrusive hill, is about S.S.E., and the whole mountain mass has the same bearing. The mass is continued beyond the gorge of the middle branch for six miles, making the whole length about eighteen miles. These six miles, however, do not display summits of such great height as the general surface of the table land, none of them being estimated to exceed 3000 feet. The southern part separates the Ste. Anne from the south branch of the Magdalen; but from a bulge toward the Ste. Anne on the western flank and the occurrence of a bare mountain mass on the east side of the stream of the same general aspect, it is supposed that the intrusive rock may cross the stream at the spot. The whole intrusive mass occupies an area of about seventy-two square miles, the greater part of which is bare rock.

What was considered to be the south limit of the unstratified mass was determined by a bearing from the Barn-shaped Mountain, and by another bearing from it, the position of the supposed igneous rock on the east side of the Ste. Anne, was ascertained to be in a line between the Barn-shaped Mountain and the profound gorge which gives egress to the middle branch of the Magdalen from the table top. The Barn-shaped Mountain as conjectured in your report of 1844, was also found to be composed of igneous rock.

In the depression of the table land and in some of the gorges, especially near the ponds, moss has accumulated to a thickness of from one to three feet, supporting spruce trees growing widely apart and from fifteen to twenty feet high. The greatest diameters of the stems vary from eight to twelve inches, and the stems preserve a very uniform measure to within a few feet of the top. These trees are very ancient and very hard; their wood taking a high polish might be valuable to cabinet makers if it were more accessible. In a stem of four inches in diameter I counted 161 rings of growth, and the largest seen I computed to be 600 years old. Under these trees, various grasses and small flowering plants, all of the most lively green, are met with. In various parts of the central depression patches of snow still lay many feet deep, on the 1st of August; and through its agency, were brought together plants just springing up from the ground, and others of the same kind in blossom only a few yards removed. Between the table land and the coast, around the small lakes at the head of the north tributary of the north branch of the Ste. Anne, spruce and balsam stand in clumps widely apart, while the surface is wet and the open spaces are covered with short wiry grass. The upper part of the Marsouin and the valley of Henley's Brook afford a thin soil, supporting balsam-fir, spruce and some white birch; but in the valley of the main stream, for six miles up from its mouth, good land prevails. There are probably from fifteen to twenty square miles of excellent agricultural soil, which at present supports a heavy growth of maple and birch, with some spruce and balsam intermixed.

Coast between Marsouin and Great Metis Rivers.

From the Marsouin to within three miles of the Ste. Anne, the coast is generally bold, the heights within half a mile of the shore, attaining from 300 to 1000 feet above the sea. At the mouths of some of the streams, considerable areas of good land exist, with maple and birch, and I was informed that the less elevated grounds some distance inland, displayed many patches of excellent soil, supporting a heavy growth of maple, birch and spruce.

From three miles below the Ste. Anne to Cape Chat, there is a distance of fifteen miles. It was stated in your report of 1844, and in Mr. Murray's of 1845, that there was here a considerable area of land fit for cultivation near the shore, which is rather low. The whole distance is now occupied by settlers, and back from the shore for two or three miles I observed clearings in the woods, on the sides of the hills, giving excellent crops of oats, barley, potatoes and timothy grass.

From the Chat to Cape Whale, between twenty-six and twenty-seven miles, the coast is generally bold and rugged, and but few settlers are as yet met with; but a new government road is now in course of construction under the superintendance of Mr. Dugald Fraser, who notwithstanding the difficulties of the ground has succeeded in laying out the road. This will not only afford a means of communication with the fine settlements already made at Cape Chat and Ste. Anne, but encourage the establishment of farms on the good lands along the route; of these at the time of my visit, people from the different parishes above, were availing themselves rapidly.

From Cape Whale to the Great Metis River, the coast is in no place much elevated, with the exception of a few points from two to three miles inland connected with ridges running parallel with the St. Lawrence; none of these appear to exceed from 500 to 600 feet above the sea, as far back as probably ten or twelve miles, and in the neighbourhood of the Tartigo River, even as far back as Lake Matapedia. Settlements are more or less established all along the coast, being continuous on approaching Matanne, and in some places between Matanne and Metis penetrating as far back as from two to four miles.

On the road from Metis to Matapedia the settlements may reach ten miles back, and although the country on this road appears to rise a little higher than it does some distance to the north-eastward, no part of it that I observed would much exceed 750 feet, with the exception of a ridge south-west of the road about ten miles from Metis. The height of this ridge is probably not under 1000 feet. It runs parallel with the other ridges met with on the road, their general bearing being from N. 32 E. to N. 30 E., and it presents a sharp rocky summit with bare rock on the north side. South of Matapedia Lake however, and as far as the Restigouche River, the principal hills, often attaining the height of 1000 or 1200 feet, and occasionally shewing rocky escarpments running for a few miles on one side or the other, appeared rather to stand up as detached masses, than to preserve any great degree of parallelism as ridges.

Except on some of the highest points, the whole of this country, from Metis to the Restigouche, for a distance of more than seventy miles in a straight line, may be said to possess a rich agricultural soil. At the head of Lake Matapedia, which is about 480 feet above the sea, Mr. Pierre Boucher has a large cleared farm, and his son has another at the outlet. On the latter, I saw a field with an excellent crop of barley ready for harvesting on the 18th of August; and both farms presented good crops of oats, potatoes and timothy grass. Thirteen miles below the lake, at the mouth of the Capscoult (a considerable tributary of the Matapedia,) Mr. Noble has about fifty acres in cultivation; the crops growing on them at the time of my visit I have seldom seen surpassed. They consisted of oats, barley, pease, potatoes, turnips and timothy grass. In their thick strong stems, and long branching heavy loaded ears, and the closeness with which the stalks stood upon the ground, the oats resembled more what is met with in a field in England than what I have usually seen in Canada. A large area of land in this neighbourhood has been denuded of its forest by fire, and much of it is of the same description as that occupied by Mr. Noble, requiring little more than ploughing to render the natural fertility of the soil available.

At the junction of the Matapedia with the Restigouche the land, except on the highest parts, which may be 800 or 1000 feet above the sea, has a soil of the richest description, and well cultivated farms are met with on the banks of both rivers. The farms on the Matapedia extend about four miles up the stream. Mr. Daniel Fraser, at the mouth of the Matapedia, feeds from seventy to a hundred head of cattle and from 150 to 200 sheep, which as well as those of his neighbours are large and unusually well conditioned. In this neighbourhood and farther down towards the Bay Chaleur, a large number of cattle and sheep are annually raised, but the want of a favorable outlet to a market naturally keeps down the value of farm produce. A government road is now being constructed in a most solid manner, and at low grades, under the superintendence of Mr. J. B. Lefebvre, from the Bay Chaleur along the east bank of the Matapedia to Matapedia Lake, and thence to some point of the St. Lawrence. This road, in addition to affording a means to the settlement of the country across the peninsula, may become of great advantage to the farming community of the Restigouche, as well as to the inhabitants of Quebec, for with steam communication up the St. Lawrence from some point near Rimouski, Quebec might be benefited by an additional supply of cattle and sheep, as well as by the establishment of a general commercial intercourse with the Restigouche scarcely now existing.

The Restigouche River to the Mouth of the Patapedia.

About eight miles below the Matapedia the Restigouche meets the tide, and there are about two miles more to the head of the Bay Chaleur. For several miles above the bay the river is from a mile to half a mile wide, and it is thickly set with low islands forming good meadow land. Above this to the Matapedia, the breadth becomes contracted to less than half a mile, and in some places, a considerable current prevails. From the Matapedia to the Patapedia the distance in a straight line is a little over twenty-one miles, in a bearing about S. 65 W.; but following the windings of the river, the distance given by the boundary commissioners is thirty-seven miles. About seven miles above the Matapedia, at a great bend to the right, a large tributary joins on the New Brunswick side. It is called the Upsalquitch and is five chains wide at the mouth. About six miles higher up a tributary not more than ten feet across, called the Brandy Brook, joins on the Canada side, and while the distance by water from the Matapedia is thus thirteen miles, it is only six and a half miles over land. Above this, several other conspicuous bends occur; the bow at Cross Point, which is the most remarkable, is thirty-one miles above the Matapedia by the river. In this curve, the distance by water is two miles, while across the land it appears to be not much over a hundred yards.

As far up as Brandy Brook the hills stand somewhat back from the river, and rise with gently sloping sides, well covered with soil, to the height of from 300 to 500 feet. Within a short distance of this both sides of the river are settled, but farther up the hills come close upon the river and often rise up abruptly to heights of from 400 to 600 feet. It is thus only on flats at intervals of several miles that sites can be obtained for settlement on its banks. The sides of the hills in this part appear to be thinly covered with soil, but farther back the land is said to be capable of cultivation. Above the Patapedia the Restigouche is wholly within the province of New Brunswick. At its mouth the Patapedia is six chains wide, including a small island dividing it into two channels, but above this the breadth does not exceed about fifty yards.

Patapedia and Great Metis Rivers.

According to my measurements the whole of the distance from the mouth of the Patapedia on the Restigouche to the mouth of the Great Metis on the St. Lawrence, following the curves of the rivers, is 91 miles, 51 chains and 90 links; while the distance between the same two points reduced to a straight line would be 64 miles. The distance in a straight line between the same two points as deduced from the survey of the Boundary Commissioners on the Restigouche, and that of Bayfield on the St. Lawrence, would be 64 miles, 8 chains.

The distance measured on the Patapedia and its tributary the Awaganasees or Pass Brook, was 40 miles, 19 chains, 52 links. The first main stretch of the valley in an upward bearing N. 61 W. is a little over twelve miles, while by the water it is a little over fifteen miles and a quarter. The aspect of the river and its banks varies but little the whole way. In the lower half the hills rise irregularly to from 100 to 400 feet, generally close upon the river, but sometimes from 100 to 300 paces back, and where intermediate flats occur they produce ash, elm, yellow birch, spruce and poplar, while the slopes are covered with white birch, spruce and balsam, with a few white pines. Except on the flats the soil appears to be in many instances adapted for pasture only. The upper half resembles the lower, except in that the hills gain a little in height, and support more white pine. It is probable, however, that the greater part of the white pine has already been carried away from both parts by those engaged in the timber trade. I observed a few heads of timothy grass growing on the edge of the river, the seeds of which had probably been carried there by the lumber-men ; the stalks measured fifty-five inches in height. The largest tributary brook seen in this part of the river is sixteen feet wide at the mouth ; it falls in on the east or Canada side, seven miles and a quarter from the Restigouche.

The second upward stretch of the valley in a straight line N. 8 E. is a little over seven miles and three quarters ; by the bends of the river the distance is upwards of thirteen miles. A little over a mile and a half up, a tributary called Pollard's Brook joins on the right side ; a short distance above its mouth it is seventy links wide. About four miles and a half above Pollard's Brook we reach the forty-eighth parallel of latitude, on which the boundary line between Canada and New Brunswick is continued to the westward from the river. The spot is marked by an iron monument on the right bank, numbered 59. The measured distance by the river from the post numbered 60 at the mouth, is 22 miles, 16 chains, 94 links, and the distance reduced to a straight line is 15 miles, 11 chains. The distance as deduced from the measurements of the Boundary Commissioners is 15 miles, 17 chains ; a little below the forty-eighth parallel a brook, measuring about twelve feet across, comes in on the right bank, and about seven miles above the parallel, there is at the end of this general bearing another tributary stream ; it is called Indian Brook, and with a breadth of about eighty links, it joins on the left side. For about half a mile up the tributary the bearing is about ten degrees south of west, and it then turns to ten degrees north of east. The place where this stream joins is sometimes called by the lumber-men The Fork.

The aspect of the river as far as Pollard's Brook in this stretch resembles the upper half of the part below, but above the brook the hills are less elevated, and excepting on the flats, which are not extensive, there appears to be a thin soil. Near the stream in this part much of the country has been overrun by fire, and the new timber springing up in place of the old is spruce, white birch and cypress, occasionally in thick groves. About a mile from the right bank the hills rise to the height of from 400 to 600 feet, and at the same distance from the opposite side they are from 300 to 400 feet.

The next general bearing of the valley is N. 52 W. to the mouth of the Awaganasees. The distance in a straight line is a little over three miles, and by the river nearly four miles. Beyond this the Patapedia is said to have a bearing a little north of west for six miles, and then west of north for six miles more; it there issues from a lake which has an upward length of three quarters of a mile; this lake three quarters of a mile farther is followed by another of double the length, and by an additional one of two miles and a half in length a mile beyond, all three in the same bearing as the river.

Although the Patapedia is rapid it is well adapted for canoes, but the lumberers use scows or flats from eight to twelve feet wide and from twenty to thirty feet long, which are drawn by horses. As they draw the scow up the stream the horses wade in the shallowest part or sometimes walk on the bank, while the steersman guides his vessel in the deepest or most convenient water. Coming down stream the horses are embarked, and all are carried down by the current, the vessel being guided by the aid of poles. It is by such means that provisions for men, as well as oats and hay for horses and cattle, are conveyed for lumbering purposes up the Restigouche and its tributaries.

The bearing of the Awaganasees from the mouth to where we left it is N. 12 W., the distance in a straight line being seven miles, by water nine miles and a quarter. At its mouth the tributary is about half a chain wide, but somewhat over six miles up, after an expansion in a beaver meadow of from three to five chains, which continues for a mile, it splits into two equal branches, and where we landed our canoes from the western branch it was not over five or six feet across. The navigation all the way up this brook was very troublesome from overhanging bushes and fallen trees. The expansion in the meadow is flanked on either side by upwards of half a mile of swampy ground supporting a growth of spruce and tamarack. Near the brook the land is generally low, but detached hills rise at the distance of one or two miles to heights of from 200 to 400 and even 500 feet. The aspect of these hills as seen from the brook induced the opinion that they bore a considerable quantity of hard-wood, and might possess a good soil.

From this the upward course of the Awaganasees turns gradually eastward, while the portage continues in the same direction as the previous bearing of the brook; the length of the portage is three quarters of a mile, and it comes upon a long narrow bay or creek of the Upper Metis Lake, near a small run of water coming from the west. The height of land on the portage is about five feet, and the waters on the opposite sides appear to be about the same level.

In the upper part of the Metis there are three lakes which in the absence of other names, we called the Upper, Middle and Lower Metis Lakes. The first bearing from the head of the Upper Lake was N. 29 W. and the distance in a straight line nine miles and a half, but a little more following the curves of the water. This bearing included two of the lakes, the bearing touching the outlet of the first and terminating at the outlet of the second. The length of the Upper Lake is four miles, the stream connecting the first and second is nearly a mile, and the second lake is again about four miles. The average breadth of both the lakes is half or three quarters of a mile; the shores of both are low and they are furnished with a dense fringe of cedar and alders, the latter overhanging the water. The land rises gradually for half a mile on either side to the height of from fifty to seventy feet, while at the distance of three quarters of a mile more, the hills attain the height of 300 or 400 feet; the slopes appear to be moderate. Near the lakes some black ash was occasionally observed, and further back some maple trees, but the principal wood of the hills is spruce.

The only difference in the aspect of the two lakes is that the second one has several small islands. At the head of this lake is a well marked depression running to the right and to the left, nearly at a right angle to the axis of the two lakes. From these depressions a brook of six feet wide falls in on the east, and a somewhat larger one on the west. About the middle of the lake a stream fifteen feet wide comes in on the west side; it has a general upward bearing S. 65 W. for about a mile, where it issues from a lake said to extend a mile and a half farther in the same bearing with a breadth of half a mile, and three quarters of a mile still farther there is another lake, said to be nearly round, with a diameter of three quarters of a mile. Just above the outlet a stream measuring twenty-four feet across comes in on the east side, with an upward bearing of N. 70 E. for half a mile, where it splits into two branches, the one branch maintaining the same upward bearing, and the other bearing north six or seven miles, in which direction it comes from among a group of mountains which appear to be not under 1000 feet in height.

The stream connecting the middle and lower lakes meanders through a low swampy tract, and presents several small expansions on its sides; a bearing N. 63 W. and a distance of two miles and a half reaches from one end to the other.

The Lower Metis Lake is two and a half miles long in a bearing S. 73 W. which runs nearly along the middle of it. The breadth is from an eighth to a quarter of a mile, the shores like those of the other two lakes are low, and the hills which bound the lower ground at a distance varying from half a mile to a mile, are of moderate height.

The respective heights of these lakes over the sea are computed to be as fellows:

Upper Metis Lake,	....	775 feet.
Middle "	....	760 "
Lower "	....	758 "

From the outlet of the lower lake a bearing of N. 27 W. takes us fifteen miles and a half down the valley in a straight line, to which distance the curves of the stream would add three miles more. In the first three miles, in which the stream is very rapid and broken, there is an estimated fall of 115 feet, or thirty-eight feet per mile; in the next mile there is a fall of 143 feet, and three portages are necessary to accomplish the descent; the upper and lower ones are only from twenty to thirty yards each, but the middle one is nearly half a mile in length and comprehends the greatest falls. In about the middle of the portage there are two vertical cascades, of which the upper gives a fall of ten or eleven feet, and the lower one, fifty paces farther, a leap of about thirty-five feet, in addition to which there are several other leaps of different heights. Both above and below these falls the river runs through a narrow gorge in which it is for the most part inaccessible. Two miles below these falls we come to the mouth of a tributary about sixty links wide, called the Rouge, which joins on the east side; and four and a half miles farther to the Misquegegish, a chain and a half wide, joining on the west side. The fall from the cascades to the Rouge is estimated at fifty-five feet, and between the tributaries twenty-six feet. In the remaining six miles the fall is estimated at seventy-eight feet. Independent of the vertical falls, the river in all those parts that are capable of descent in a canoe, has a very rapid current.

The breadth of the river above the Rouge is about one chain, and below it is two chains; except at the portages the banks of the river are generally low, but at a little distance from the stream detached hills rise up to heights of 100 or 200 feet, and occasional escarpments of twenty and thirty feet come close upon the river. In the neighbourhood of the cascades and as far back as the lower lake the soil appears to be thin, while below the River Rouge, although spruce is most abundant, maple and yellow birch are not wanting, and elm is occasionally met with near the river. Below the Misquegegish after a short interval of comparatively level land, low ridges begin to appear, rising to heights of 100 and 200 feet, and towards the end of the distance they attain 300 feet. The ridges are unlike the detached hills above, for they preserve a general parallelism with one another, with courses varying from N. 45 E. to N. 83 E.; except in two cases where the summits were bare rocks, the ridges both on their sides and tops support a heavy growth of spruce, maple and yellow birch, with balsam fir. The flats, which are sometimes extensive, in addition to these species of trees, produce elm and ash, which are occasionally abundant.

The next bearing in the general course of the river is N. 87 W.; the distance in a straight line is three miles, and following the course of the channel, half a mile more. The fall is thirty-seven feet. Between this part and the lower portion of that which preceeds it, the difference is confined to an extension of the flats, which are here under cultivation. The breadth of the valley is now from three-quarters of a mile to a mile in width, and on each side of it ridges rise up gradually to heights of 150 and 300 feet; approaching the end of the distance the River Neigette comes in on the west side ; its width is seventy-five links at the mouth, and its upward course is westward with the general bearing of the ridges; in this direction it reaches to within a few miles of the River Rimouski, and to a position not exceeding five or six miles south-east from the St. Lawrence; it then turns southward for some distance to a lake of no great extent, from which the stream issues.

The last general bearing of the River Metis to its mouth in Metis Bay is north; in a straight line the distance is six miles, and following the sinuosities of the channel ten miles and a little over. The first six miles and a half present no new feature with the exception of ridges which occur three miles down, rising to the height of 300 feet at the respective distances of 100 and 300 paces on opposite sides of the stream, and run parallel with the other ridges. The fall in these six miles is forty feet, and in the rest of the distance to the mouth 215 feet; the remaining distance is upwards of three miles and a quarter, in the upper half of which there occurs a vertical fall of ninety feet, and another of fifteen feet over the dam of Messrs. W. Price & Sons' saw-mill, with still another a mile and a quarter farther down over the grist-mill dam, of twelve feet. These three vertical falls, amounting to 117 feet, leave ninety-eight feet for the slope of the intervening spaces. From the upper fall to the grist-mill the river forces its way between banks rising from 50 to 100 feet over its bed, and from three to four chains separated from one another.

The entrance to the Metis from the bay is at a point or bluff of rock rising on the west side to the height of about fifty feet, and at low water the channel is not over two chains across to a low point on the east side composed of sand and clay. Inside of this, a basin sixty-seven chains long and about half that measure in width, affords a good harbor for schooners of moderate draught. The bay outside of this is protected by a point a mile out from the mouth of the river, projecting from the west side eastwardly, and this with two low narrow elongated islands lying a little within the point, yields shelter for a larger class of vessels. Any vessel however drawing more than nine or ten feet would be in danger of injury from the numerous large boulders of Laurentian rocks that lie scattered over the bottom of the bay.

Country between Metis and River du Loup.

To the westward of Metis as far up as the River Rimouski, a distance of twenty-seven miles, the rise, either immediately upon the shore or in a distance of from 100 to 200 paces from it, is from thirty to forty feet. Beyond this for a breadth of from one to two miles the surface is nearly level; a great part of it is swampy and covered with moss. This swampy tract is widest about half-way up, narrowing considerably toward the two extremes; for two or three miles beyond the breadth of this low ground, the surface rises gradually to the height of from 400 to 500 feet above the sea, and then breaks into undulations which extend as far as the Neigette River. Opposite to where this river takes its upward turn to the south, the ridge on the north, over-looking its valley, is about 400 feet high. This ridge at this place and for some distance eastward and westward presents an exposure of bare rock. From the turn on the Neigette, the depression of the eastward and westward portion of its valley continues westward, and it becomes occupied by another small stream called the Bois Brulé, which flows westward until it joins the River Rimouski, about six miles above the mouth of the latter. An apparent continuation of the valley of the Bois Brulé brings the Little River Rimouski from the westward, to join the main stream a little above the former, so that there is a marked continuation of one valley for upwards of thirty miles.

Below these tributaries the Rimouski flows towards the St. Lawrence through a deep and not very wide gorge, which continues to within a mile of its mouth, where Messrs. W. Price

& Sons have a saw-mill, which is situated a little above high water mark. Below the mill the banks of the river become less elevated, and they are quite low at the mouth. Above the junction of the two tributaries the Rimouski is rapid, and continues confined in a narrow gorge as far up as eight miles in a straight line. The breadth of this gorge at the top is from five to six chains, but the breadth of the channel, which is from 100 to 200 feet below, does not exceed a chain or a chain and a half. In the whole distance given, (eight miles) only one place was observed where an approach to the water from the top is tolerably easy; it was at the mouth of a brook coming from an extensive marsh in the township of Macpes, and falling into the Rimouski on the fifteenth lot of the third range of Duquesne.

The falls of the Rimouski are situated on the twenty-third lot of the fifth range of the same township. The descent is in two cascades; the height of the upper is about sixty feet, while that of the second, which is about a hundred paces farther down, is only twenty feet. Immediately above the falls the river is but little below the top of the banks, and a moderate current and good land on each side of the stream are said to prevail from the falls to the head waters of the river.

From the falls to within a mile of the Bois Brulé River the hills are detached, but not elevated; below them swamps and small lakes are abundant. The timber is spruce, balsam, white and some yellow birch, with now and then a pine tree. The soil appears to be thin, and the timber is not large. Between Metis and Rimouski, to the north of the Neigette valley, and in it, the very best soil prevails. This is evident in the numerous well built farm steads. Approaching the village of Rimouski the country is highly cultivated, and the beautiful village itself shews considerable wealth in its many tasteful large and substantial buildings.

From the Rimouski for a distance of seven miles to a small stream called the River Athie, within two miles of Bic Harbour, the coast is still low except in two places, one of them opposite Barnaby Island, where the bank has a height of fifty feet, and another two miles farther up the coast, where the bank is about sixty fe high. From the low ground of the shore there is a gradual rise in the surface for two miles back, where it attains 400 feet above the sea, and then breaks into parallel ridges, which succeed one another to the valley of the Little Rimouski River.

From the River Athie to Pointe aux Trembles, two miles below Trois Pistoles church, the coast is rock-bound nearly the whole way; the distance is twenty-six miles and a half, and except at Bic Harbour and another place a little below St. Fabien, no settlement can be effected along it. Towards the east end there are three indentations in the coast line; one of these is Bic Harbour, which is bounded on the east by a rocky point lying between Bic River and the St. Lawrence, and by two small islands, the larger called L'isle Massacre, lying in continuation of the point; and on the west by Cape Enragé, which runs into a peninsular form in the same line as the islands and point on the opposite side. Another of the indentations forms a deep bay between Cape Enragé and a jagged sided promontory of a peninsular form, running out a mile from the continuous line of coast and called Cape Orignal. The third is Haha Bay, which lies on the west side of the peninsula of Cape Orignal.

This uninhabited part of the coast forms a belt of from one to two miles wide, which is ribbed by sharp longitudinal ridges rising over the sea from 400 to 500 feet, and even occasionally 600 feet, with an elevated point which on Bayfield's chart is called the Highland of Bic, and to which is given the height of 1263 feet. To the south of this belt, long stretches of a flat valley run parallel with it, having a breadth of from half a mile to a mile, succeeded by another sharp ridge from a quarter to half a mile across. These valleys and ridges follow one another in the neighbourhood of St. Fabien and St. Simon, for about four miles, to a well marked depression holding the waters of a stream called Rivière du Sud-Ouest, which in its course expands into several long narrow lakes and empties into the south-west corner of Bic Harbour; beyond this the country is more elevated but less broken.

From Point aux Trembles, two miles below Trois Pistoles church, to Rivière du Loup a distance of nearly thirty miles, the coast is in in no place bold, and it is all the way accessible from the land. The only prominent rocky points are one just above the church of Trois Pistoles, running up from it a mile, and from twenty to fifty feet high; another about a mile above Trois Pistoles River, which runs along the coast for another mile with the height of forty feet; and a third over three miles above Green Island River, which runs along the coast for three miles and a half, making straight for Cacouna Peninsula, and separated from it about half a mile. The ridges behind are not so well marked as farther to the east, but there are indications that the spaces between them are well filled up with drift clays and sands, two terraces of which run along the country from the east of Green Island River to the River of Trois Pistoles. The first is about a mile from the St. Lawrence and 110 feet above its surface; the second is 170 feet higher and a mile farther back. The greatest development of these terraces is to the west of Trois Pistoles River, but before reaching Green Island River their marked outline is lost.

To the east of Rivière du Loup village several low rocky ridges and hills are seen, but these have been already described by yourself in your Report of 1849. A well displayed ridge crosses the falls above Rivière du Loup, but it loses its marked outline in its easterly extension in the rear of the village of Cacouna. On the south of this the waters of Green Island River flow to the eastward, and farther south in the townships of Viger and Whitworth higher lands rise up, the north side of which may be the continuation of the highland already mentioned as lying to the southward of the valley of the river.

DISTRIBUTION OF THE ROCK FORMATIONS.

The rocks prevailing in the district of which some of the geographical features have been given above, are similar to those of the previous season's Report. Without repeating the explanations then given, I shall describe their characters as they appeared to me, the following being their supposed sequence in ascending order.

A, Graptolitic shales and sandstones,....... } Lower Silurian.
B, Conglomerate limestones often magnesian, }

C, Pillars and stonesand red shales,..Middle Silurian.
D, Gaspé limestone,................Upper Silurian.
E, Gaspé sandstone, ...Devonian.

Section between the mouth of the Marsouin and the Table-topped Mountain.

A little below the mouth of the Marsouin River there occurs a set of grey slightly calcareous sandstones, divided into beds of from two to three feet thick; some of the beds are coarse grained and hold small translucent fragments of blackish quartz, little pebbles of grey and black chert, and small fragments of black shale and of brownish-weathering magnesian limestone. The coarse beds under atmospheric influences become rough on the surface and present the character of fine conglomerates, the pebbles seldom exceeding the size of peas, but in fresh fractures this character is not so conspicuous. These sandstones at the spot present a vertical attitude with a strike bearing N. 49 E.,* but at a point about three quarters of a mile eastward very nearly in the strike, the dip becomes N. 41 E. $< 64°$. Crossing obliquely southward from this it soon becomes S. 26 E. $< 30^0 — 55^0$, and for two miles and a half in a coast line oblique to the measures it continues southerly, bringing out higher and higher strata,though from disturbances and irregularities it is difficult to say what the thickness may be. Still farther on the coast continues to cross the measures obliquely, but several undulations occur, and the measures acquire a general but irregular dip, apparently southward at a somewhat high angle. The sandstones become yellow-weathering and fragments of bivalve shells are met with in them, while black shales holding graptolites become more and more interstratified.

The irregularities of the dip render it difficult to determine the thickness exposed, but the mass appears very much to resemble part of a group of strata described by yourself in the Report for 1844, as occurring four miles below the Magdalen River on the south side of an anticlinal, and then again on the

* The bearings in this Report are in reference to true north.

north side of it at Gros Mâle. The group below the Magdalen includes certain strata still underlying those given above; they are stated to be a set of splintery sandstones with very large yellow-weathering calcareous nodules or patches, interstratified with grey slates. Perhaps this portion may be exposed somewhat farther below the Marsouin, but the section was not followed far enough to ascertain it. The total thickness given to the whole group in 1844 is 2000 feet; the part seen below the Marsouin may represent half the amount. The beds are supposed to belong to Division A.

A little above the mouth of the Marsouin there occurs a set of black bituminous shales highly charged with nodules of iron pyrites and interstratified with thin layers of limestone, and in these beds graptolitic remains are abundant, with an occasional *Orthoceras* replaced by iron pyrites. On a small island at the mouth of the river, masses of black and green compact rock resembling jasper occur, very similar in aspect to masses described in the Report of 1852–3, as met with in association with black graptolitic shales on the north-west side of the St. Lawrence, a mile and a half above Cap Rouge River. Immediately above the black pyritiferous graptolitic shales at the mouth of the Marsouin there occurs a band of red shale, interstratified with green shale, and associated with a bed of conglomerate from six to twelve inches thick, in which a multitude of rounded masses of black chert, with some softer masses resembling the chert, are set in a dolomitic limestone, the masses being somewhat flattened and some of them reaching an inch in diameter.

Although these strata are somewhat disturbed, the red shales can be traced several miles up the coast. The black graptolitic pyritiferous shales are considered to belong to the top of the Division A, and the red and green shales with their thin conglomerate band to the Division B. But between the obscurely fossiliferous sandstones below, and the black graptolitic shales above the mouth of the Marsouin, though they both belong to the same division, there is supposed to be wanting a considerable thickness of black graptolitic shales interstratified with black yellow-weathering dolomites, which on the Magdalen River were found to overlie the sandstones. It would be hazardous to assign to the beds wanting any specific thickness; but it would seem probable that there is a dislocation running up the Marsouin, with an upthrow on the east side of it, the value of which would be represented by the beds wanting.

Passing up the valley of the Marsouin about a mile and a quarter, sandstones resembling those seen on the coast below the mouth are met with, interstratified with black shale, and dipping S. <48°. A mile farther the debris in the stream was black calcareous shale, and black shales were again seen in the bed of the stream two miles still farther up. Upwards of two miles beyond this we came upon a set of black slates, which though uniform in color, presented a diversity in mineral character, some of them being somewhat calcareous, while others appeared to be destitute of carbonate of lime, and shewed small scales of mica on the surfaces. The divisional planes were nearly vertical, with a strike N. 47 E. Rock of a similar character prevailed for two miles, and at the end of the distance the divisional planes shewed a dip N. 11 W. <64°. The thicknesses of the slates were very regular, varying from a quarter to three-eighths of an inch; and with these thicknesses slabs of eight or ten feet square might be obtained. Loose masses indicated that from some beds, which were not seen in place, slabs of from two to three inches might be obtained, capable of yielding excellent flag-stones, while the others would form good tile-stones or good roofing slates, provided the calcareous parts were avoided. No change in the character of the rock was observed for upwards of three miles farther, the planes of division about half-way shewing a dip N. 26 W. <60° — 70°.

In the valley of Henley's Brook, rock of a similar character was observed about four miles from the coast. It prevailed in the upward course of the brook for two miles and a half, and the rock of this valley would be a material of a very superior description for roofing slates and flag-stones. The position of the most northern exposure of these slates on Henley's Brook would be in the strike of the divisional planes of the most northern exposure on the main stream, while the strike of the more southern exposures does not differ materially from what may be considered that of corresponding positions in the two valleys, though the slope in the one is northward and in the other southward, the dip in the more southern exposure on Henley's Brook being S. 8 E.< 50° — 80°. From this, it appears probable that there is not much difference between the cleavage planes and the bedding of the rock.

Beyond these roofing slates no exposures of rock were seen for some distance. The nearest south of the position on Henley's Brook was on the small lakes at the source of the north tributary of the north branch of the Ste. Anne, where the rock that forms the sides and the bottom of the lakes is a black hard brittle slate, holding cubes of iron pyrites; and the nearest to the slates of the Marsouin was at the junction of the south tributary with the main stream of the north branch. This was also a hard and brittle black slate; it was traversed by strings of white quartz, but contained no observed pyrites; the dip was S. 26 E.<60°. The whole of the rocks from the sandstones at the mouth of the Marsouin up to this point, are supposed to belong to the group A.

A mile and a half southward of the black brittle slates an exposure occurs on the high narrow ridge constituting the north end of the table-topped mountain. The beds dip S. 64 E.< 70°—80°, and the following is the section which they present in ascending order:

Blueish-grey slate in beds of from one quarter to one half an inch; it appears to have disseminated through it very small grains or imperfect crystals of chloritoid...........................	510
Blueish-grey slate as before, interstratified with beds of from two to six inches of grey sandstone; some of the beds are coarse enough to constitute a conglomerate, the pebbles of which consist chiefly of colorless transparent and translucent quartz as large as small peas....................................	319
Reddish-grey slate with a nacreous or pearly lustre, showing a great abundance of imperfectly formed crystals of chloritoid.	49
Blueish-grey slate in beds of from a quarter to half an inch with very small grains of chloritoid; the slates are interstratified at intervals of ten, fifteen, and twenty feet with thin bands of white crystalline feldspar..............................	828
	1706

The stratigraphical place of these beds is somewhat uncertain, but the pearly lustre of part of the slates, and the presence of chloritoid give them the aspect of slates often met with near the dolomites and serpentines of the Eastern Townships, and they may represent some part of the summit of Division A., or the base of division B.

These strata appear to plunge under the great mass of igneous rock of which the table-topped mountain is chiefly composed. As already stated this mass extends probably eighteen miles to the southward, with a breadth of four miles in general, but opposite the middle branch of the Magdalen, it becomes broader and extends across the Ste. Anne. The rock appears to be a fine grained granite, composed of flesh-red feldspar and brown mica, with so sparing an amount of quartz in some places that it is very difficult to detect it, while boulders, supposed to be derived from the mountain, show it to be abundant in others. The northern limit of the mass was traced from the neck of the narrow ridge where it turns from east and west to south, as far as the small lake which gives origin to the main stream of the north branch of the Ste. Anne.

The position of this mass of intrusive rock makes it probable that the dislocation supposed to exist at the mouth of the Marsouin will have some connection with it, in which case the most likely course for the dislocation would be up the valley of Henley's Brook and of the small lakes at the source of the north tributary of the north branch of the Ste. Anne, from which it would gain the west side of the igneous mass, passing close in front of the chloritoid slates mentioned above.

Section from the Ste. Anne to the Barn-shaped Mountain and the Valley of the Cascapedia.

Mr. Murray in his survey of Mount Albert established three stations for the purpose of triangulating the peaks of various mountains in the neighbourhood. The traverse line which I followed from the junction of the north and south branches of the Ste. Anne to the neighbourhood of the Cascapedia and the Barn-shaped mountain, led me in the first instance by two of these stations, and the following are the bearings and distances of the courses followed to within six miles of the Cascapedia.

S. 53 W.	2 miles	8 chains,	to Mr. Murray's 1st station.	
S. 35 W.	2 "	60 "	to "	2nd "
S. 29 W.	10 "	40 "	to within 6 miles of the Cascapedia River.	

The Barn-shaped mountain was visited as we returned, but for the convenience of description I shall give the bearings of our courses in reverse order, starting from Mr. Murray's second station; they are as follows:

S. 39 W.	7 miles	38 chains	to Barn-shaped Mountain.
S.	2 "	77 "	to within six miles of the Cascapedia.

In the section along the coast the rocks at the mouth of the Ste. Anne belong to division B.

The description given by Mr. Murray in his Report of 1844 of the brecciated or conglomerate limestones in that part of the stream which runs along the foot of the Shickshock range, shews that there must there be a repetition of the coast rocks. In successive exposures along this part of the stream, Mr. Murray has traced the conglomerate limestones, associated with black slates and black thin bedded limestones, for between twelve and thirteen miles, showing that for this distance the stream probably runs in the strike. The last exposure of the conglomerate limestones in ascending the stream reached to within two miles and a half of the union of the north and south branches, and the black slates and thin limestones to within a mile and a half. According to Mr. Murray, green slates appeared to occupy the interval, and these slates resembled some that he had seen among the Shickshock Mountains.

The black slates and thin calcareous layers must be repeated at the mouth of the north branch, or another band of them be interstratified there, as they constitute the beds from which my traverse started; the breadth visible was only a few yards, and the thickness would not exceed twenty or thirty feet. They were immediately succeeded by a mass of dark green serpentine, holding disseminated crystals of diallage in some abundance; exteriorly the rock weathered to a brownish-yellow. The breadth of the mass on the measured line was 230 yards, and this taking the dip of the nearest strata above and below, would give a vertical thickness of 430 feet, which appears to preserve much uniformity of character throughout. After a concealed interval of nearly half a mile, part of which, from the form of the surface, is supposed to be underlaid by the serpentine, the next rock seen was a green coarse tough chlorite slate, with a somewhat fibrous or ligneous structure, partly marked with spots of epidote; it had a tendency to break into long splinters. The breadth was about sixty yards and the dip S. 24 W.$<45^{\circ}$, which would give a vertical thickness of 115 feet. The succeeding 1100 yards were concealed, but they were followed by 1000 yards, in which only 250 yards towards the commencement were deficient in exposed strata. The exposed strata consisted of green chloritic and epidotic slate similar to the previous, some parts of it displaying thin patches of whitish quartz irregularly distributed among the layers. The dip of the mass was S. 29 W. $< 42^{\circ}$, and the thickness would be about 600 feet. To this succeeded a belt of black rather coarsely crystalline hornblende slate, divided into beds of greater or less thickness, some not exceeding a quarter of an inch, interstratified with grey layers scarcely exceeding the eighth of an inch, deriving their tint from the presence of more or less white feldspar. Nearly the whole mass was more or less studded with small red garnets, sometimes thickly distributed in clusters. The breadth of this mass was 250 yards, and the dip S. 14 W.$< 74^{\circ}$; the thickness would be about 570 feet. The summit of this rock passed close by Mr. Murray's first station.

The two miles and three quarters to the second station were wholly occupied by serpentine, which continued for four miles and nearly three quarters farther on the S. 39 W. course. On all the lines it generally presented evidences of stratification, in some parts remarkably clear and distinct, in other parts more obscure. That part which immediately rested on the hornblende slate displayed the bedding very beautifully by differences of color on the weathered exterior, as well as on freshly fractured surfaces. The weathered exterior was marked by a set of red and opaque white bands, the white broader than the red, and varying from the eighth of an inch to an inch, and becoming often interstratified with layers of a brownish-fawn color, which varied in breadth in the same way. The interior when cut and polished displays parallel bands of a rich mahogany-brown, with thin blood-red vein-like lines running through those beds which are red on the weathered surface ; these blood-red lines are sometimes disposed after the manner of false bedding. With the red layers there are parallel bands of asbestus not much thicker than stout paper, looking like mere partings among the broader layers, and these asbestus partings, as well as occasional crystals of diallage, when in the proper light, give golden reflections. With the red-tinted beds chromic iron is associated, which is sometimes diffused in grains along the layer in a clouded manner, and sometimes is arranged in a manner somewhat resembling false bedding; occasionally minute faults dislocate the beds, and when these cross the layers containing chromic iron, the fissure connected with the fault is also filled with the mineral for a considerable distance on each side.

The thickness of this well stratified red and brown part appeared to be about 400 feet. But the great mass of the serpentine exposed was of various shades of green, much of it bottle-green, and came in succession to the well stratified part. To calculate the thickness of this part it would not be safe to take the measures on the second and third courses on the line of traverse, as these very probable run much in the strike. In its aspect this portion resembles the serpentine first met with near the Ste. Anne, and as the measure there was clearly transverse, though a little oblique to the strike, the elements of a calculation for thickness are much more certain. Taking the thickness thus ascertained this part of the rock would probably exceed 600 feet, giving 1000 feet for the whole.

Somewhat above the well stratified serpentine, chromic iron was observed in considerable quantity, in loose angular blocks, which were traced on the strike for a considerable distance ; and there were indications on the traverse line, of a repetition both of the well stratified rock and the ore, near the commencement of the third course. At the southern limit of the serpentine black shales and thin limestone beds, similar to those on the Ste. Anne were met with, shewing the probability of an outcrop connection between the two places. The dip of the shale was S. 44 E. $< 80^{\circ}$, which would be an overturn ; but the exposure being only a couple of yards in extent the attitude is too near the vertical to contradict the supposition of the structure you have suggested as deducible from the other facts ascertained ; namely that the serpentine of the Ste. Anne and that at Mr. Murray's first station are the same, on the opposite sides of a synclinal form, with an overturn dip on the south side, and that the hornblende slate and the chloritic and epidotic rocks overlie the serpentine ; so that the repetition of the well stratified serpentine and chromic iron on the line of traverse is due to an anticlinal axis, over which the serpentine folds so as to give another synclinal form on the south side.

Beyond the base of the serpentine on the S. 39 W. line, and above 260 yards from it, a mass of intrusive rock presented itself. The same intrusive rock was met with on the S. 29 W. line at the distance of about two miles and a half, which would be very nearly in the strike of the black shales and limestones underlying the serpentine on the other line. This intrusive rock continued on the west line for about the breadth of 540 yards, and on the east one for upwards of a mile and a quarter, appearing thus to widen to the eastward. This intrusive rock has the aspect of a trachyte, passing into a granite. It has some resemblance to the granite of the Table-top Mountain. Its color is a yellowish-flesh tint, and it is composed chiefly of feldspar, distinct crystals of the mineral of about an eighth of an inch in diameter being imbedded in a fine feldspathic paste. Brownish mica is present in small quantity, and quartz in still less amount, being indeed detected with difficulty. Many small druses exist in the rock, lined with a reddish-brown film, which may be peroxyd of iron.

The descent from the summit of Mount Albert is very rapid on the serpentine ; less so on the intrusive rock. It is still less on the succeeding rock, which consists of greenish-grey shale, occupying a valley. This rock was not seen in place ; but its presence was indicated by the fragments brought up on the roots of overturned trees, and these fragments prevailed for a distance of three quarters of a mile or a mile.

Beyond this we again came upon an intrusive rock, identical in its composition with the previous one, which rose rapidly up to form the Barn-shaped Mountain. The breadth of this mass on our lines of traverse exceeded two miles; its length appeared to be about three miles from east to west, and in this direction it displayed two summits about two miles apart, of about 3400 feet each in height above the sea, with a ridge between them about 400 feet lower. The hill was about 700 or 800 feet higher than the valleys on each side of it.

At the foot of the south flank fragments of greenish-grey sandstone in abundance, with a few of yellow-weathering chert were met with, mixed up with fragments of the intrusive rock, in the bed of a brook, and in pieces brought up on the roots of overturned trees. They appeared to belong to beds of from one to four inches thick, and the faces of many of them were marked by the presence of carbonized comminuted plants. Thin beds of sandstone were met with in place about a mile south of the intrusive rock, interstratified with shaly limestones holding obscure fossils. The dip of the beds was from S. 15 W. to S. 16 W. and the slope three degrees. These beds prevailed to the termination of the traverse; they are supposed to belong to the very summit of the Gaspé limestones, or group D, and to the same group are probably to be referred the shales on the north side of the mountain.

The shales between the two masses of intrusive rock, and the sandstones and limestones on the south of them, appear to be unchanged at the contact. They present at the same time a very moderate dip, approaching indeed to horizontality. They thus appear to overlie and finish against the intrusive rock as if it had been an elevated mass when they were deposited, and this may account for the absence of the great body of the limestones belonging to group D, which yet appears in great force where you crossed it in your traverse from the Chat to the Cascapedia in 1844, its breadth between the forks of the Chat and the intrusive mass of the Conical Mountain being from eight to ten miles.

As seen from the summit of the Barn-shaped Mountain, the country to the westward appeared to offer no obstacle to the supposition that the group D, from the position near the intrusive rock, will at a short distance to the westward come upon the serpentine, from which it will follow the flank of the Shickshock range, gradually widening as it proceeds, until it reaches the position where you met with its base, on the River Chat north of the range. In an opposite direction it will probably present a much narrower zone, if it does not become altogether covered up by the sandstones of group E. But it is evident from the dips shewn in the map of your exploration, that the sandstones of group E. gradually round toward the south-east from the turn of the river near Berry Hill, and this course may give room for the limestones to curve round the southern extremity of the intrusive mass connected with the Table-top Mountain.

Coast Section from the Marsouin to the Metis and to the River du Loup.

The black graptolitic shales and thin interstratified limestones which occur above the mouth of the Marsouin and constitute the top of group A, have already been mentioned. They are seen along the foot of the cliff and have a thickness of about thirty feet.

The strata which overlie them are, first a band of red shale, succeeded by rather hard olive-green shales which do not effervesce with an acid, interstratified with pale olive-green beds slowly effervescing, and brownish-black beds which effervesce a little more freely. These calcareous beds weather to a brownish tinge, and it appears to me not improbable that they may be of a magnesian character, and possibly fit for hydraulic purposes. The lighter olive-green beds are from one to four inches in thickness, and peculiarly marked on their under sides by short ridges, all ranging one way and overlapping one another, and all coming to a pointed termination in one direction. They are very probably the casts of furrows made in the lower bed by running water. On these surfaces there are occasionally many small flat pebbles of black chert. The blackish-brown beds are some of them a foot thick ; they have a conchoidal fracture, and an impalpable grain, and are sufficiently hard to receive a polish. Above these were olive-green shales with thin greyish-brown limestones. These beds occupied the coast more or less all the way from the Marsouin to the Martin River, a distance of nearly five miles, with a general dip towards the land ; the cliff in which they are exposed rose abruptly from the shore and shewed so many violent twists, that it is difficult to be assured either of the sequence or the thickness. After much trouble in endeavouring to disentangle the details, the following is the best arrangement I could make of them in ascending order.

1.	Red shale,......................................	10 feet.
2.	Olive-green shale,..............................	10 "
3.	Pale olive-green slightly calcareous beds,......	8 "
4.	Brownish-black dolomite,........................	22 "
5.	Olive-green shales and greyish-brown limestones,	200 "
		250 "

Above the Martin River, strata of a similar character continue to a prominent cliff about a mile up, where they become capped by about forty feet of light grey fine grained sandstones, in beds of from two to six feet. On the top of the cliff they appear to be in a nearly horizontal position, but out a little way from the foot of it similar sandstones occur, with a small dip towards the water; proceeding along the shore the beds of the cliff descend, and those of the shore approach the cliff, and the two bands joining shew a turn related to the north side of an anticlinal form.

Beyond this, and apparently overlying the previous beds, the rock of the cliff consisted of black shale with thin dark colored limestones and yellow-weathering limestone conglomerates, with which were associated grey sandstones, some of the beds sufficiently coarse to constitute fine conglomerates, the pebbles of which, consisting chiefly of white quartz and black shale, were about as large as peas. The cliff was about a hundred feet high, and it extended from the sandstones to the Ruisseau Vallée, a distance of a mile and a half, and for two miles farther; but the disturbances exhibited in it were so numerous that it was impossible to determine the thickness of the mass with any approach to truth.

Farther on, a change occured in the character of the rocks composing the beach and the cliff, and the new strata were supposed to overlie the previous beds, though I was not successful in tracing the connection. On the shore there occurred light grey strongly calcareous sandstone in massive beds of from four to six feet thick, giving an aggregate of about ninety feet. The rock was free and somewhat coarse grained, and displayed small fragments of black shale with small green specks resembling chlorite; it was intersected in many directions by veins of calc-spar. Above the sandstone blackish and greenish banded shale occupied the cliff, with a bed of lead-grey shale of about thirty feet thick in the middle. These beds were followed by a set of brownish-grey limestone beds of from one to two inches thick, interstratified with black shale and grey sandstone. These strata, most of which were yellow-weathering, occupied the cliff for upwards of a mile and a half.

About seventeen miles of the coast are occupied by the rocks given thus far, and from the Marsouin they reach to within two miles of the Ruisseau Castor. The whole of them are supposed to belong to the Division B. The hills which this division forms to the distance of perhaps two miles south from the coast, do not appear to be higher than between 300 and 400 feet, but those resulting from the succeeding group suddenly rise to about 1000 feet. This rise is seen in an escarpment which faces the east; the most salient part of it in that direction is over a mile and a half above the Ruisseau Vallée, and removed about a mile or a mile and a half from the coast. From this position the rocks which compose it sweep round towards the coast and come upon it at the place attained by the last strata described. The coast is occupied by these new rocks from this spot to Cape Tourette, a distance of seven miles. They consist of massive greenish sandstones, weathering to a drab color. They have been particularly described in your Report for 1844 p. 22, as the Pillar sandstones, the name being derived from the remarkable pillars worn out of the strata in this neighbourhood by the action of the sea.

Along the coast these sandstones run upon the axis of an anticlinal, on which, at the spot where the inferior strata plunge beneath the sandstone at the east end of the seven miles, the dip is S. 74 W.∠84°. The inferior strata emerge again on the axis about a mile below Cape Tourette, near the east limit of the bay immediately below the cape. On the north side of the axis the sandstones, in a nearly vertical attitude, cross the bay to the pillar or tower which gives the cape its name, and run along the front of the cape to the west, while on the south side they turn inland, and sweeping round at some distance behind the cape, come out again upon the coast about 1000 yards above it. Beyond this they occupy one third of a mile along the shore, with dips towards each other on the opposite sides of the exposure, exhibiting a synclinal form, in which it can be shewn that the sandstones extend under the water for at least two miles to the westward, the continuation of the rock on the south side of the trough being observable between high and low water mark about 200 paces out in front of Little Cape Ste. Anne. This trough is very probably subordinate to a much more important one south of it, connected with the great escarpment lower down, which has been mentioned as rising to 1000 feet. This forms a mountain which keeps its height until reaching a position behind Cape Tourette, and there gradually falls in an escarpment facing westward, but before the base of the sandstone crops out on the axis of the synclinal, it appears to reach the eastern side of the valley of the Little Ste. Anne River, as exposures of the rock were met with about a mile back from the mouth of that stream, with the subjacent calcareous strata coming from beneath. This great synclinal mass of sandstone may have a length of about eleven miles. Its precise breadth was not ascertained, but probably it does not exceed between three and four miles. The axis of the anticlinal over which the rock folds on the north, is as has been said coincident with the coast, and the great amount of disturbance affecting the coast section all the way from the Marsouin may very probably be due to it.

The subjacent strata emerging from beneath the sandstone on the anticlinal near Tourette are as follows in descending order.

Green shale interstratified with beds of greenish sandstone of from three to twelve inches thick,........	100
Green arenaceous shale,............................	20
Red and green shale interstratified with grey compact calcareous beds of two or three inches thick, weathering brown	50
	170

The beds which succeed these are brownish-grey limestones interstratified with brownish-black shales, all weathering yellowish; they are similar to those which sink beneath the sandstones seven miles to the eastward. The first 120 feet of the above section may be considered beds of passage, but the red and green shales appear to be a new feature, and are worthy of remark, as they are in the stratigraphical place of the red shales which make so conspicuous a figure at Cap Rouge near Quebec, being there as you have described, 1000 feet thick.

The coast is occupied by the strata of group B from the vicinity of Little Ste. Anne River to the River Chat, and the best exhibition of the beds belonging to it in the whole distance, which is between three and four miles, is met with at a prominent point between two and three miles west of the Ste. Anne. But as you have given the details of this section in your Report for 1844, it is unnecessary for me to repeat them here, and I shall only remark that among the black shales of the locality which come next in succession to the red and green shales, *Phyllograpsus*, one of the new genera of graptolites from Point Lévi described by Mr. Hall, is frequent.

In your Report for 1844, you allude to a hill of about 320 feet in height which stands on the right bank of the River Chat, about a mile and a half from the mouth, and state that the hill is composed of sandstone, apparently of the group C, the strike of which would bring the rock out upon the coast near the mouth of the Ste. Anne. This hill it is probable is not far removed from the eastern extremity of a trough on the same synclinal axis as the one which has been shewn to pass in front of the Little Ste. Anne. The axis westward appears to come upon the coast just above Cape Chat in a small cove in a well marked notch. On the north side of the axis are all the sandstones and interstratified red shales mentioned by you as forming the coast from the river to the cape. The beds at the cape dip S. 11 E.<44°, while those on the south side of the axis at the notch dip S. 17 W. <64°, shewing an overturn. Red shales interstratified with greenish sandstones, still belonging to the same group, come upon the coast about a mile above the cape and continue along the shore for a mile more. At the east end of the distance the dip is S. 9 W. <32° and at the west end S. 25 E. <40°. But notwithstanding the reduction of the slope the beds must still be considered as inverted; for in the bay of the Little Capucin River, about four miles above Cape Chat, black shales and black limestones, with black and green shales above them, which are supposed to belong to group B, make their appearance. These however cannot be far removed below the green sandstones, for while the strike on the east would bring the sandstones into the east side of the bay, they re-appear on the west side in considerable force, occupying a mile of the coast, and constituting the point between that bay and another two miles to the westward which receives the Great Capucin River.

On the west side of the river a band of red shale is met with, in which occurs a small vein of quartz, running with the beds and holding a few spots of yellow sulphuret and green carbonate of copper. North of the red shale the sandstones again present themselves, and form a point on the west side of the bay marked by a pillar of twenty feet in height and eight feet in diameter, similar to those of Tourette. The strata dip S. 25 E.<45° and shew a thickness of 700 feet. The mass maintains a pretty uniform course along the coast for four and a half miles, and terminates at a point within a quarter of a mile of the Little Michaud River, where it dips S. 45 E.<43°. That this mass is inverted is made manifest by the attitude of the strata at the west horn of the bay into which the Little Michaud empties. Along the shore of the bay between the river and the point, a distance of three quarters of a mile, the black and green shales occur, above which there is a band of 100 feet of red and green shale followed by green sandstones. The shales dip N. <80°, and a turn occurs in the sandstones above them giving a dip S. 87 E. <60°, shewing the axis of the trough to which the sandstones belong.

About a mile and three quarters west from the Little Michaud River, and about 200 yards back from the coast, massive coarse limestone conglomerates, interstratified with grey calcareous sandstones, rise at once in vertical strata to the height of sixty or eighty feet, and run for some distance either way parallel with the coast. These strata would come in beneath the red shales of the west horn of the Little Michaud bay, and black shales seen near the mouth of the Great Michaud River a mile farther up, would come in between, but in what volume is uncertain, though it must be considerable.

Conglomerates and sandstones of the same character are again seen about a mile above Great Michaud River, and they run along the coast for another mile, to a point opposite two small islands called Les Islets. These islands are composed of similar rocks underlying the beds at the point. The dip is S. 25 E. <30°, and while the vertical strata near the Little Michaud are on the south side of a synclinal form, those of Les Islets are supposed to be on the north, and to leave the coast before reaching the Grand Michaud to run north of the Cape Chat sandstones.

The masses exposed at Les Islets consist of grey calcareous sandstones, composed of translucent colorless quartz grains of the size of pin-heads, cemented together with calcareous matter. The beds are from one to two feet thick, and the divisional planes are sometimes marked by a film of black unctuous material, probably argillaceous. The sandstones are interstratified with an equal and perhaps greater amount of beds of conglomerate of from one to three feet thick, consisting of rounded and flattened masses of compact grey and black limestone in a matrix of calcareous sandstone similar to that of the sandstone beds, with cracks that are often lined with a black mineral resembling coal, being identical with the altered bitumen you have mentioned as existing at Cape Ste. Anne, Point Lévi, Quebec, Sillery, and other places. Among the sandstones and conglomerate beds, are interstratified deep brownish-black shales, with obscure graptolites, resembling some of those of Point Lévi.

Strata of this character occupy the coast for three quarters of a mile above Les Islets, and after an interval of the same distance showing black shales and interstratified thin limestones, the conglomerates and calcareous sandstones again appear, and continue for a mile and a half. In this mile and a half they strike more into the land, and present an anticlinal axis about half-way, the bearing of which is S. W. On the south-east side the dip is S. 45 E.$<41^{\circ}$, and on the north-west N. 45 W.$<56^{\circ}$; but a quarter of a mile farther, beds of the same character show a dip N. 76 E.$<36^{\circ}$, apparently indicating that the anticlinal fold is not of great importance. These limestone conglomerates reach to within half a mile of Rivière à Crapaud, the interval to the river being concealed. Above the river, for a mile and a quarter, but one band of limestone conglomerate is met with, its position being about half-way; the space on the east side is occupied with grey calcareous sandstones interstratified with thin hard grey limestones and black shale, and then red and green shales interstratified with hard grey limestones and black shales, each of the groups of strata being about equal in amount. West of the conglomerate band are compact grey limestones interstratified with black shale, with nearly half a mile of fine black shale beyond, terminated with an interstratification of thin black limestones.

Above this on the coast, about a mile is occupied with a mass of limestone conglomerates with sandstones more or less calcareous, and these are considered to be a repetition of the sandstones and conglomerates of Les Islets. At about mid-distance of this exposure an anticlinal axis is displayed, and the masses in the half mile on each side of it appear so nearly to correspond that they are supposed to represent one another, notwithstanding that a part of the western side shows a dip which must be overturned, in which the overturn inclination is reduced to twenty-six degrees. The following is a description of the strata as they succeed one another in what is supposed to be an ascending order, with the thicknesses on the east and west sides of the anticlinal.

	East side.	*West side.*
Black shale	20 feet	20 feet.
Limestone conglomerates, with pebbles of grey limestone and light grey sandstone, of which the average weight is about a pound	75	70
Concealed	50	
Grey mottled hard slightly calcareous sandstone resembling quartzite; no indication of subdivisions into beds, though looked for, was observed	137	149
Greyish-brown calcareous sandstone, yielding with facility to the weather, without observable divisions into beds	22	
Grey calcareous sandstone interstratified with coarse limestone conglomerate beds, the sandstone predominating	22	33
Grey mottled sandstone resembling quartzite	12	
Grey calcareous sandstone in beds of from two to four feet; the stone crumbles readily under the influence of the weather	15	50
Limestone conglomerate,	14	
Grey mottled hard slightly calcareous sandstone resembling quartzite	6	136
Light grey calcareous sandstone	63	
Limestone conglomerate,	6	
Grey compact limestone in beds of from two to three inches associated with greenish shale	22	39
Concealed on the west side; limestone conglomerate on the east side	113	
Limestone conglomerate with pebbles and boulders of compact grey limestone weighing from half an ounce to several tons; smaller masses of black limestone and occasional masses of amygdaloidal trap weighing from one to thirty pounds; the conglomerate beds are from one to six feet thick and are interstratified with light grey calcareous sandstones of from one to three feet thick; the whole mass is cut by numerous veins of calc spar, and iron pyrites is disseminated in nodules in all the beds in some abundance	90	194
	667	691

The coast composed of these limestone conglomerates and sandstones is known under the name of Les Crapauds. The rocks render the shore very rough and broken, but though a somewhat bold cliff rises from the beach, the country inland is moderately smooth. About two miles and a half above Les Crapauds a bold headland rises over the sea, and from it to Cape Whale, about three quarters of a mile farther up, the coast is almost inaccessible. I was here under the necessity of examining the coast line from a boat; but inland at a distance of a quarter or half a mile I was aided by a road. The rocks on the coast line and the road were found to consist of the greenish sandstones and associated red and green shales of group C. These composed also the shore as far as Long Point, a distance of five miles more.

About a mile below Long Point the sandstones are massive; the beds are from six inches to six feet thick and very even. The rock is fine grained, and while the main body of it appears to be free from carbonate of lime, there are included portions of various shapes and sizes, from one to several inches in diameter, which when reduced to powder, effervesced with an acid. The sandstones at irregular intervals are interstratified with bands of red and green shale, which include greyish-green layers of from one to six inches thick, weathering to a whitish-yellow. These effervesce with an acid but with difficulty until reduced to a powder, and are probably magnesian. The red shales are spotted and striped with green, and the green with red.

Where the greenish sandstones of group C terminate at Long Point, the dip is S. 21 W. $<46^{\circ}$, and about 250 yards in the direction of the dip, the grey calcareous sandstones and conglomerates of group B again make their appearance, continuing along the coast for about two miles, where the following section occurs:

	Feet.
Grey calcareous sandstones interstratified with limestone conglomerates, each in beds of from six inches to two feet; among the beds occur a few layers of grey quartzite, and the whole resemble the strata of Les Islets.	60
Brownish-black arenaceous limestone, sometimes finely laminated, and occasionally weathering to a whitish hue and pulverulent condition on the exterior; the limestones are interstratified with black shale, and the whole mass is cut with many strings and veins of calc spar; in the cracks occurs the black mineral resembling coal so often met with in the rocks of Point Lévi and Quebec	50
	110

The dip of these strata is S. 19 W. $<53^\circ$, and as this would apparently place them over the sandstones of group C at Long Point, while in reality they are stratigraphically inferior, it is evident that the dip must be an overturn.

From Long Point upwards the coast is occupied with the rocks of group B for thirty-one miles, with the exception of a small interval about a mile below Little White River; although there appear to be several small folds in the strata, the coast line and the strike seem nearly to coincide the whole way, and it is the upper parts of the formation that occur in most of the exposures, consisting of red, green and black shales, or of the summit of the limestone conglomerates and calcareous sandstones. These conglomerates, in addition to the exposure near Long Point, were seen about half way between the Little and Great Matanne Rivers, at the mouth of the Tartigo, also between two and a half and three miles above the Trent, as well as three miles below the Little Metis River. Black shales which would seem to come in a little north of the exposure of the Tartigo, display fragments of encrinites and broken shells, but too obscure to be determined.

The following is the section about a mile below the Little White River, where one of the folds above alluded to occurs, the beds being given in ascending order.

	Feet.
1. Greenish-grey compact limestones weathering to a whitish-yellow and supposed to be magnesian, separated by thin layers of olive-green shale	22
2. Greenish-grey compact limestones of the same character, separated by layers of red shale of an inch thick, striped and spotted with green.	5
3. Greenish-grey compact limestones as before, interstratified with layers of from one to six inches of red shale striped with reddish-black bands and spotted with green................................	10
The whole of these limestones would be well adapted for flagging were they not cut by two sets of joints, parallel in strike but different in slope, the underlie of the one being S. 43 W. $<18^\circ$ and the other S. 43 W. $<80^\circ$. The joints of the first set are from two to three feet apart and of the second from five to ten feet apart.	
4. Olive-green fine grained shale striped with black....................	30
5. Indian-red shale interstratified with beds of greenish-grey compact limestone as before, of two or three inches thick..................	24
6. Measures concealed..	30

	Feet.
7. Greenish sandstone of group C in one bed	6
8. Olive-green and black shale, interstratified with greenish-grey compact limestones as before of two and three inches thick, finely laminated	53
9. Greenish fine grained even bedded sandstones seen out in the tide-way; the thickness is doubtful, but at least	30
	210

The dip of these strata is N. 67 W. < 80° but strata resembling number 8 are seen with a sharp rise at the mouth of the Little White River, so that the sandstones of group C scarcely do more than touch the coast at this part.

The exposure of conglomerate about two miles and a quarter above the Trent dips S. 40 W. < 34°, and north-east of it about 300 yards there is an exposure of the greenish sandstones of group C with red shale in the interval, which appears to curve round the south-eastern end of the sandstone, as if these constituted the extremity of a trough with an overturn dip on the south side.

About two miles below the mouth of the Little Metis the greenish sandstones of group C again succeed the conglomerates, and in addition to forming the coast for the two miles below the river, they extend for two miles along the coast above it, running into Metis Point. About a quarter of a mile out from the mouth of the Little Metis River there appears to be an anticlinal axis running about W.S.W., over which the sandstones fold, assuming the form of a trough in Metis Point. It is probable that the sandstones run for about a mile on the anticlinal axis, and the synclinal form which they present on the south may have the breadth of a mile in this part.

Where the sandstones cease at the upper corner of Metis Point the following section was observed, in ascending order:

1. Red shale	25
2. Green and black shale interstratified with greyish fine grained limestones, weathering yellowish and supposed to be magnesian, in beds of from one to two inches, with a few bands of grey compact pure limestone of the same thickness	25
3. Greenish sandstones in even beds of from six inches to two feet, interstratified with black and green shales	180
4. Greenish sandstones of the same character, without shales	187
	1017

Between Metis and Green Island River, a distance of about seventy-five miles, the coast is occupied with the rocks of group B only ; but a strip of between nine and ten miles extending from Green Island River to the point at Rivière au Moulin, and passing thence to the upper end of the island of Cacouna, consists of the greenish sandstones of group C, and though it has not a breadth of more than half a mile, presents several folds subordinate to a general synclinal form.

These sandstones form another narrow strip, running about two miles along the coast and terminating at a point about two miles below Rivière du Loup ; they seem here to be brought into this position by a transverse dislocation with a downthrow on the south-west side.

In the vicinity of Bic Harbour there is a great display of the limestone conglomerates and the associated calcareous sandstones of group B, and it is to the resistance which they have offered to the destroying agencies that have worn away the other rocks of the coast, that the formation of Bic Harbour is due. A great deal of very beautiful structural detail might be obtained in the neighbourhood of Bic, but it would have required too much time for me to have attempted its minute investigation without abandoning other parts of the work. One point ascertained, however, which may prove useful at a future time is the existence of a small synclinal patch of the green sandstones of group C, as it furnishes the means of determining the summit of the subjacent rocks so much spread around. Bic Point is about two miles below Bic Harbour, and the sandstones in question were met with about three quarters of a mile inland from the bight of the bay below the point. The bearing of the synclinal axis is N. 65 E. and the area of the sandstone trough measures about three quarters of a mile long by 250 yards wide. The sandstones appear to be surrounded by red and green shales, and the limestone conglomerates come into their place on the outside of the shales. The relations of the strata are here better shewn than in many other parts, as none of the dips are overturned.

In the limestone conglomerates the masses inclosed are sometimes very large ; a boulder of dark grey limestone inclosed in one of the bands at Metis was measured and computed to weigh twelve tons ; another in another part of probably the same band measured eleven feet long by six feet broad, and was supposed to weigh upwards of twenty-five tons. At Trois Pistoles there is a band with a multitude of large boulders, which may be the continuation of the same one. The following section, of which the details were obtained in a mile along the coast from the church of Trois Pistoles, will shew the place of this band in relation to other parts of the deposit. The beds are given in ascending order :

	Feet.
Limestone conglomerate in which occur rounded masses of amygdaloidal trap, weighing from a pound to a ton ; of dark grey arenaceous limestone from a few ounces to a ton ; of grey compact limestone from an ounce to a pound ; with pebbles of white quartz from the size of snipe shot to that of musket balls. The matrix is a grey calcareous sandstone, and iron pyrites is frequently met with in it,	13
Grey calcareous sandstone,	3
Limestone conglomerate the same as above ; but with no trap, and much smaller constituent masses,	3
Grey calcareous sandstone in beds of from a quarter of an inch to an inch thick,	4
Limestone conglomerate,	2
Grey thin bedded calcareous sandstone,	9
Limestone conglomerate,	4
Grey calcareous sandstone,	2
Limestone conglomerate occupying the whole thickness of the bed in some parts, but in others becoming gradually a greycalcareous sandstone, the conglomerate character being confined to a width of three inches,	2
Grey calcareous sandstone in beds of one foot, alternating with thin bedded aggregations of a foot,	42
Limestone conglomerate,	3
Grey coarse grained calcareous sandstone, becoming a limestone conglomerate in the run of the bed,	8
Grey coarse grained calcareous sandstone,	2
Limestone conglomerate,	7
Grey coarse grained calcareous sandstone,	11
Limestone conglomerate,	2
Grey calcareous sandstone,	4
Grey calcareous sandstone beds, alternating with beds of limestone conglomerate,	24
Limestone conglomerate, in one bed	16

	Feet.
Measures concealed,..	36
Reddish-grey fine grained shale, interstratified with bands of reddish-black shale, and beds of greenish-white compact limestone of from one to three inches thick,........................	71
Chocolate-red shale, ...	5
Green shale, ...	2
Red shale with a thin layer of green shale, ...	1
Red shale interstratified with greenish-white compact limestone beds of one and two inches thick, ...	10
Green shale with similar beds of greenish-white compact limestone, ...	4
Green shale interstratified with beds of grey limestone, and a one-inch bed of black shale, ...	2
Green and black shale, interstratified with one another..........	2
Green and chocolate-red shale, interstratified with one another...	6
Red shale interstratified with green shale,.....................	4
Reddish-grey shale with two beds of grey limestone of three inches each,..	2
Brick-red shale interstratified with light grey bands of pure limestone of from one to four inches thick, at intervals of from six to twelve inches,..	10
Brick-red shale and light grey compact pure limestone, with two masses of limestone conglomerate of about 200 pounds weight each, imbedded about the middle of the whole; the pebbles of these two masses are in part of light grey very fine and compact limestone, with some of red limestone not so compact, others of black limestone, and a few of green and yellow limestone; the pebbles are flattened and fitted against one another,......	12
Red shale interstratified with grey limestone of a coarser grain than before,..	4
Grey arenaceous limestone, sometimes becoming conglomerate in the run of the band, ...	1
Green and red shale interstratified with thin beds of greenish-white compact limestone, ...	3
Green shale, ...	1
Greenish-white thin even bedded limestone,....................	2
Green and red shale,......	1
Greenish-white thin even bedded compact limestone, interstratified with two bands of black shale,.........................	1
Grey even thin bedded compact limestone, interstratified with green shale,..	9
Red shale interstratified with beds of greenish-white limestone of two inches thick, ...	1
Green shale with greenish-white thin bedded compact limestone,.	2
Green shale interstratified with bands of chocolate-red shale and two inches of greenish-white limestone at the base, ...	3
Green shale, ...	2

	Feet.
Grey thin bedded limestone,..	2
Green shale with thin greenish-white compact limestone and two bands of black shale of one inch each,........................	6
Red and green shale,..	3
Grey thin bedded limestone,..	1
Black shale interstratified with green bands and greenish-white compact thin bedded limestone,..............................	7
Green and red shale,..	1
Green shale interstratified with black shale,..................	3
Brick-red shale,..	15
Greenish-white thin bedded compact limestone tinged with red,.	5
Brick-red shale,..	12
Green shale,...	2
Red shale,..	8
Reddish-grey drab-weathering shale striped with reddish-black with strings of calspar,..	6
Reddish-grey drab-weathering shale striped with reddish-black shale and holding iron pyrites in nodular aggregations of cubic crystals,..	15
Reddish-grey drab-weathering shale striped with reddish-black bands, with less iron pyrites than the last,..................	250
	694

Section of the Metis and Patapedia Rivers.

As has already been stated, an anticlinal axis bearing about S. 65 W. runs about a quarter of a mile north of the mouth of the Little Metis River, throwing the greenish sandstones of group C in Metis Point into the form of a trough. These strata on the lower part of the Little Metis River assume a corresponding synclinal form on the south side of the axis. The north rim of the latter trough would cross the Great Metis River about three quarters of a mile inland from the mouth. No exposure of the sandstone is seen on the stream, but over a mile southward of west from the river, there occurs an escarpment of it, which can be traced running in a pretty straight line for about two miles farther, with a dip of S 35 E. $<36°$; its place on the river would be about the position indicated. The breadth which these sandstones might have on the stream would not exceed between 700 and 800 yards, as exposures of the lower rocks occur on both sides of this breadth; the calcareous conglomerates of group B are conspicuous in two parallel bands below the position, one of them being at the very outlet of the river, and the other about half a mile from it up the stream. In weathered fragments, resting on the lower band and of the same character with it, were obtained well defined examples of a coral allied to *Favosites Gothlandica*, which occurs at Cape James in Anticosti, near the summit of the Hudson River group.*

Above the position assigned to the sandstones of group C, the banks of the Great Metis in the first mile transverse to the measures, shew grey quartzite, green shales and grey calcareous sandstones with limestone conglomerates; in the second there are no exposures, and in the third the only rock seen is a band of black shale. There then occurs an exposure of red shale, followed by the green sandstones of group C immediately above. The distance of this from the mouth, across the measures, would be about four miles. On the east side of the river the sandstones present a breadth of about 600 yards, and appear to stand in the form of a double trough, the sandstones only of the south synclinal belonging to which cross the river to the west, their breadth on the immediate bank of the river being reduced to about 300 yards.

In the next half mile south of the sandstones, limestone conglomerates and black shales belonging to group B are met with, the conglomerates being not far removed from the green sandstones. Farther southward to the Neigette, there are no exposures. Beyond this as far up the river as cultivation extends, a distance of about three miles in a straight line, the only rocks seen were green shales. In the third mile still beyond this, the calcareous conglomerates are again seen, and black shales beyond them, in which there occur the remains of graptolites. For three miles farther on to the mouth of the Musquegegish, the only exposure met with was one of smooth unctuous black shales interstratified with thin limestones, which with all the rocks from the exposure of green sandstone, are considered to belong to group B.

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* All that occurs in this Report in respect to the fossils is stated on the authority of Mr. Billings.

In the first four miles above the Neigette, the river makes a semi-circular sweep to the north-east, in which it passes round the north-eastern extremity of Mont Commis. This mountain, with a breadth of from one to two miles, extends for about twelve miles to the south-west and appears to be composed of the sandstones of group C. In its highest part it may rise about 700 feet above the valley of the Neigette.

A little below the mouth of the Musquegegish large loose angular blocks of fine grained white sandstone are abundant, the rock being similar to that which you describe in your Report of 1844 as underlying the Gaspé limestones at the forks of the Chat, and in the Report for 1849 as being found in a similar stratigraphical place in relation to the same limestones on Lake Matapedia; at the mouth of the Musquegegish, calcareous rocks occur, which would come in the same sequence in regard to these sandstones as the limestone of the Chat and Matapedia. These calcareous rocks, with a dip S. 66 E. $< 45^{\circ}$, presented an escarpment of about twenty feet high, and consisted of grey nodular fossiliferous limestone, divided into beds of two and three feet. In one of the fragments near the escarpment were obtained a *Pentamerus* resembling *P. Knightii*, a *Strophomena* like *S. inequiradiata*, and another species which is resupinate and resembles *S. punctilifera*; I may here mention that in passing Lake Matapedia going south, I met with a fossil in the white sandstones strongly resembling *Pentamerus oblongus*.

Farther up the stream at a distance of about 850 yards at right angles to the strike, another exposure occured, and here the beds consisted of limestone of the same character interstratified with greenish shale, the dip being S. 65 E. $< 32^{\circ}$. About fifty chains still farther up, another exposure was met with, but here the dip was N. 75 E. $<$ from 2° to 6°. These beds consisted of dark grey argillo-calcareous shale interstratified with greenish shales; at the base a bed of about three feet thick consisted of greenish arenaceous limestone, and contained obscure fossils, one of which resembled *Pentamerus oblongus*. There is little doubt that the beds of these three exposures overlie one another. Their total thickness, with what is concealed, is computed to be about 2000 feet.

For two miles above this, no exposures occurred, but in the succeeding two and a half miles to the River Rouge several were met with, consisting in the first exposure of greenish crumbling arenaceo-calcareous shale, and in the others, of grey micaceo-arenaceous limestones or strongly calcareous sandstones, well fitted for flagging stones, interstratified with purplish-brown arenaceo-calcareous shale. Masses of similar character constituted the rocks of the falls between the Rouge and the Metis Lakes and near the lowest lake, but both above and below the Rouge, they showed various and sometimes opposite dips, with occasionally very high angles. In part of the distance the rocks exhibited a cleavage independent of the bedding, and it was often difficult to distinguish the one from the other. I have in consequence found it impossible to compute the thickness; but the rocks, from the amount of calcareous matter which they contain, are supposed to belong to group D, and to represent a higher part than before mentioned of the Gaspé limestones.

No rocks were seen on the lower Metis Lake; on the middle lake, strata were observed in several places in the upper half; they consisted of grey granular limestone, weathering brownish-yellow, and containing obscure fossils. The beds were from six to twelve inches thick, and were interstratified with less calcareous layers, greyish-green in color, and weathering to a brown. An obscure cleavage existed in the less calcareous layers, and they separated with difficulty in the direction of the beds. The strata, with several minor undulations, appeared to preserve a general horizontality. These rocks were supposed to be a repetition of the lower part of the Gaspé limestones.

The shores of the upper lake are strewed with many large flat fragments of calcareo-arenaceous shale mixed with sandstones, and in one place the bottom of the lake was paved with a greenish sandstone, interstratified with greenish shale, and the beds appeared to be horizontal. After passing the watershed, an exposure about half-way down the Awaganasees consisted of greenish calcareous sandstones in beds of from six to eight inches, dipping N. 3 W. $\angle 24^{\circ}$, and below this to within a mile of the Patapedia, there appeared flagging stones very similar in character to those below the lower Metis Lake and near the Rouge, excepting that they are more even and regular in their divisional planes ; in some parts the thicker slabs are separated by calcareous slates, which split into large and remarkably even slabs, no thicker than the eighth of an inch, of a dark grey internally, but changing rapidly in the weather to a greyish-yellow or light drab. Rocks of a similar character, but not so evenly bedded, prevailed for the remainder of the distance to the Patapedia, and they were considered to be a repetition of the upper part of group D, to which is here assigned a breadth of between fourteen and fifteen miles.

Between the mouth of the Awaganasees and Indian River, and half a mile below the latter, the rocks are dark grey compact thin bedded limestones, interstratified with blackish calcareous slates, recurring twice, and followed on each occasion by dark grey calcareous shales. Below this for seven miles, as far as Pollard's Brook, there prevails greenish-grey arenaceous shale weathering yellowish-brown, sometimes calcareous and sometimes not. At Pollard's Brook and a short distance below, we have a recurrence of dark grey calcareo-argillaceous finely laminated slates, splitting into large slabs of about the thickness of roofing slates, and weathering to a greyish-yellow or drab like those of the Awaganasees. With the exception of these drab-weathering slates, the prevailing rocks, for five miles below Pollard's Brook, are dark grey argillaceous and calcareo-argillaceous slates, interstratified with occasional more calcareous layers ; for four miles below this the rock is a dark grey calcareous slate or shale, and this is succeeded by two miles of slates of a similar character interstratified with more calcareous bands. For a mile and a half farther, thin bedded black and often very pure limestone, occurs a third time, interstratified with black and dark grey argillaceous shales, beyond which the only rocks for two miles to the mouth of the Patapedia are dark grey calcareous shales or slates, interstratified with greenish arenaceous shales and greenish sandstones.

In all these rocks on the Patapedia, there is a cleavage independent of the bedding, and it is very often very difficult to say which is cleavage and which bedding. Occasionally the strata are much contorted, and it is impossible for me to state what the thickness may be, or how many repetitions there may be of equivalent groups of strata. No fossils were found in these rocks, and it is in consequence difficult at present to determine the age of the mass, but it is not supposed to be older than the Gaspé limestones.

The greenish arenaceous shales and sandstones of the mouth of the Patapedia appear to have a dip up the river, and to underlie the thin bedded limestones and dark grey shales beyond; they can be traced down the Restigouche to Cross Point, a distance of about four miles, where the beds associated with them are calcareous and hold fossils consisting of fragments of trilobites and bivalve shells, but too much broken to be identified. The sandstones attain the neck of Cross Point, while the thin bedded limestones above them occur at the north part of the turn in the river. To this point the strike and the general valley of the river run about north-east; lower down they turn together, and the sandstones and their associated dark grey calcareous shales are every now and then seen for seven miles in a bearing nearly east. Here the river separates from them, and while they appear to continue in a pretty straight course to the junction of the Upsalquitch, the Restigouche makes a turn to the north-eastward on the thin bedded limestones to Brandy Brook, and returns upon them south-eastward to the sandstones at the Upsalquitch. From the Upsalquitch, the Restigouche appears to flow on the thin bedded black limestones to the mouth of the Matapedia. According to your Report of 1844 the thin bedded black limestones strike away from the river on the north side of the Restigouche a short distance below the mouth of the Matapedia, followed farther down, near the mouth of Seller's and Anderson's Brooks by a fossiliferous limestone which directs its course to the road-bridge on Little River. The succession which you give at this place shows a set of calcareous and arenaceous shales coming in between the fossiliferous limestones and the thin bedded limestones, and these probably represent the calcareo-arenaceous rocks at the mouth of the Patapedia. The fossils of Little River I believe, are supposed to resemble some of those of the Gaspé limestones, and it may thus be inferred that the rocks of the Patapedia, which are all more or less calcareous, may be related to these fossiliferous strata, as a higher part of the group D.

Section of Rimouski River.

In describing the coast section from Metis to Rivière du Loup, mention was made of a synclinal patch of the green sandstones of group C, which lies about three quarters of a mile inland from the bay below Bic Point. The axis of this synclinal would cross the Rimouski River probably not far above its mouth. On the south side of the synclinal patch of green sandstones there appears red shale, and a white-weathering green shale, succeeded by limestone conglomerate. The white-weathering green shale appears upon the road up the Rimouski River about four miles back from its mouth; it has south of it a grey sandstone, and somewhat to the east grey sandstone and blueish-grey brown-weathering limestone, which probably represent the limestone conglomerate. The strata appear to dip to the north at a very high angle. The blueish-grey limestone is repeated in a short distance down the stream with a south dip, but independent of this there are no exposures of rock to the mouth, with the exception of two, one of them shewing red shale interstratified with thin hard greenish siliceous beds.

About a mile farther south than the grey sandstones, the green sandstones of group C make their appearance, with red shales to the north of them, and it is probable that on the south of the anticlinal axis, which must pass between the exposures of the grey and green sandstones, the conglomerate band, or the grey sandstone representing it, is repeated although concealed. The green sandstones are traceable to the east for some distance, and after five miles in that direction they form the south limit of Great Lake, which is tributary to Rivière au Moulin. From this, with the conglomerate band north of them and the red shale between, they trend for five miles toward the escarpment belonging to group C, which it has been stated crosses the Metis about three quarters of a mile from its mouth.

The Rivière au Moulin, into which Great Lake discharges, joins the St. Lawrence about two and a half miles below the Rimouski, and the conglomerates just alluded to would cross the stream about half a mile below the outlet of the lake. They were traced for a mile to the south-westward, and about two miles and a half to the north-eastward, with the red shales accompanying them. Vast masses of the conglomerates, some of them weighing fifty tons, occasionally marked the outcrop, and from these were often obtained the coral allied to *Favosites Gothlandica*; some of the shales also in the vicinity of the band were fossiliferous, but the shales were too soft to permit the successful extraction of the fossils. About two miles farther down the Rivière au Moulin, limestone conglomerates were again met with, and here also the same coral was obtained. Westward of this from one to two miles, large exposures of grey calcareous sandstone of the group B were observed in two places, about half a mile from one another across the measures, and their strikes so converged that they would meet to the north-eastward before reaching the Rivière au Moulin. The sandstones were largely made up of dark transparent grains of quartz and small fragments of green shale, and contained much iron pyrites. Similar sandstones were observed a mile nearer Great Lake, and being in this position still a mile and a half from the margin of the lake, they were supposed to be on the north side of the anticlinal which limits the green sandstones of group C on the Rimouski.

These sandstones on the Rimouski have a breadth of about a mile, with a synclinal form, and their southern outcrop appears to be on the flank of the ridge which overlooks the valley of the Bois Brulé River, and farther to the north-eastward, of the Neigette River; after folding over an anticlinal axis to the south-east, the outcrop follows the Neigette to the Metis. Sonth of the outcrop of the sandstones on the Rimouski there are exposures of striped green and black shales, interstratified with hard silicious beds of from one to two inches thick, and also of green argillaceous shales, which are studded with scales of mica and are somewhat pyritiferous. These strata, which are on the Bois Brulé, and above it on the Rimouski, dip northward at high angles. They belong to group B, and are probably not far removed from an anticlinal axis; southward from them however we have a new series of rocks.

These rocks are the Gaspé limestones. Where they cross the Rimouski they are about nine miles and a half in a straight line from the mouth, but no more than seven miles from the coast between Rimouski and Bic. They rise in a well marked escarpment over a hundred feet high, on the right bank of the Rimouski. The rock at the base is a whitish-grey calcareous sandstone, of which between twenty and thirty feet are seen, probably representing the sandstone of Matapedia Lake and the Chat River; it shews a dip S. 39 E. < from 7° to 9°. This is succeeded by beds of from six inches to two feet thick of blue-ish argillaceous limestone, which constitutes the remainder of the escarpment. Limestone of a similar character is met with at intervals for about five miles up the Rimouski to a large swamp on the fourteenth lot of the third range of the township of Duquesne. This would be about two and a quarter miles across the measures, and the dip is here S. 60 E.<45°. The rock is here a dark grey calcareo-argillaceous shale, interstratified with greenish calcareous sandstones in beds of from one to two inches. A ridge rises south of the swamp to the height of about 150 feet, and there is a depression on the south side of the ridge, which on the east side of the river contains Lake Macpes and its discharging stream, and on the west the River Touradif. The depression is over half a mile from that of the swamp, and the rocks seen in it are much the same as those just described, with perhaps a somewhat smaller quantity of shale; the dip was S. 59 E.<30°. A mile and a quarter above this, across the measures, there is another depression, occupied on the west side by the Rivière à France; and two miles and a half farther up, we have the fall of the Rimouski on the twenty-fourth lot of the sixth range of Duquesne. The rock at the fall is a greenish-grey calcareous sandstone in beds of two or three inches, separated by grey calcareous shale, the shale and the sandstone being about equal in quantity, but irregularly interstratified. The dip at the fall is S 44 E. < 60°, but just below the fall there is a small undulation, by which the same beds are at the surface for a distance of about forty-five yards across the measures. The Rimouski for a considerable distance below the fall flows in a very deep and inacessible chasm; the strata in consequence were examined only at considerable intervals, and if there should be many undulations similar to that at the fall, these would materially diminish the thickness deducible from the dips ascertained.

About a hundred yards below the fall the rock is very evenly divided into beds of from one to four inches thick, and would yield excellent flagstones of from two to three feet wide and from four to six feet long. They very much resemble the flagstones already described on the Metis, and their stratigraphical place may very possibly be the same in the vertical sequence. Fossils were observed in several parts of the series, but the only one that could be identified was the pear-shaped variety of *Favosites basaltica.*

From the position where the escarpment of the Gaspé limestones is seen on the Rimouski River, the outcrop, after crossing the stream to the west side, appears to keep on the south side of its tributary, the Little Rimouski, very nearly to the water-shed between it and the east tributaries of the River Trois Pistoles. Turning here more southward it runs a course about parallel with the Toledo, and comes upon Lake Temisquata, where you have described it as forming Mount Wissik or Lennox. In an opposite direction it runs N. 60 E. on the south side of the valley of the Bois Brulé for some three miles and a half. It then turns about east for a mile and gains the south side of the valley of the Neigette, running with it for about five miles. From this the escarpment turns south-east for about five miles and crosses the south-western extremity of Mount Commis, leaving a small valley between it and the mountain, and again sweeping round to the north-eastward, in about fourteen miles it gains the Metis at the mouth of the Misquegegish.

DRIFT.

From Rivière du Loup to the Marsouin, clays, sands and gravels are met with in numerous places on the coast. Inland, long stretches between sharp ridges are deeply covered with them, and this is particularly the case in the parishes of St. Simon and St. Fabien, below Trois Pistoles.

Two terraces, already mentioned, were observed in the drift to the west of Trois Pistoles River, with the respective heights of 130 and 300 feet above the sea, and there was another at the mouth of the Matanne and below the Metis River, the height of which was from forty-eight to fifty feet. Stratified clay occurred at the head of Lake Matapedia, where a surface was computed to be 480 feet above the sea, and near the outlet of the lake there were deposits which appear to be of the same character, of which the height was computed to be 530 feet, but no marine shells were met with at these heights.

Marine testacea were found in clay and sand on the east side of the Matanne River at the summit of a terrace fifty feet above the sea; the species were *Mya arenaria*, *Tellina Grœnlandica* and *Mytilus edulis*. At Metis River they were observed at the same height on the east side, and again about two miles to the west at 130 feet. In the last place the species were *Saxicava rugosa* and *Mya arenaria*. Eight miles up the Metis River the following species were observed at 245 feet above the sea, *Saxicava rugosa*, *Natica clausa* and *Balanus hameri*. To the east of Rivière du Loup *Mya arenaria* and *Scalarea borealis* were found in abundance at ten feet and twenty-four feet above the sea, in numerous places.

At the Ste. Anne River there are five or six distinct terraces in a height of twenty four or twenty-five feet, each abounding in fragments of *Mya arenaria* and *Saxicava rugosa*, and it would seem as if there had been an interval of rest in the elevation of the coast after every few feet of rise.

Ice grooves were observed in two places only. One of them was half a mile below Trois Pistoles church, sixty feet above the level of the sea; the course of the grooves was S. 32 E. The other was on the Kempt road about two miles from Lake Matapedia; here the grooves run S. 80 E., and the height of the spot above the sea is 630 feet.

ECONOMIC MATERIALS.

The substances capable of economic application met with in the course of my investigations, were bog iron ore, wad or bog manganese, copper ore, chromic iron, serpentine, roofing slates, tile stones, flagstones, building stones, limestone for burning, mill stones, shell-marl, peat, and the water of mineral springs.

Bog iron ore. This ore was abundant in the second concession of the seigniory of Green Island, on the land of Mr. Félix Avril. About the middle of his lot it occured in patches of from three feet up to eight feet in diameter and from twelve to twenty inches thick. Between these patches there were intervals of thirty or forty paces. With a breadth that was not observed to exceed a hundred yards, the length of the area over which these patches were disseminated extended across ten lots, in the bearing S. 27 W., and half a mile in rather less abundance, in a contrary direction.

In the seigniory of Cacouna at the village of La Plaine on the lot belonging to Mr. Stanislaus Roy, a patch of the ore was seen, measuring fifty feet by fifteen feet, with a thickness of four inches. On the adjoining lot to the east, another patch of about the size of the previous one, was met with ; yellow ochre occurred in the same place in small quantity.

Another locality was in the seigniory of Villeray about three miles west from Green Island River. On the land of Mr. Narcisse Marquis there is a patch of the ore about 270 feet long, and from twenty to thirty feet wide, with a thickness of from six to twelve inches. The ore was likewise observed on several adjoining farms in smaller quantities, but from the information I obtained from the farmers, it appeared not unlikely that the spread of such patches of the ore is considerable in the neighbourhood.

Traces of the ore were seen in several other places in the seigniories of Green Island, Villeray, Cacouna and Rivière du Loup, as well as in the townships of Viger and Whitworth, but the quantity was too small to require particular mention. As a whole, the ore-bearing tract is about twenty-four miles east and west by about five or six north and south. Whether the ore can be found in sufficient abundance to warrant the establishment of a smelting furnace is perhaps as yet doubtful. From the wooded character of a great part of the country to the south of the tract, charcoal for smelting purposes could be procured easily for many years to come.

Wad or bog manganese. This ore was found in the seigniory of Cacouna, on the lot of Mr. Stanislaus Roy already mentioned, in a patch measuring twenty-five feet by twenty feet; it occurs in nodules of from a half to a quarter of an inch in diameter, imbedded in sand, and forming a layer of the thickness of four or five inches.

Copper ore. Notwithstanding the great area over which the limestones and limestone conglomerates of the same age as the copper-bearing rocks of Upton, Acton and Leeds were examined, the only traces of copper ore met with were near the mouth of the Great Capucin River. Here, as already has been mentioned, the pyritous sulphuret is disseminated in small specks in a bed of greyish-green quartz, interstratified in red shale, while the green carbonate invests some of the cracks in the two inches of thickness containing the sulphuret.

Chromic iron. On the summit of Mount Albert, near the second station established by Mr. Murray for his measurements, chromic iron was strewed in abundance on the surface among the fragments of serpentine. It occurred in loose masses weighing from a few ounces to twenty pounds. It was almost all quite free from rock, and the masses, continuing for a little over half a mile in a bearing N. 44 E. gave indication that this was the probable direction of its run, though the bed itself was not seen. The loose masses were so abundant that in a few hours a ton of the ore might have been collected by a single person; and their cleanness leaves little doubt that there must be a rich deposit close to the surface beneath the moss and soil.

About four miles to the north-east of this, a bed of the ore of about one inch thick was observed in the serpentine; but the ore was not so pure as the masses on the summit of the mountain. The bed was traceable in the strike of the serpentine for about fifty paces.

Serpentine. The serpentine of Mount Albert, occupying an area of not less than ten square miles, would yield an inexhaustible supply of material capable of economic application. The rock appears to be unusually solid, and in several places vertical cliffs of several hundred feet in height shew nothing but bare serpentine; while masses of eight and ten feet in diameter, fallen from them, lie at their base. The general colors, as far as observed, were green, or green mottled with red, and mahogany-brown striped with red; occasionally a blueish tint was mingled with the other colors. The distance of the locality from the St. Lawrence by the valley of the Ste. Anne River is thirty-four miles. By the valley of the north tributary branch of the Ste. Anne and the valley of the Marsouin the distance is twenty-four miles. In either direction roads could be easily constructed, while a great part of the way is well adapted for settlement.

Roofing slates, tile stones and flagstones. The best roofing slates were observed on Henley's Brook. The nearest exposure of the rock yielding them is about two miles and a half above the junction of the brook with the Marsouin, or about four miles from the St. Lawrence, and it prevails for a breadth of two and a half miles up the valley of the brook. The slates might be obtained in thicknesses varying from an eighth to a quarter of an inch, and in slabs of eight or ten feet square, with very smooth surfaces. Some part of the rock gave thicker slabs, measuring from two to three inches, and would serve as excellent flagstones. The color of the rock is a dark bluish-grey or black. Some bands of the slate are calcareous, and these, for roofing purposes, should be avoided.

The same rock comes out in the strike upon the Marsouin River from seven to nine miles from the St. Lawrence, and would here give a material of much the same character.

Allusion has already been made in the geological description to the flagstones of the Metis. They occur about twenty-six miles and a half from the mouth of the river, and consist of calcareous sandstones weathering to a light drab. Slabs might be obtained of two feet square, with thicknesses ranging from two to four inches.

Another locality for flagstones is on the Awaganasees Brook about thirty-four miles and a half from the mouth of the Patapedia. They so much resemble those of the Metis River that they are supposed to be of the same geological formation. The slates however were of larger dimensions, some of those seen being two feet square, and others four by eight feet, the thicknesses being from one to two inches. Another exposure about a mile lower on the Awaganasees would yield as large but thinner slabs, which would form excellent tile stones.

Another locality of the same description of material was met with on the Patapedia about seventeen miles and three quarters from the mouth. Here good tile stones might be obtained.

On the Rimouski River below the fall, on the twenty-fourth lot of the sixth range of Duquesne, flagstones might be obtained of a character so similar to those of the Metis, that they are supposed to have the same stratigraphical place. The dimensions observed, as already stated, were two by three feet, and four by six feet, with thicknesses varying from one to four inches.

Mill stones. On Lake Matapedia the white sandstones which underlie the Gaspé limestones would answer the purpose of mill stones. When I passed the lake Mr. Pierre Boucher shewed me a stone which he had prepared from the rock to be used in a mill about to be erected by him. The rock is undoubtedly hard and solid enough for the purpose, but wants the small cavities required for mill stones of the best description.

Building stones. From the grey calcareous sandstones of group B excellent building stones may be obtained, and so many localities in which these sandstones occur, have been named in the geological description, that farther allusion to them is unnecessary. The more solid beds at the base of the Gaspé limestones, as they appear on the Middle Metis Lake and Lake Matapedia, would give good building stone.

Lime. In the limestone conglomerates of group B masses of the rock are found, in most localities, which yield stone of sufficient purity for burning into quick-lime. At Metis a single boulder of dark grey limestone imbedded in one of the conglomerate bands was calculated to weigh twenty-five tons. It was being quarried for lime-burning at the time of my visit to the place. Pretty good stone for burning might be obtained from the base of the Gaspé limestones as far as they were traced.

Shell-marl. About five miles below the Matanne River just over the bank of the St. Lawrence, on the lot of Mr. Denis Gougé, there occurs a deposit of fresh-water shell-marl. It is at the outlet of a swamp, and where dug through it had a thickness of fifteen inches. I was informed that on an occasion when the swamp became dry in summer, the deposit had been seen in other parts of it. The swamp has an area of between fifty and sixty acres.

The only other locality in which shell-marl was observed was on the Lower Lake Metis. In the upper part of this lake wherever the dredge was used it always brought up shell-marl, but the thickness of the deposit is uncertain.

Peat. A large area in the seigniory of Rivière du Loup is covered with peat. The locality is called the Savanne de la Plaine. The exact boundaries were not ascertained, but the area cannot be less than nine or ten square miles. It stretches along both sides of the river from the third to the sixth mile, and to the eastward it has a length of three miles, diminishing to the breadth of a mile at the east end. Its length on the west side of the river I was not able to ascertain.

Peat was observed in abundance on the first and second concessions of Green Island Seigniory, and from a point two miles below the Rimouski River there is a belt of it extending nearly all the way to Metis River, a distance of over twenty miles. The northern edge of the belt approaches in some places to within a quarter and in others to within half a mile of the St. Lawrence, and its width is from a quarter of a mile to a mile. The thickness of the deposit where observed was from one to six feet.

The swamp which has been mentioned on the Rimouski in the third range of Duquesne is underlaid with peat; from within half a mile of the Rimouski it extends two miles to the east in Duquesne, and from one to two miles more in Macpes. Its breadth is about three quarters of a mile, and its thickness from five to twelve feet. Where tried by me, a pole was sunk in it nine feet; but I was informed by one of the inhabitants that a pole had been sunk in it to a depth of thirty feet on Bouchette's road.

Mineral springs. Mineral springs occur in abundance in the neighbourhood of Cacouna and Green Island, and from the circumstance of this part of the St. Lawrence being a considerable place of resort in the summer for persons in search of health it would perhaps be desirable that the medicinal properties of the most important of the springs should be ascertained. Without attempting a description of any of them, the following is a list of those which came under my own observation and of which I obtained information :

1. I was informed that one mile south from Cacouna village there is a copious saline spring, but I could not ascertain the proprietor's name.
2. About half a mile below the village, a spring was observed about three feet under high-water mark ; it appeared to be sulphurous and saline.
3. About a quarter of a mile farther down the coast, another of the same character was met with about three feet above high water mark.
4. Three miles west from Green Island, on the farm of Mr. Narcisse Marquis, in the second concession of the seigniory of Villeray, there are two strong saline and sulphurous springs, specimens of which were brought to Montreal.
5. On the next farm to the westward belonging to Mme. Marie Beaulieu, there is another strongly saline and sulphurous spring.
6. Just below the bank to the west of Green Island River, at the village there are several springs. The first is 200 yards from the river, on the land of Mr. Paradis. On the next adjoining lot belonging to Mr. J. B. Dumont, there are two springs, and in the succeeding one, the property of Mr. Coté, there are two more. These five springs occur on a nearly east and west line, within a length of 200 yards. They are not so copious nor so strong as those mentioned to the west. I was informed that there are many other mineral springs in the same neighbourhood, but I was not able to ascertain their exact localities.
7. About six miles below Cap Balêine or Whale Point, at the upper end of Les Crapauds, there is a sulphurous spring below high-water mark. The water had also a saline taste, but as the tide had just left the spot it was not certain whether the taste was not derived from an admixture of sea-water.
8. About two miles farther down the coast there are two springs about half a mile apart, with the Rivière à Crapaud between them. These are both under high-water mark ; they had a strong sulphurous odor and saline taste.

9. There are two springs above Ste. Anne River. One of them is two and the other five miles from the river. Both are under high-water mark, and they are both sulphurous and may be saline.
10. Another of a similar character occurs between high and low water mark, about 200 paces below Little Ste. Anne River.
11. In the valley of the Marsouin, on the east side of the river about nine miles up, there is a spring with a small flow of water; but it is strongly sulphurous and slightly saline. Well beaten paths lead to it, shewing that it is much resorted to by the wild animals of the country.

I have the honor to be,

Sir,

Your most obedient servant,

JAMES RICHARDSON.


GEOLOGICAL SURVEY OF CANADA
Sir W.E. Logan F.R.S Director
PLAN
SHOWING THE
DISTRIBUTION OF THE DEVONIAN
AND
SILURIAN FORMATIONS
in a part of
GASPÉ
To illustrate the Exploration of
J. Richardson.
1858.
Scale of Statute Miles
RIVER ST LAWRENCE
NEW BRUNSWICK
BAY OF CHALEUR
SEIGNY OF MATANNE
MATANNE
MACNIDER
SEIGNY METIS
SEIGNY OF THIBIERGE
SEIGNY OF LESSARD
NEIGETTE
SEIGNY OF BIC
DUQUESNE
SEIGNIORY OF LAKE MATAPEDIA
SEIGNIORY OF LAKE METIS
Shickshock Mountains
Chloritic and Epidotic Rock
Mount Albert
Conical Mt
Berry Hill
Sandstone of Group C
Supposed base of Gaspé Sandstone
Supposed base of Gaspé Limestone
Longitude West 67° from Greenwich
Reference
Dip
Overturn Dip
Anticlinal

REPORT

FOR THE YEAR 1858

OF

MR. T. STERRY HUNT, F.R.S.

CHEMIST AND MINERALOGIST TO THE GEOLOGICAL SURVEY OF CANADA,

ADDRESSED TO

SIR W. E. LOGAN, F.R.S.

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 1*st May*, 1859.

SIR,

At the close of my Report for 1856, I had occasion to call your attention to the composition of some varieties of intrusive rock, occurring in the vicinity of Montreal, and locally known as white traps. These rocks, which are sometimes compactly crystalline, at others are porphyritic, the base being dull and earthy in aspect, and enclosing crystals of feldspar. My analyses showed these rocks to be essentially composed of a feldspar approaching orthoclase in composition, with occasional admixtures of a silicate of alumina and alkalies decomposable by acids, together with carbonates of lime, magnesia and oxyd of iron. These carbonates were sometimes entirely wanting, but in other varieties of the rock equalled five or six per cent. In like manner certain varieties gave to muriatic acid only traces of alumina from the decomposable silicate, which in other specimens equalled five or six per cent. and in one case from 36·0 to 46·0 per cent. and had the composition of natrolite, gelatinizing with acids;

the insoluble portion in this as in the other cases consisted of a feldspar resembling orthoclase. This rock which contained besides, about seven per cent. of carbonates, I described under the name of phonolite. (Report for 1856, p. 490.)

The feldspathic residue from these white traps contains from 60·0 to 66·0 per cent. of silica, and only traces of lime, with from 10·0 to 13·0 per cent. of alkalies, in which potash sometimes predominates, while more often soda makes up the larger portion, a fact observed in many orthoclase feldspars, especially those from trachyte; for to this class of rocks, the white traps are for the most part to be referred, as you have already indicated by describing as a trachytic porphyry, the feldspathic trap from Chambly, whose analysis is given at page 486 of the Report just cited, (see also your Report for 1847, p. 17.)

Under the title of trachytes lithologists have included a large class of igneous rocks, generally more or less rough to the touch (as the name indicates,) white or of pale colors, and composed essentially of orthoclase or a closely related feldspar, with small portions of mica, hornblende and more rarely pyroxene. Some varieties contain disseminated grains of quartz. The typical trachytes have an uncrystalline base, which is sometimes porous and at others compact, generally dull and earthy in aspect; the base is sometimes vitreous and passes into obsidian and pumice, while in others it is finely crystalline. These varieties often become porphyritic from the dissemination of crystals of glassy feldspar and other minerals, passing into the so-called argillophyre or clay porphyry. The base is sometimes highly silicious and becomes a sort of petrosilex, which is probably nothing more than an intimate mixture of quartz and feldspar; through such trachytes, and those which contain disseminated quartz, we have a passage to true granites, which consist of orthoclase feldspar mingled with quartz and mica. There are not wanting trachytes whose whole mass is coarsely crystalline, constituting granitoid and even gneissoid trachytes. Such are some of the rocks about to be described, which are only distinguished from true granites and syenites by the absence of quartz. The analyses of other trachytic rocks show them to consist of orthoclase mingled with more basic feldspars, or with hydrated silicates like natrolite, thus passing into phonolites. The accidents of structure which are supposed to characterize this class of rocks are however so little dependent upon chemical composition that in many of the so-called trachytic rocks of Hungary and Guadaloupe the predominant mineral is a basic feldspar like labradorite, containing large amounts of lime and soda, with but little potash.

Among the trachytic rocks of Lower Canada, I have met with none which are porous or vitreous. The white trachytic dykes at Lachine are finely granular, and sometimes earthy in texture; they occasionally assume a concretionary structure, and are often porphyritic from the presence of crystals of feldspar. The reddish-gray trachytic porphyry of Chambly offers an example of well-defined feldspar crystals in a paste consisting of finely lamellar orthoclase with a slight excess of silica and small portions of mica. Several dykes about Montreal consist of a trachytic porphyry with large feldspar crystals in a compact purplish or lavender-gray base of a waxy lustre, which effervesces with acids from an admixture of carbonates, and closely resembles in appearance certain trachytes from the Siebengebirge upon the Rhine. Other varieties can hardly be distinguished from the so-called domite, the trachyte of the Puy de Dôme, and exhibit small drusy cavities. The presence of carbonates in trachytes has generally been overlooked; Deville however found seven per cent. of carbonate of lime in a trachytic rock from Hungary, and I have observed it disseminated in some of the trachytes of the Siebengebirge.

In my Report already referred to I have shown that some of the trachytes of our vicinity apparently contain carbonates of magnesia and iron, and perhaps of manganese, in addition to carbonate of lime. Many of these rocks weather to some depth of a reddish-brown from the peroxydation of the iron. One of this kind, which forms a large dyke in the limestones at the Mile-End Quarries, is remarkable for its large proportion of carbonates. It is grayish-white with dark gray spots, granular, sub-vitreous in lustre, and has the aspect of an impure quartzite. It loses by ignition 11·0 per cent. of its weight; reduced to powder it effervesces freely with nitric acid, disengaging carbonic acid, which when heat is applied is mingled with nitrous fumes from the peroxydation of the iron. 100 parts of the rock gave in this way to the ácid, 4·84 of alumina, besides lime, magnesia and iron, which represented as carbonates equalled carbonate of lime 11·60, carbonate of magnesia 3·58, carbonate of iron 3·82 = 19·00 ; a small portion of these bases was perhaps united with the alumina in a silicate. The insoluble residue gave as follows :

	I.
Silica,	61·62
Alumina,	21·00
Lime,	2·69
Magnesia,	(traces)
Potash,	4·66
Soda,	5·35
Volatile,	2·37
	97·69

It will be seen that this residue is near to orthoclase or rather to oligoclase in composition ; as I have suggested in a previous Report, the decomposition of a portion of the feldspar, which has been converted into a hydrated silicate of alumina with loss of the alkalies and a portion of silica, will explain the presence of water and an excess of alumina, not less than the deficiency of silica and alkalies, in the feldspathic matter of the more earthy of these trachytes.

These trachytic rocks occur in dykes cutting the dolerites and melaphyres of the Mountain of Montreal, and constitute the little island known as Moffatt's Island, but the most remarkable exhibition of them is met with in the mountains of Brome and Shefford. The former occupies an area of about twenty square miles in the township of Brome and the western part of the township of Shefford, and consists of a great mass of trachyte rising into several rounded hills, of which Brome and Gale Mountains are the principal, and may have an elevation of about 1000 feet above the surrounding plain, from which the intrusive rock rises boldly. It shows divisional planes, giving it the aspect of stratification, and is divided by other joints into rectangular blocks. Another similar mass, covering an area of about nine miles, is met with in the township of Shefford a little to the N. W., and distant in the nearest point only about two miles from the last. These masses of rock, as you have shown in your Report for 1847, break through the slates and sandstones of the upper portion of the Hudson River group, which in that vicinity, although on the confines of the metamorphic region, are but little altered.

The rock of these two mountainous areas presents but very slight differences, being everywhere made up in great part of a cleavable feldspar with small portions of brownish-black mica or of black hornblende, which are sometimes associated. The proportion of these two minerals to the mass is never above a few hundredths and often less than one-hundredth. The other minerals are small brilliant crystals of yellowish sphene and others of magnetic iron, amounting together probably to one-thousandth of the mass; in some finer grained varieties rare crystals of sodalite and nepheline are met with.

These rocks never contain quartz, but being made up entirely of cleavable grains of feldspar without any cementing material, are very friable and subject to disintegration; so that for some distance around the mountains, the soil is almost entirely made up of the disaggregated crystals of feldspar, which however show but little tendency to decomposition, and retain their lustre. The rock is sometimes rather finely granular, but is often composed of cleavable forms, which are from one-fifth to one-half of an inch in breadth and sometimes nearly an inch in length. The cleavages of the feldspar are those of orthoclase. The lustre is vitreous and in the more opaque varieties pearly, but the crystals never exhibit that eminently glassy lustre nor the fissured appearance which characterises the feldspar of many foreign trachytes, identical with these in composition. The color of the feldspars of these mountains is white, passing to reddish on the one hand and to pearl or lavender-gray on the other.

Specimens of the rock of Brome Mountain were taken from the side near the village of West Shefford; it was coarsely crystalline, lavender-grey in color, and contained a little brown mica, sphene and magnetic iron, but no hornblende. The density of fragments of the mass was found to be 2·632—2·638. Selected grains of the feldspar had the specific gravity of 2·575 and did not yield anything to the action of hydrocloric acid. The analysis was effected in the usual way by fusing with an alkaline carbonate. The alkalies were determined from another portion, which was decomposed by ignition with a mixture of carbonate of lime and muriate of ammonia. The analyses of two portions from different specimens gave as follows:

	II.	III.
Silica,	65·70	65·30
Alumina,	20·80	20·70
Lime,	·84	·84
Potash,	6·43	....
Soda,	6·52	....
Volatile,	·50	....
	100·79	

A specimen from the south side of Shefford Mountain was next examined. A little above the place where it was collected the rock was a coarse greyish-white feldspar with a little black mica, and closely resembled that just described, but the portion selected contained a little black brilliant hornblende in crystalline grains about the size of those of rice, with very small portions of magnetite and yellow sphene, disseminated in a base, which although completely crystalline, was more coherent and finer grained than that of Brome, rarely exhibiting cleavage planes more than one-fourth of an inch in length. Its colour was yellowish-white, and it was sub-translucent with a somewhat pearly lustre. Fragments of the rock gave a specific gravity of 2·607—2·626—2·657. By crushing and washing the mass, the white feldspar grains were separated from the heavier minerals, and had in powder a specific gravity of 2·561.

The composition of this feldspar is almost identical with that from the trachytes of Brome and Chambly. For the sake of comparison, the analysis of the crystals from the latter is subjoined. (A) See Report for 1856, p. 486.

Analysis gave for the feldspar of Shefford :

	IV.	A.
Silica	65.15	66·15
Alumina,	20·55	19.75
Lime,	·73	.95
Potash,	6·39	7.53
Soda,	6·67	5·19
Volatile,	·50	·55
	99·99	100·12

Going westward from the mountains of Brome and Shefford, which from their proximity and their identity of composition may be looked upon as forming but one great trachytic mass, we meet with a series of intrusive masses, less extensive, but similar in attitude, and which as you have remarked are placed along the line of a anticlinal, traceable as a gentle undulation for 180 miles across the country as far west as the Lac des Chats on the Ottawa. The hills lying to the west of Brome and Shefford are in the order of their succession, Yamaska, Rougemont, Belœil, Montarville, Mount Royal and Rigaud, all of which are intruded through Lower Silurian strata. A few miles to the south of Belœil is Mount Johnson or Monnoir, another intrusive mass, which although somewhat out of the range of those just mentioned, apparently belongs to the same series. The mineral composition of these intrusive masses varies considerably, not only for the different mountains, but for different portions of the same mountain.

Yamaska Mountain.—The greater portion of this mass is a granitoid trachytic rock, which differs from that of Brome and Shefford in being somewhat more micaceous and more fissile. The dark brown mica is in elongated flakes, and hornblende is absent in the specimens collected, which however hold small portions of magnetite and minute crystals of amber-yellow sphene ; these seem to be disseminated in veins of segregation, which are of a lighter colour than the mass.* The feldspar grains which make up this rock are brilliant, of a vitreous

* For an examination of the sphene of the Yamaska Mountain see the Report for 1851, p. 119. By an error of the press, the determined specific gravity is said to be 2·76 instead of 3·76.

lustre and often yellowish or reddish-gray in color. Separated by washing from the crushed mass, the crystalline feldspar in powder had a density of 2·563, and gave by analysis as follows (V.) Another specimen of this granitoid trachyte, having been crushed and separated by a sieve from the greater portion of the mica, gave for the composition of picked grains (VI.):

	V.	VI.
Silica,	61·10	58·60
Alumina,	20·10	21·60
Peroxyd of iron,	2·90	2·88
Lime,	3·65	5·40
Magnesia,	·79	1·84
Potash,	3·54	3·08
Soda,	5·93	5·51
Volatile,	·40	·80
	98·41	99·71

The south-eastern part of the mountain offers a composition entirely different from the last, being a dolerite made up of a pearly white crystalline translucent feldspar, with black brilliant hornblende, ilmenite and magnetic iron. This rock is sometimes rather fine grained, though the elements are always very distinct to the naked eye, while in other portions large cleavage surfaces of feldspar half an inch in breadth are met with, which exhibit in a very beautiful manner the striæ characteristic of the polysynthetic macles of the triclinic feldspars. The associated crystals of hornblende are always much smaller and less distinct, forming with grains of feldspar a matrix to which the larger feldspar crystals give a porphyritic aspect. Finer grained bands, in which magnetite and ilmenite predominate, traverse the coarser portions, often reticulating; while the whole mass is also occasionally cut by dykes of a whitish or brownish-gray trachytic rock, which is often porphyritic. If, as is not improbable, these dykes belong to the great trachytic portion of the mountain, it would show that here as in Mount Royal the trachytes are more recent than the dolerites or diorites, but the relations of these different rocks have yet to be made out.

A portion of the coarse grained diorite selected for examination, contained besides the minerals already enumerated, small portions of black mica, with grains of pyrites, and a little disseminated carbonate of lime, which caused the mass to effervesce slightly with nitric acid. The macled feldspar crystals, sometimes half an inch in length and beautifully striated, were so much penetrated by hornblende that they were not fit for analysis, but by crushing and washing the rock a portion of the feldspar was obtained which did not effervesce with nitric acid, and contained no visible impurity except a few scales of mica. The specific gravity of the powdered feldspar was 2.756—2.763. It was attacked by hydrochloric acid with separation of pulverulent silica, but the complete analysis by this means was somewhat difficult, a portion of the mineral escaping decomposition, so that the ordinary method of fusion with an alkaline carbonate was had recourse to. Two analyses gave as follows :—

	VII.	VIII.	B.
Silica..........	46.90	47.00	47.40
Alumina.......	31.10 }	32.65	30.45
Peroxyd of iron.	1.35 }		.80
Lime...........	16.07	15.90	14.24
Magnesia.......	.65	......	.87
Potash.........	.58	......	.38
Soda...........	1.77	......	2.82
Volatile........	1.00	......	2.00
	99·42		98.96

This feldspar then approaches closely in composition to anorthite, which although formerly regarded as a rare species, has recently been shown by Deville, Damour and Forchammer to enter into the composition of the volcanic rocks of Iceland and Teneriffe, and Scott has lately described a coarse-grained diorite from near Bogoslowsk in the Urals, which contains a feldspar of specific gravity 2.72, composed of silica 46.79, alumina 33.16, peroxyd of iron 3.04, lime 15.97, potash 0.55; soda 1.28 = 100.79. It is associated with a greenish-black aluminous hornblende, containing some soda and titanic acid, together with a little mica and some quartz. (*Phil. Mag.* (4,) xv. 518). Quartz was also observed by Delesse in the orbicular diorite of Corsica, the feldspar of which contains according to him silica 48.62, and lime 12.02, approaching to anorthite in composition. In all of these feldspars however, the proportion of silica is somewhat greater than in pure anorthite, which contains only 43.2 per cent. of silica. I have already in a previous Report discussed the question of the composition of these feldspars, and my reasons for regarding them as mixtures of two or more species. (Report for 1853-56, p. 383, and *Phil. Mag*. (4) ix. 262.) I may here call attention to my analysis of the Bytownite of Thompson from near Ottawa; this is a granular feldspar, forming with occasional grains of hornblende a diorite, and having a specific gravity of 2.732, which in my Report for 1850, p. 39, I described as an impure anorthite. Its analysis is for comparison placed along side of that of the feldspar of the Yamaska diorite, and marked B.

Mount Johnson or *Monnoir*, is composed of a diorite which in general aspect greatly resembles that of Yamaska except that it is rather more feldspathic; the finer grained varieties are lighter colored and exhibit a mixture of grains and small crystals of feldspar with hornblende, brown mica and magnetite. Frequently however the rock is much coarser grained, consisting of a mixture of feldspar grains with slender prisms of black hornblende often half an inch long and one-tenth of an inch broad, and numerous small crystals of amber colored sphene.

In this aggregate there are imbedded cleavable masses of the feldspar often an inch long by half an inch in breadth. At the southern foot of the mountain large blocks of the coarse grained diorite are found in a state of disintegration, affording detached crystals of feldspar with rounded angles, and weathered externally to an opaque white from partial decomposition. Near the base of the mountain a coarse grained variety of the diorite encloses small but distinct crystals of brown mica, and a fine grained micaceous variety near the summit contains sphene.

The feldspar in all the specimens which I have examined appears uniform in its character; it is white, rarely greenish, or grayish; lustre vitreous inclining to pearly. In its cleavages it resembles oligoclase, to which species it is shown to be related by its specific gravity and chemical composition; but I have never seen among its crystals the polysynthetic macles so common in triclinic feldspars. The specific gravity of a carefully selected fragment was 2.631, of another specimen in powder 2.659. The analyses of two different specimens gave as follows:

	IX.	X.
Silica	62.05	62.10
Alumina	22.60	
Peroxyd of iron	·75	
Lime	3.96	3.69
Potash	1.80	
Soda	7.95	
Volatile	.80	
	99.91	

Belœil or Rouville Mountain.—The specimens which I have examined from this mountain may be described as a micaceous diorite. The feldspar, which predominates so far as to give a light grey colour to the rock, is in white translucent vitreous cleavable grains, with small distinct prisms of black hornblende and scales of copper-colored mica. Magnetic iron is also disseminated, and the rock resembles the micaceous portion of Yamaska. A portion of the feldspar separated by washing, still retained a little mica, and gave by analysis:

	XI.
Silica	58.30
Alumina / Peroxyd of iron	24.72
Lime	5.42
Magnesia	.91
Potash	2.74
Soda	6.73
Volatile	.50
	99.32

It will be seen that this feldspar approaches very closely to that from Yamaska numbered VI., and there is much resemblances between the two rocks.

Montarville or Boucherville Mountain.—The collection of specimens from this intrusive mass offers two or three remarkable varieties of rock not met with in the mountains already described; and characterized by the presence of augite and olivine. The first variety consists almost entirely of coarsely crystalline black augite, with small scales of brown mica, and rare grains of white feldspar; others of calcite are also scattered throughout the mass, and their removal by solution has left numerous little pits on the weathered surface; it may be described as a highly augitic dolerite. Another and remarkable variety of dolerite appears to form the greater part of the mountain; it consists of olivine in rounded crystalline masses, from one-tenth to half an inch in diameter, associated with a white or greenish-white crystalline feldspar, black augite and a little brown mica and magnetic iron. The augite appears both in the form of small grains, and of well defined crystals, often an inch in length by half an inch in diameter, and partially coated with a film of brown mica; the olivine is evidently the predominant mineral.

An average specimen of this olivinitic dolerite was reduced to powder; it did not effervesce with nitric acid, and when ignited lost only 0.5 per cent. When heated with sulphuric acid the olivine was readily decomposed with separation of silica, and by the subsequent use of a dilute solution of soda, followed by hydrochloric acid, and a second treatment with the alkaline ley, 55·0 per cent. of the mass were dissolved. The dissolved portion consisted of,

	XII.
Silica	37.30
Magnesia	33.50
Protoxyd of iron	26.20
Alumina	3.00
	100.00

Another portion of the same pulverized specimen was gently warmed with dilute sulphuric acid, and the silica being removed from the residue by a solution of soda, some grains of olivine which still remained, were decomposed by a repetition of the process. The undissolved portion equalled 44·7 per cent., and appeared to consist of feldspar and pyroxene, with some mica and a little magnetite. The acid solution gave a quantity of magnesia equal to 18·0 per cent. of the rock.

Selected grains of the olivine were now submitted to analysis. The powdered mineral gelatinized with hydrochloric acid even in the cold, and was almost instantly decomposed when warmed with sulphuric acid diluted with an equal volume of water, the silica separating for the most part in a flocculent form, and enclosing small grains of undecomposed mineral, which were left after dissolving the ignited silica. One or two hundredths of silica were however retained in solution, and were precipitated by ammonia with the oxyd of iron. Two analyses of separate portions of the olivine gave as follows, after deducting the undecomposed mineral.

	XIII.	XIV.		Oxygen.
Silica,	37·13	37·17	=	19·82
Magnesia,	39·36	39·68	=	15·87
Protoxyd,	22·57	22·54	=	5·10
	99.06	99·39		

If we suppose the 18·0 per cent. of magnesia found above to correspond to olivine containing 39·5 per cent. of magnesia, we shall have 45·5 per cent. of olivine in the rock examined. The silicates not attacked by sulphuric acid were decomposed by fusion with an alkaline carbonate, and gave as follows:

	XV.
Silica	49.35
Alumina	18.92
Protoxyd of iron	4.51
Lime	18.36
Magnesia	6.36
Loss (alkalies?)	2.50
	100.00

A crystal of the black cleavable augite from the olivinitic dolerite had a hardness of 6.0 and a density of 3.341; its powder was ash-gray. Analysis gave,

	XVI.
Silica	49.40
Alumina	6.70
Lime	21.88
Magnesia	13.06
Protoxyd of iron	7.83
Soda with traces of potash	.74
Volatile	.50
	100.11

In some portions of the dolerite of Montarville, the feldspar is more abundant and appears in slender crystals, with augite and a smaller proportion of olivine than the last. A specimen of this variety crushed and washed, gave 3.9 p. c. of magnetic iron, and 10.0 p. c. of a mixture of ilmenite with olivine. The feldspar was obtained nearly pure, in the form of slightly yellowish vitreous grains having a density of 2.731–2.743. Its analysis gave the composition of labradorite :

	XVII.
Silica,	53·10
Alumina,	26·80
Lime,	11·48
Peroxyd of iron,	1·35
Magnesia,	·72
Potash,	·71
Soda,	4·24
Volatile,	·60
	99·00

Rougemont.—The rocks from this mountain offer very great varieties in composition and appearance. Some portions are a coarse grained dolerite in which augite greatly predominates ; grains of feldspar are present, and a little disseminated carbonate of lime. In some specimens the augite crystals are an inch or more in diameter, with brilliant cleavages, and grains of pyrites are abundant, with calcite, in the interstices. This rock approaches closely to the highly augitic dolerite of Montarville. The olivine which characterises the latter mountain is also very abundant in two varieties of dolerite from Rougemont. One of these consists of a grayish-white finely granular feldspathic base, in which are disseminated well defined crystalline grains of black augite and amber coloured olivine, the latter sometimes in distinct crystals. The proportions of these elements vary in the same specimen, the feldspar forming more than one-half the mass in one part, while in the other the augite and olivine predominate. By the action of the weather the feldspar acquires an opaque white surface, upon which the black lustrous augite and the rusty-red decomposing olivine appear in strong contrast.

Another variety of dolerite from this mountain may be described as a fine grained grayish-black basalt enclosing a great number of crystals of dark bottle-green translucent olivine, which appear in high relief upon the weathered surfaces, and are often half an inch in diameter.

In your notes upon this mountain you have remarked that dykes of a fine grained granitic trap cut the augitic mass; and I find among the collections from this locality specimens of a light gray rock which is made up of a white crystalline feldspar with small prisms of black hornblende and scales of brown mica, resembling somewhat the finer grained diorite of Mount Johnson, while others more micaceous approach to that of Belœil.

Mount Royal or Montreal Mountain.—A large portion of this mountain consists of a dolerite in which augite greatly predominates, resembling the highly augitic varieties of Rougemont and Montarville. The white crystalline feldspar, which is often very sparsely disseminated, is at other times more abundant, and occasionally predominates in bands, which traverse the dark coloured rock and appear to be veins of segregation. At the east end of the mountain a variety of dolerite containing olivine occurs; it consists of a base of grayish-white granular feldspar, which constitutes in the specimen before me about one-half the mass, and incloses crystals of brilliant black augite, and others of semi-transparent amber-yellow olivine. This rock closely resembles the feldspathic olivine rock of Rougemont described above, but the imbedded crystals are somewhat larger, although much smaller than the crystals of the same mineral in the dolerite of Montarville. A portion of the feldspar freed as much as possible from augite, gave by analysis the following result, which shows that it approaches labradorite in composition:

	XVIII.
Silica,	53·60
Alumina,	25·40
Peroxyd of iron,	4·60
Lime,	8·62
Magnesia,	·86
Alkalies, by difference,	6·12
Volatile,	·80
	100.00

The silica contained 1·60 of matter insoluble in carbonate of soda, apparently titanic acid from intermingled ilmenite, from whence a portion of the oxyd of iron is also derived.

Rigaud Mountain.—This, the most western of the series of intrusive masses under consideration, is in great part made up of a rock which approaches in character those of Brome and Shefford, being an aggregation of large crystalline grains of what appears to be a reddish orthoclase, often without any cementing medium; at other times the feldspar crystals are imbedded in a fine grained grayish base, and the rock closely resembles the trachytic porphyry of Chambly. Quartz and hornblende are both however sometimes present, the rock passing into a granite or syenite. These rocks are cut by thin veins or dykes of a hard reddish-brown jasper-like feldspathic rock.

A portion of Rigaud Mountain however consists of a rather coarse grained diorite, which is made up of a crystalline feldspar, white or greenish in colour, with small prisms of brilliant black hornblende and crystals of black mica, in some specimens the feldspar and in others the hornblende predominating. These diorites resemble closely those of Belœil and Rougemont.

The rocks of all these mountains, and especially of Montreal and Rigaud, still demand a great deal of study, and these observations and analyses are to be looked upon only as preliminary to a more extended examination, which shall determine the mutual relations of the trachytes, diorites, dolerites and olivinitic rocks above described, as well as their probable relations to the stratified deposits of more ancient periods.

The eruption of these augitic and olivinitic rocks was evidently antecedent to the deposition of the Lower Helderberg rocks, since in the dolomitic conglomerate of that age we meet with fragments of augite, olivine and mica identical with those found in the dolerites just described (Report 1857, p. 202.)

The metamorphic action exerted by these intrusive masses upon the Silurian strata in their immediate vicinity appears to have been very local, but is not less worthy of study, innsmuch as its results on a small scale resemble those produced by the wide-spread action which has altered such vast areas of similar rocks in the Green Mountain chain, far removed from the influence of intrusive rocks.

Among the sandstones and shales of the Hudson River group which surround Rougement, there occur beds of those highly ferruginous dolomites so often met with in this formation, and similar to those which I have described in previous Reports.

In one of these, which is conglomerate or concretionary in its structure, the paste has been converted into a dark greenish crystalline hornblende, which retains its colour on the weathered surfaces, while the nodules of buff coloured dolomite have become reddish-brown and pulverulent.

In another specimen of this rock, also from Rougemont, and made up of thin layers of white crystalline red-weathering dolomite with others of a compact greenish-gray mineral, are interposed layers of blackish-green crystalline hornblende from one-sixth to one-fourth of an inch in thickness; like the other bands they are variable in thickness and interrupted. Occasionally the cleavages of the hornblende, which are nearly perpendicular to the beds, are seen cutting through thin layers of the dolomite, which as before, weathers reddish-brown.

A portion of the rock free from hornblende was attacked with effervescence by warm dilute nitric acid, which dissolved 54·0 per c. of carbonates of lime, magnesia and iron. The soluble portion had the following composition.

Carbonate of lime............	38.9
" magnesia........	31.2
" iron............	29.9
	100.0

Minute grains of pyrites were disseminated through the rock, which gave to the acid traces both of copper and nickel. The residue decomposed by fusion with carbonate of soda was found to contain—silica 65.40; alumina 10.10; lime 0.56; magnesia 2.05; protoxyd of iron 4.80; titanic acid 7.30; volatile 2.20; loss (alkalies ?) 7.59 = 100.00.

The fossiliferous limestones around the mountain of Montreal appear to have suffered very little change from the proximity of the igneous rocks. In one instance a portion of the limestone for the distance of five or six inches from the dolerite was seen to be whitened, and intermixed with a portion of a greenish matter having somewhat the aspect of serpentine. Nitric acid dissolved from the crushed rock carbonate of lime with some alumina and a trace of magnesia, and the residue dried at 212° F., gave by analysis, silica 40.20 ; alumina 9.30 ; protoxyd of iron 5.22 ; lime 36.40 ; magnesia 3.70 ; volatile 0.20 = 95.02. The insoluble matter of these limestones is generally aluminous, and contains only traces of earthy protoxyd bases. A portion of the gray fossiliferous limestone from the vicinity of the mountain left by the action of a dilute acid a residue black with carbonaceous matter, which became white by ignition, and equalled 12·8 per cent. of the rock. It was an impalpable powder which gave to dilute soda ley, 9·5 per cent. of its weight as soluble silica, while the residue had nearly the composition of a potash feldspar ; analysis giving me silica 73·02, alumina 18·31, lime 0·93, magnesia 0·87, potash 5·55, soda 0·89 = 99·57. (See Report for 1857, p. 198.) It would appear that under the influence of the heat of the intrusive rock this argillaceous matter combines with lime, magnesia and oxyd of iron to form the silicate whose analysis has been given above, a portion of alumina being set free in a soluble form.

Intrusive Rocks of Grenville.

In your Report for 1856, you have described a series of intrusive rocks which cut the gneissoid rocks of the Laurentian system in Grenville, and are evidently older than the Silurian strata, which in some instances rest upon the worn surfaces of these intrusive rocks. The syenite, which is more recent than the dykes of a variety of dolerite found there, is cut by a quartziferous porphyry; while all of these are intersected by dykes of a porphyritic dolerite or melaphyre, whose relations to the Silurian strata you have not yet determined.

These syenites and porphyries are very distinct from the rocks which we have found intruded among the Silurian strata, and being the oldest known intrusive rocks upon the earth's surface, their composition presents no small interest. My examinations of them are as yet incomplete, but I give the results of analyses of the porphyry, dolerite and melaphyre.

The Grenville porphyries belong to what has been called felsite porphyry, hornstone porphyry and orthophyre, having a base of petrosilex, which may be regarded as an intimate mixture of orthoclase and quartz, colored by oxyd of iron, and varying in color from green to various shades of red and black, according to the state of oxydation of this metal. Throughout this paste, which is homogeneous and conchoidal in its fracture, are disseminated well-defined crystals of a rose-red or flesh-red feldspar, apparently orthoclase, and although less frequently, small grains of nearly colorless translucent quartz. Some varieties of this rock which you have caused to be wrought, rival for the fineness of texture, brilliancy of polish and beautiful contrasts of color, the rarest antique porphyries. An analysis was made of a characteristic variety, the paste of which was greenish-black, jasper-like, and slightly translucent on the edges; its fracture was conchoidal and its lustre somewhat waxy. The hardness was nearly equal to that of quartz and the specific gravity 2·62. A few well-defined crystals of flesh-red feldspar and some small grains of quartz were found disseminated; the composition of the paste, as free as possible from these, was found to be:

	XIX.		
Silica	72.20	= Oxygen	38.51
Alumina	12.50		5.84
Protoxyd of iron	3.70		.82
Lime	.90		.26
Potash	3.88		.66
Soda	5.30		1.36
Volatile	.60		
	99.08		

The oxygen ratios of the alkalies and the alumina are 2.02 : 5.84; or very nearly as 1 : 3; the alumina requires 43.80 of silica to form with the alkalies 65.48 of orthoclase or a feldspar with the oxygen ratios 1:3:12; leaving 28.40 of silica, of which a small portion only is combined with the lime and oxyd of iron.

The intrusive syenite of this region is generally made up of flesh-red orthoclase and grayish vitreous quartz, with a portion of blackish-green hornblende, which is sometimes almost or altogether wanting. The feldspar is generally distinctly crystalline and cleavable; at other times it is nearly compact. In some portions the syenite has undergone a peculiar decomposition which has reduced it to a soft unctuous greenish matter, having somewhat the aspect of serpentine or rather of steatite. This change, as you have remarked, is observed in the vicinity of those remarkable veins of chert so much resembling buhr-stone, which are here found cutting the syenite, and is more or less complete for a distance of 200 yards on either side of them. In specimens of this altered rock, the quartz remains unchanged, while the feldspar, still preserving its cleavages, has a hardness no greater than carbonate of lime; it is somewhat unctuous to the touch and has a feeble waxy lustre; its color is sometimes reddish, but more often of a pale green; such a specimen was selected for analysis and gave:

	XX.		
Silica	80.65	= Oxygen	43.01
Alumina	12.60		5.89
Oxyd of iron and magnesia, traces,	....		
Lime	.60		.17
Soda and a little potash	2.65		.68
Volatile	2.10		
	98.60		

It will be seen from the oxygen ratios of the alumina and alkali, that the feldspar has lost nearly two-thirds of its alkali, the iron and other bases having also for the most part disappeared. This change is therefore in fact a conversion of the feldspar into kaolin, and as the process involves a separation of silica as a soluble alkaline silicate, it is not improbable that this decomposition has been the source of this chert, which I have found to be nearly pure silica approaching to calcedony.

The oldest dykes of this region are cut by the syenite, and are of a fine-grained dark greenish-gray dolerite or greenstone, which weathers grayish-white, and is seen by the aid of a glass to consist of a greenish-white feldspar with a scaly fracture, mixed with pyroxene, occasional scales of mica and grains of pyrites. These dolerites contain no carbonates.

The analyses of specimens from two dykes varying a little in texture, gave the following results:

	XXI.	XXII.
Silica	50.35	50.25
Alumina	17.35 }	32.10
Peroxyd of iron	12.50 }	
Lime	10.19	9.63
Magnesia	4.93	5.04
Potash	.69	.58
Soda	2.28	2.12
Volatile	.75	1.00
	99.04	100.72

The iron although represented as peroxyd, exists in the form of protoxyd, and in the case of XXI., in part as sulphuret. These rocks evidently correspond to mixtures of basic feldspars with pyroxene, and present nothing in their composition to distinguish them from ordinary dolerites.

The newer dykes, which cut the quartziferous porphyries, have a grayish black, very fine-grained base, earthy and subconchoidal in its fracture, somewhat resembling the dolerites just described, but contain occasional crystalline masses of black augite, sometimes half an inch in diameter, brilliant black grains of titaniferous iron ore, and small cleavable masses of white carbonate of lime, with which indeed the whole rock seems penetrated. A portion of the paste when reduced to powder and treated with dilute nitric acid, was attacked with abundant evolution of carbonic acid, followed on the application of heat, by red fumes. The acid solution contained an amount of alumina and oxyd of iron equal to 6·50 per cent., 0·50 of magnesia, and lime equal to 8·7 per cent. of carbonate, in which state it evidently existed in the rock. The sum of the dissolved matters equalled 15·70 per cent. and the residue dried at 212°=83·30. There had evidently been a decomposition of an aluminous silicate by the acid, but the examination was not carried farther, and the dried residue gave on analysis:

	XXIII.
Silica,	52·20
Alumina,	18·50
Peroxyd of iron,	10·00
Lime,	7·34
Magnesia,	4·17
Potash,	2·14
Soda,	2·41
Volatile,	2·50
	99·26

Except in the somewhat greater proportion of potash it will be seen that the insoluble portion of this melaphyre (deducting a little silica,) approaches very nearly in composition to the older dolerites described above.

You have described as occurring at Lake Simon on the River Rouge, (*ante*, p. 28,) a peculiar gnessoid feldspathic rock, whose composition offers considerable interest. The rock has a granular base, which is perfectly white, crystalline, and resembles in appearance a coarse-grained marble; it encloses large masses of a white semi-transparent orthoclase feldspar, having three distinct cleavages, one of 90°. The specific gravity of selected fragments of this orthoclase was 2·564—2·566. Its analysis showed no traces of iron or magnesia, and gave as follows:

	XXIV.
Silica,	65.75
Alumina,	19·40
Lime,	·45
Potash,	13·60
Soda,	·69
Volatile,	·25
	100·14

By the analysis of the finely granular portion of the rock, which contained no carbonate of lime, the following results were obtained:

	XXV.
Silica,	70·10
Alumina,	16·40
Lime,	1·42
Potash,	10·96
Soda,	·79
Volatile,	·40
	100·07

Disseminated through this rock were small rounded masses of garnet from one-tenth to one-half an inch in diameter. They were much fissured and very fragile; the fragments were transparent and rose-red inclining to brownish, the powder a pale pink, becoming a bright buff by ignition. The analysis of selected grains of this garnet gave :

	XXVI.
Silica,	37·80
Alumina,	21·00
Lime,	1·81
Magnesia,	8·85
Protoxyd of Iron,	29·03
Volatile,	·18
	98·67

A fragment of reddish feldspathic gneiss from Grenville, gave by analysis as follows :

	XXVII.
Silica,	69·00
Alumina,	17·90
Lime,	2·80
Potash,	3·86
Soda,	3·70
Volatile,	1·00
	98·26

ON SOME MINERALS FROM THE SILURIAN ROCKS.

In many localities in the Eastern Townships the altered clay slates hold small crystalline plates of a mineral which has been designated in your Report for 1847, as phyllite. This name was applied by Dr. Thompson to a similar mineral said to occur in like rocks in Massachusetts, but which has never been re-examined, nor satisfactorily identified. The mineral in question is abundant in a fine grained grayish wrinkled micaceous schist from Brome, and in larger specimens from Leeds, where it occurs in a similar rock, which is pearl-gray in colour passing to greenish-gray, and is made up of quartz with a mineral having a talcose aspect, but aluminous in its composition, and apparently a mica. The rock resembles somewhat the mica schist of St. Gothard, in which are found the well known kyanite and staurotide crystals. The mineral about to be described occurs in this mica schist of Leeds in small lamellar masses, rarely more than one-fourth of an inch broad and one-eighth thick; in some specimens there occur spherical masses of it, a half an inch or more in diameter, composed of lamellæ radiating from a centre, and often making up one-half the volume of the rock. It has a perfect cleavage in one direction, and two less distinct transverse cleavages; the lamellæ are often curved, and are not easily separable. The mineral somewhat resembles hypersthene in appearance. Its hardness is 6, and its density 3·513. The color is dark greenish-gray to black, and appears brilliant black upon the faces of perfect cleavage, which have a vitreous lustre; the surfaces of fracture have a feeble waxy lustre. The streak and powder are greenish-gray. The analysis of carefully selected fragments gave as follows:

	XXVIII.
Silica,	26·30
Alumina,	37·10
Protoxyd of iron,	25·92
Protoxyd of manganese,	·93
Magnesia,	3·66
Water,	6·10
	100·01

The analysis shows the mineral in question to be chloritoid, with which its physical characters correspond. This same species has been described under the name of barytophyllite, chlorite-spar and sismondine; it is the masonite of Jackson, which occurs in argillaceous slates in Rhode Island, and the phyllite of Thompson may prove to be the same species.

Epidotic Rocks.—The presence of epidote characterizes great portions of the altered rocks of the Eastern Townships. It is generally associated with quartz, and often forms veins or patches in a granular quartz rock, which passes into argillite; chlorite is not an unfrequent accompaniment. In many localities there is found a rock which is made up entirely of quartz and epidote, sometimes in distinct grains, but at others forming an apparently homogeneous mass, generally of a pale yellowish-green colour. Characteristic specimens of this rock are found in various localities in the range of metamorphic rocks, from St. Armand on the line of Vermont to the Shickshock mountains in Gaspé, where upon the Grand Matanne River, the epidotic rock forms large beds among the chloritic schists. The specimens which I have examined are compact, very tough, sonorous, and have a granular sub-conchoidal fracture; the colour is pale olive-green or pea-green, occasionally stained or barred with brick-red; the rock has a feeble waxy lustre and is translucent on the edges. In some parts grains or thin layers of quartz become apparent. The hardness of the compact homogeneous specimens is equal to that of quartz, and the specific gravity 3·04—3·09. A portion of density 3·04 was submitted to analysis and gave as follows:

	XXIX.		
Silica,	62·60	= Oxygen	33·38
Alumina,	12·30		5·78
Peroxyd of iron,	9·40		2·82
Lime,	14·10		4·03
Magnesia,	·72		·29
Soda,	·43		·11
Volatile,	·16		
	99·71		

The oxygen of the protoxyds and peroxyds in the above analysis equals 4·43 and 8·60. If to these we add the silica corresponding to 13·00 of oxygen, we shall have 61·33 parts of epidote, leaving 38·22 parts of silica uncombined. The density is that of a mixture of quartz and epidote in these proportions, and in portions where the rock becomes granular the two species are easily distinguishable.

On the green colouring matter of some sandstones.

The quartzose sandstones of the Quebec group are often colored by disseminated rounded grains of a peculiar greenish matter, having very much the aspect of glauconite; they have the softness of gypsum and give a pale green powder. It was not possible to separate the grains for analysis, but as I found them to be decomposed by hydrochloric acid, a specimen of the sandstone from Indian Cove at Point Levi, which was free from calcareous matter and contained a large proportion of the green grains, was pulverized and digested for some days with warm hydrochloric acid until the green colour disappeared. The acid solution was then submitted to analysis, and the soluble silica removed from the residue by a dilute solution of caustic soda. In this way there were obtained from five grams of different portions of the sandstone the following elements.

	XXX.	XXXI.
Silica,	·570	·613
Alumina,	·283	·342
Protoxyd of iron,	·378	·319
Lime,	·010	·009
Magnesia,	·022	·043
Potash,	·080	·074
	1·343	1.400

The soluble portions of this sandstone amounted only to twenty-eight per cent; and as the results might be vitiated by the presence of some decomposable silicate other than the green mineral, we could only conclude as to the existence of a silicate containing a large amount of protoxyd of iron and considerable potash. Last summer however, I discovered a more abundant supply of the green grains, in thin layers of sandstone among the magnesian conglomerates of the Island of Orleans. The rock consisted of little more than a very friable aggregation of colorless quartz sand with grains of the green mineral, the whole cemented by a little carbonate of lime. After crushing and sifting to separate the coarser grains of quartz, the carbonate of lime was removed by cold dilute nitric acid, and the green grains were obtained free from all apparent impurity other than the grains of quartz. This mixture was analyzed as before by digestion with hydrochloric acid, and the soluble silica separated from the residue by a boiling solution of carbonate of soda. There were obtained in two analyses, respectively of 2.5 and 2.0 grams, as follows, calculated for 100 parts:

	XXXII.	XXXIII.
Silica,	31·32	31·30
Alumina,	12·20	12·15
Protoxyd of iron,	5·29	5·27
Magnesia,	2·26	
Potash,	5·05	5·60
Soda,	·33	
Water (by ignition)	5·25	
Insoluble quartz,	35·96	
	97·66	

If we subtract the quartz we shall have for the composition of the green grains :

	XXXIV.		Oxygen.
Silica,............................	50·7	=	27·04
Alumina,..........................	19·8		9·25
Protoxyd of iron,...................	8·6		1·91
Magnesia,..........................	3·7		1·48
Potash,............................	8.2		1·39
Soda,..............................	·5		·13
Water,.............................	8·5		7·71
	100·0		

It is evident from these results that this green matter differs chemically from the glauconite or green-sand of the cretaceous and tertiary strata, which is a hydrous silicate of protoxyd of iron and potash, with only a few hundredths of alumina; at the same time the physical characters of the green grains from the Silurian sandstones, not less than the presence of a large proportion of potash, suggest relations which should not be overlooked. This Silurian green-sand may be looked upon as a glauconite in which alumina replaces a large portion of the protoxyd of iron, just as in pyrophyllite it is substituted for the magnesia of talc. The connection of this material with what I have described as parophite, and with the dysyntribite of Shepard, hydrated aluminous rocks, containing much potash, deserves to be considered. The history of these substances is as yet but very imperfectly known. (See my Report for 1852, p. 94, and G. J. Brush, *Am. Jour. of Science*, (2) xxvi., p. 68.)

FARTHER CONTRIBUTIONS TO THE HISTORY OF MAGNESIAN LIMESTONES.

In my Report for 1857, after describing a number of our magnesian limestones, and recalling the principal facts in the history of magnesian rocks, I proceeded to notice the different theories which had been proposed to account for their formation. I then detailed the results of some experiments made for the purpose of ascertaining the action of waters containing alkaline bicarbonates upon sea-water and other waters holding in solution muriates and sulphates of lime and magnesia. It was shewn that at the ordinary temperature, and in somewhat dilute solutions, the whole of the lime may thus be separated as a crystalline carbonate retaining only one or two per cent. of carbonate of magnesia, and that the addition of an excess of the alkaline bicarbonate gives rise to a very soluble bicarbonate of magnesia, whose solution deposits by evaporation a hydrated monocarbonate.

Previous experimenters had already shown that solutions of magnesian carbonate have the power of decomposing solutions of muriate and even of sulphate of lime ; a solution of the latter is according to Mitscherlich slowly but completely decomposed when digested at the ordinary temperature with carbonate of magnesia or dolomite. I found, however, that under certain conditions these affinities are apparently reversed, so that sulphate of magnesia may be decomposed by bicarbonate of lime with formation of gypsum and bicarbonate of magnesia. As I conceived this reaction to be of great importance in a geological point of view, I have since carefully investigated it, and have now to submit the results.

The observations of Bischof and other chemists shew that at the ordinary temperature and pressure, water charged with carbonic acid will hold dissolved about one-thousandth of carbonate of lime ; such a solution according to Lassaigne contains about six equivalents of carbonic acid for one of lime, while from an experiment of Bischof it would appear that water may retain about six-tenths of this amount of lime combined with only one and a-half equivalents of carbonic acid. According to the latter author however, one thousand parts of water saturated with carbonic acid dissolve only 1·35 of magnesian carbonate, but the experiments of Bineau and my own show that in the presence of neutral salts at least, its solubility is many times greater. The liquids obtained by adding bicarbonate of soda to an artificial sea-water, gave more than four parts of magnesian carbonate to 1000, and by adding known quantities of carbonate of soda to a solution of carbonate of magnesia through which was passed a current of carbonic acid, I found it easy to produce permanent solutions retaining 21·0 grams of bicarbonate of magnesia in a liter of water. Bineau by prolonging the action of the carbonic acid obtained 11.2 grams of magnesia (equal to 23·5 grains of monocarbonate,) dissolved in a liter of water, with very nearly two equivalents of carbonic acid. This comparatively great solubility of bicarbonate of magnesia, is as we shall hereafter see, of much importance in a geological point of view.

It has long been noticed that alkaline carbonates, sulphates and chlorids as well as the neutral salts of magnesia, augment the solubility of the carbonate of magnesia in water, but these for the most part do not sensibly affect the solubility of the carbonate or bicarbonate of lime. I have however found that the sulphates of soda and magnesia offer in this respect a remarkable exception ; in fact a litre of water which contains a small portion of either of these neutral salts, is capable of dissolving in the presence of carbonic acid at the ordinary pressure, from 1·56 to 1·82 grams of carbonate of lime, or nearly twice as much as pure water under the same circumstances. A farther investigation of this unexpected reaction showed me that the lime existed in these solutions in the state of sulphate, of which they are in fact nearly saturated solutions. The solubility of this salt has been variously stated ; according to Bucholz it requires 480 parts of hot or cold water, while Giese found it soluble in 380 parts of cold and 388 parts of hot water. I found a solution prepared by agitating pure gypsum frequently for several days with distilled water, to contain one part of sulphate in 483 of water, but by evaporating a portion of this same solution at a gentle heat until crystals of gypsum separated, the clear liquid decanted after twelve hours of repose at 60° F, contained one part of sulphate of lime ($CaO\ SO_3$) in 372 parts of water, a result which approaches closely to the determination of Giese.

When a solution of bicarbonate of lime is mixed with one of sulphate of soda or sulphate of magnesia, or when a current of carbonic acid gas is passed through a solution of either of these salts holding carbonate of lime in suspension, there are formed by double decomposition, sulphate of lime and bicarbonate of soda or magnesia. The addition of alcohol to these solutions determines a copious precipitate of sulphate of lime, and the filtrate by evaporation gives a residue of bicarbonate of soda or of carbonate of magnesia. The following, among other experiments, were made in illustration of this reaction.

To 400 cubic centimeters of a recent solution of bicarbonate of lime, free from all traces of chlorid or sulphate, were added two grams of crystallized sulphate of soda and an equal volume of alcohol; the white flocculent precipitate which immediately separated was collected after a few hours, and washed with dilute spirit of wine; it was completely soluble in water, from which it was again thrown down by alcohol, with the addition of a few drops of hydrochloric acid. It was pure sulphate of lime, weighing after ignition 0·428 grs. which correspond to 0.915 gr. of carbonate of lime to the liter.

400 c. c. of a similar solution of bicarbonate of lime were mingled with two grams of sulphate of magnesia and precipitated by alcohol; the sulphate of lime equalled 0·467 gr., and by boiling a copious precipitate separated, which contained a little lime and 0·276 gr. of carbonate of magnesia, theory requiring 0·288.

500 c. c. of a solution of bicarbonate of lime, with two grams of hydrated sulphate of soda and an equal volume of alcohol, gave a precipitate of gypsum, which dissolved and reprecipitated as in A, gave 0·570 of sulphate of lime, corresponding to 0·838 gr. of carbonate to a liter. The alkaline filtrate was evaporated to dryness; the residue dissolved and precipitated at a boiling heat by a dilute solution of chlorid of calcium gave an amount of carbonate of lime, free from sulphate, which was equal to 0·445 gr. of carbonate of soda; theory demands 0·442.

To a little more than 200 c. c. of lime-water were added four grams of sulphate of soda, and a current of carefully washed carbonic acid was then passed through the liquid for four hours, at the end of which time the solution of the lime was nearly complete. The liquid now gave with alcohol 0·555 gr. of sulphate of lime, and by the indirect method described above, the carbonate of soda was found to be equal to 0·434 gr., theory requiring 0·432.

In order to determine more carefully the increased solubility of carbonate of lime in the presence of sulphates, the following experiments were made.

250 c. c. of water containing ten grams of hydrated sulphate of soda and two grams of pure carbonate of lime, were exposed for an hour and a-half to a current of carbonic acid gas, and the solution was then left for four hours in a covered flask, after which 150 c. c. of it were mixed with an equal volume of absolute alcohol. The precipitate of gypsum thus obtained was completely soluble in water, and equalled 0·363 grs. of sulphate of lime, being 2·420 grs. to a liter.

In a similar experiment the precipitate of gypsum from 200 c. c. was dissolved in pure water and thrown down as oxalate of lime. It gave an amount of carbonate equal to 1·820 grs. to the liter, or 2.475 of sulphate of lime.

A current of carbonic acid gas was passed for an hour and a quarter through a solution of sulphate of magnesia containing suspended carbonate of lime. The filtered liquid remained transparent after many hours of exposure to the air, but 200 c. c. of it gave with alcohol a precipitate of gypsum, which was collected after twelve hours, and was completely soluble in water, from which solution the lime was thrown down as oxalate, giving an amount of carbonate equal to 1·565 gr., or 2·128 gr. of sulphate of lime to the liter. The filtrate, being evaporated to dryness over a water-bath, gave a little carbonate of lime, and an amount of carbonate of magnesia equal to 1·100 grs. to the liter; theory requires 1·312, but it is difficult to separate in this way the whole of the carbonate from the sulphate of magnesia. The solutions in the last three experiments contained respectively one part of gypsum in 413, 405 and 459 parts of water.

When a solution like the last is evaporated at a gentle heat gypsum is deposited, while bicarbonate of magnesia remains in solution. I have already alluded to this unexpected reaction in my Report for 1857, p. 216, and the following experiments were made in confirmation of it. The sulphate of magnesia was carefully recrystallized and free from all traces of lime; its solution did not alter the color of curcuma, but slowly restored that of reddened litmus. The carbonic acid was evolved by hydrochloric acid from limestone, and carefully washed, so that its solution was not disturbed by nitrate of silver.

To 500 c. c. of water were added twelve grams of sulphate of magnesia and half a gram of precipitated carbonate of lime, and a current of carbonic acid gas passed for two hours through the liquid, when the carbonate of lime was nearly all dissolved. The solution was now evaporated in a porcelain basin at a temperature varying from 90° to 110° F., until crystals of sulphate of magnesia separated; a little water was then added, and the solution being immediately filtered, contained no lime-salt, but was strongly alkaline to curcuma paper. When heated it became turbid before boiling, and after fifteen minutes ebullition deposited a flocculent precipitate containing 0·208 gr. of carbonate of magnesia. The basin in which the evaporation had been conducted was covered with a crystalline crust, which effervesced but slightly with hydrochloric acid; it was soluble in a large volume of water, and was principally gypsum.

To 800 c. c. of water were added twenty grams of sulphate of magnesia and one gram of pure carbonate of lime; a current of carbonic acid gas was now passed through the liquid for an hour and a half, when the lime was nearly all dissolved; the solution was saturated with the gas, but contained no trace of chlorids. It was neutral to curcuma, and gave with alcohol a precipitate of gypsum. A portion of it heated to boiling remained clear for five minutes, but then grew turbid and deposited an abundant precipitate of carbonate of lime.

200 c. c. of this solution were evaporated at a temperature of 180°-190° F., until crystals of sulphate of magnesia separated; after twelve hours repose in the cold a little water was added, and the solution decanted from a precipitate, of which ·272 grm. were collected; when this was treated with hydrochloric acid and dilute alcohol, a portion of carbonate of lime was removed, and there remained ·236 gr. of crystalline gypsum, weighing when ignited, ·185, equal to ·925 gr. of sulphate of lime to the liter. This filtered solution of sulphate of magnesia was strongly alkaline to curcuma, and gave by boiling a precipitate, which

contained no lime, but a portion of carbonate of magnesia equal to ·490 gr. to the liter ; theory demands ·570.

A solution of twelve grams of sulphate of magnesia in 300 c. c. of water was mingled with carbonate of lime and saturated with carbonic acid. It was then filtered and evaporated at about 160° F., until sulphate of magnesia separated. By this means a sparingly soluble crystalline precipitate was formed, which contained gypsum equal to ·235 grm. of sulphate of lime, with a little carbonate. The filtrate gave by boiling a precipitate of carbonate of magnesia, which equalled ·098, while theory demands ·145.

To 600 c. c. of a solution of bicarbonate of lime were added twenty grams of sulphate of magnesia, when the liquid, which was before turbid from a portion of suspended carbonate, became clear, and gave by evaporation at 90° F. a precipitate containing ·144 of sulphate of lime, with some carbonate of lime and a trace only of magnesia.

A solution of five grams of sulphate of magnesia was mingled with a portion of solution of bicarbonate of lime, and evaporated at 160°–180° F., further portions of the latter, amounting in all to 300 c. c. being added as the evaporation went on. There was deposited a mixture of carbonate of lime, with crystalline gypsum equal to ·373 gr. of sulphate of lime to the liter.

It will be remarked, that while the recent solution, containing gypsum and carbonate of magnesia with excess of carbonic acid, is neutral to curcuma, and may be boiled for some minutes before a precipitate of carbonate appears, the liquid from which gypsum has been deposited by evaporation is strongly alkaline to curcuma paper, and lets fall a precipitate of carbonate of magnesia even before attaining the boiling point ; this precipitate is in part redissolved as the liquid cools. When this alkaline liquid is mixed with a solution of gypsum, it deposits in a few hours, especially if gently warmed, a crystalline precipitate of carbonate of lime, resulting from the decomposition of the sulphate of lime by the carbonate of magnesia.

The sulphate of magnesia retains the carbonate of magnesia in solution in such a manner that the latter is not rendered completely insoluble, even when the liquid is evaporated to dryness over a water-bath. Hence the deficiency observed in the determinations of carbonate of magnesia whenever in the preceding experiments, a large portion of sulphate was present. The filtrate from the carbonate in these cases is still alkaline to curcuma paper, and gives with nitrates of silver and copper, precipitates of carbonates.

In the preceding experiments all salts other than those concerned in the reaction, were excluded, but similar results were obtained in the presence of sea-salt and chlorid of magnesium. Twenty grams of pure chlorid of sodium, and ten grams of sulphate of magnesia, with a portion of carbonate of lime, were added to 800 c. c. of water, and the solution saturated with carbonic acid gas. Of this liquid 400 c. c. were evaporated at 160°–180° F., until sea-salt separated, and gave ·045 grm. of sulphate of lime, mixed with ·291 of carbonate.

Ten grams of chlorid of sodium and twenty grams of crystallized chlorid of magnesium were added to 600 c. c. of solution of bicarbonate of lime, containing two grams of sulphate of magnesia; 300 c. c. of this solution were now evaporated at 160°–180° F., until crystals of sea-salt appeared; there were obtained ·057 gram. of sulphate of lime.

A saturated solution of one part of sea-salt and two parts of sulphate of magnesia was exposed to a cold of 32° F., when a large amount of sulphate of soda separated. The mother liquor, containing besides some sea-salt and sulphate of magnesia, a large amount of chlorid of magnesium, was diluted with four parts of water. 500 c. c. of this solution were mingled with carbonate of lime, saturated with carbonic acid, and then evaporated at a temperature of 85°–90° F., to one-twelfth, when crystals of sea-salt separated, and a crystalline residue of gypsum was obtained. It did not effervesce with hydrochloric acid, and was soluble in a large volume of water. The saline liquid by evaporation to dryness, gave ·331 of carbonate of magnesia, equal to ·535 of gypsum.

To another portion of 100 c. c. of the saline solution employed in the last experiment, 500 c. c. of a solution of bicarbonate of lime were gradually added, the mixture being meanwhile evaporated at a temperature below 100° F., and at length carried to dryness. On treating the mass with water, the strongly saline filtrate was found to contain no salt of lime, but sulphate of lime was abundant in the washings, and the residue on the filter, when treated with hydrochloric acid, left crystalline grains of gypsum.

In the foregoing experiments it is not easy to separate the more soluble salts from the gypsum, which although insoluble in saturated saline liquids, is readily dissolved by washing with water, in place of which a solution of gypsum may be used. In either case, as a solution of sulphate of lime is decomposed by the dissolved carbonate of magnesia, the washings should not be mingled with the alkaline filtrate in which we wish to determine this salt. As a solution of magnesian carbonate which has lost its excess of carbonic acid by evaporation, is incompatible with dissolved gypsum, it is evident that the presence of an excess of this acid must be one of the conditions required for the crystallization of gypsum from such a solution. It often happens that some slight variations in the conditions of the experiment with two portions of the same solution, will give in one case abundance of gypsum and in the other chiefly carbonate of lime.

The power of bicarbonate of baryta to decompose sulphate of magnesia and even sulphate of soda, is well known; and I have found that the insolubility of the sulphate of strontia determines a similar result. A solution of bicarbonate of strontia, prepared by passing carbonic acid gas through water holding the carbonate in suspension, was divided into two portions, one of which was mingled with a portion of sulphate of soda and the other with sulphate of magnesia. The mixtures, at first clear, soon became troubled from the separation of a precipitate, which adhered to the sides of the vessels, and like ammonio-magnesian phosphate, along the lines marked by the rod in stirring. After twelve hours the liquids decanted from the precipitate, which was in each case sulphate of strontia, were evaporated at a gentle heat to a small volume, during which process they deposited a portion of carbonate of strontia.

The first contained some sulphate, with a large proportion of carbonate of soda, and the second, which gave no trace of dissolved strontia, let fall by boiling a copious precipitate of magnesian carbonate.

An analogous reaction between the sulphates of iron and zinc and the bicarbonate of lime, resulting in the production of gypsum and carbonates of zinc and iron, has already been suggested by Monheim to explain the association of these minerals in a modern deposit from the waters of a mine. The experiments of Bischof have established the fact of such a decomposition for the sulphate of copper, as well as for the sulphates of zinc, and protoxyd of iron.—(*Lehrbuch*, ii, 1198–1202.)

The carbonates of lime and magnesia, although so frequently combined in nature in the form of dolomite, exhibit under ordinary circumstances, little disposition to unite with each other. The carbonate of lime, as we have seen, separates nearly pure from solutions of bicarbonate of magnesia at ordinary temperatures; and if by the aid of heat a portion of magnesian carbonate is at the same time precipitated, the two appear to be only in a state of admixture.

Karsten long since observed that dilute acetic acid, at temperatures below 32° F., readily dissolves carbonate of lime, but is without action on the double carbonate of lime and magnesia, which constitutes dolomite. By this means he was enabled to make proximate analyses of many magnesian limestones, which he found to be mixtures of dolomite with carbonate of lime. Before undertaking a series of experiments on the production of this double carbonate, I endeavored to fix by experiment the limits of error in Karsten's process.

For this purpose I took a pure acetic acid containing 29·4 p. c. of glacial acid; this was mixed with an equal volume of water, so that the dilute acid used in the following experiments contained about 15·0 p. c. of glacial acetic acid. Unless otherwise specified, it was employed at 32° F. (lower temperatures being difficult to regulate), and this temperature was maintained by a bath of ice and water. In these conditions the acid dissolved precipitated carbonate of lime and pulverized limestone with lively effervescence, even when farther diluted. A pure crystalline dolomite in fine powder was however slowly attacked, subsiding to the bottom of the liquid, and disengaging small bubbles of gas from time to time. After six hours digestion with a large excess of the acid at 32° F., 1.680 grs. of this dolomite had lost .082 of carbonate of lime and ·063 of carbonate of magnesia, equal to 8·63 p. c. of dolomite. At a temperature of 60° F. the same acid caused a slow but continued disengagement of gas bubbles from the powdered dolomite, which after thirty hours had lost 28·0 p. c. of its weight, the dissolved portion containing 45·0 p. c. of carbonate of magnesia. At 125° F. the action of the acid upon the powdered dolomite was accompanied with gentle effervescence, and the amount dissolved after two hours digestion, was 13·6 per cent.

A white crystalline magnesite from Styria, whose only impurity was a portion of carbonate of iron equal to 0·9 p. c. of peroxyd, and which was slowly but completely soluble in hot hydrochloric acid, was also slightly attacked by dilute acetic acid at 60° F.; after twelve hours digestion there were dissolved 0·63 p. c. of the carbonate. At 125° F. however a distinct effervescence was produced with the acid, and at the end of three hours 11·0 p. c. of the magnesite were dissolved.

From these experiments it was evident that although not insoluble in acetic acid of 15 0 p. c. at 32° F., this liquid might serve to separate dolomite from carbonate of lime, and also to effect a partial separation of dolomite from magnesite.

In subsequent experiments I found that a much more dilute acid, prepared by mixing one part of the above acetic acid with nine parts of water, and consequently containing only about 3·0 p. c. of glacial acetic acid, attacks pure carbonate of lime with lively effervescence at 60°, and even at 32° F., and may be therefore used with still greater advantage in the investigation of these mixed carbonates.

The insolubility of the double carbonate of lime and magnesia in carbonic acid water is also an important fact in the history of dolomite. Bischof found that by the prolonged action of a solution of carbonic acid upon a limestone containing 11·54 p. c. of magnesian carbonate, there were dissolved 4·29 p. c. of carbonate of lime, and not a trace of magnesia. In like manner a manganesian iron-spar which contained 14·0 p. c. of carbonate of lime and 15·0 p. c. of carbonate of magnesia, gave to carbonic acid water four parts of carbonate of lime for one part of magnesian carbonate.—(*Lehrbuch*, ii, 1176.)

The following experiments were made to determine the solubility of dolomite in carbonic acid water. The magnesian limestone of Galt, which is a nearly pure crystalline dolomite, was selected, and one gram of this in fine powder was suspended in a little more than half a liter of water, which was then saturated with carbonic acid gas, and the mixture digested for eighteen hours at about 65° F. with frequent agitation, when the quantity of dissolved carbonates in a liter of the filtered liquid was found to be 0·150 grs., consisting of carbonate of lime 57, carbonate of magnesia 43. In order to determine the influence of time and a greater surface of the solid matter, two grams of the same dolomite were treated as above for five days, when there were dissolved of the double carbonate ·390 grs. to a liter.

A mixture of one gram of the dolomite and one gram of artificial carbonate of lime were digested as above with half a liter of carbonic acid water for eighteen hours, when there were found in solution, of carbonate of lime ·380, and of carbonate of magnesia ·007, equal to .015 of dolomite, so that only four parts of dolomite were dissolved for ninety-six parts of carbonate of lime.

Accepting the idea that dolomites have been formed by the alteration of beds of carbonate of lime, Haidinger long since suggested that a solution of sulphate of magnesia at a high temperature might produce this change, giving rise by double decomposition to carbonate of magnesia and sulphate of lime, although Mitscherlich had shown that at ordinary temperatures sulphate of lime and carbonate of magnesia are mutually decomposed. Von Morlot subsequently verified this conjecture of Haidinger; he found that by heating together to 200° centigrade, for six hours in a sealed tube a mixture of two equivalents of carbonate of lime and one equivalent of crystallized sulphate of magnesia, the latter was completely decomposed with the production of sulphate of lime and carbonate of magnesia, which he seems to have regarded as forming with the excess of carbonate of lime a double carbonate.—(Liebig and Kopp, *Jahresbericht,* 1848, ii, 500). Desirous of verifying this observation I have repeated the experiment of Von Morlot, but have found that although the sulphate of magnesia is indeed completely converted into carbonate, this remains for the most part in the form of magnesite, mechanically intermixed with the excess of carbonate of lime which may be separated by the aid of dilute acetic acid.

100 parts of pure precipitated carbonate of lime (two equivalents,) and 123 parts of crystallized sulphate of magnesia (one equivalent,) were intimately mingled and exposed in sealed glass tubes for six hours to a temperature of 392° F. (200° C.) The resulting white tasteless mass was treated with cold dilute acetic acid, which immediately caused a strong effervescence. When this action had subsided the residue was washed with cold water and then treated with dilute hydrochloric acid, which produced no effect in the cold, but by the aid of a gentle heat dissolved a large portion with effervescence. The addition of alcohol threw down abundance of gypsum from the solution, and the filtrate from this being evaporated to dryness and then moistened with hydrochloric acid, was digested with absolute alcohol, by which the chlorids alone were dissolved, leaving a small residue of gypsum, and were found to consist of chlorid of magnesium with but very little chlorid of calcium. The acetic acid on the contrary had dissolved a large portion of carbonate of lime, with but little carbonate of magnesia, and a little gypsum. Thus in one experiment the acetic solution gave besides ·079 of sulphate, ·523 of carbonate of lime and ·016 of carbonate of magnesia, equal to 3·0 p. c. of the dissolved carbonates, while the portion insoluble in acetic acid, separated from gypsum by the process just described, gave ·459 of carbonate of magnesia and 0·17 of carbonate of lime, or 96·3 p. c. of magnesian carbonate. In another experiment there was obtained from the residue insoluble in acetic acid, carbonate of magnesia ·437, carbonate of lime 0·20.

The crystallized sulphate of magnesia undergoes the aqueous fusion at about 230° F., and contains sufficient water to render the mixture with carbonate of lime somewhat moist after heating. The above experiment was however repeated with the addition of a portion of water, but with the same result as before; the carbonates not dissolved by acetic acid consisted of ·242 of carbonate of magnesia and ·008 of carbonate of lime.

A subsequent experiment in a metallic tube upon a larger quantity of the mixture of crystallized sulphate of magnesia and carbonate of lime, with the use of an acid of only 3·0 p. c., confirms the previous results, and shows the sparing solubility of the carbonate of magnesia which is formed. Of the carbonates from the acetic solution, that of magnesia equalled only seven thousandths, while the carbonate of magnesia remaining with the gypsum retained but 1·3 p. c. of carbonate of lime. In separating small portions of lime from magnesia I have repeatedly had occasion to verify Scheerer's observation that an excess of magnesian salt hinders the precipitation of oxalate of lime, so that it is necessary to separate the two bases as sulphates by the aid of spirits of wine.

The experiments of De Senarmont have shown that when carbonate of magnesia is formed at a temperature of 150°–175° C. by the reaction between solutions of sulphate of magnesia and carbonate of soda, or by the decomposition of a solution of bicarbonate of magnesia, it separates as a crystalline powder sparingly soluble in acids and apparently identical with magnesite.—*Ann. de Chim. et de Phys.* [3], xxxii, 148. It is evident from the results just detailed that a similar result takes place when carbonate of lime is substituted for the carbonate of soda, the carbonate of magnesia formed in the presence of an excess of carbonate of lime retaining only a very small proportion of this carbonate.

According to Marignac when carbonate of lime is heated in sealed tubes with a solution of chlorid of magnesium to 200° C. for six hours, there is obtained, besides a portion of chlorid of calcium, a product consisting of 48·0 parts of carbonate of lime and 52·0 of carbonate of magnesia; at the end of two hours' heating, the proportion of magnesian carbonate was less. (*Bul. Soc. Geol. de France* [2] vi. 318.) It does not appear whether Marignac examined the product by the aid of acetic acid, but I find that in this process a portion of double carbonate of lime and magnesia is really formed.

A mixture of six parts of pure precipitated carbonate of lime with five parts of pure crystallized hydrated chlorid of magnesium, dissolved in a little water, was placed in sealed tubes, and heated for eight hours to a temperature of 150° C., which was gradually raised to 220° C. Two hours after cooling, the matter was removed from the tubes, washed, dried and treated with dilute acetic acid, which caused a violent effervescence; as soon as this had subsided, the liquid, which contained a large excess of acid and still attacked carbonate of lime with energy, was separated by filtration from the undissolved residue, which was but little more than one-fifth of the whole. The dissolved portion consisted of carbonate of lime 96·86, carbonate of magnesia 3·14.

Previous experiments had shown me that in operating with glass tubes, a portion of silicate of magnesia is always formed, and as this is decomposed by mineral acids, acetic acid was employed in the analysis of the undissolved carbonates, of which ·800 gr. from the last experiment were treated with acetic acid of 15 p. c. at 60° F. No action was apparent even after some minutes, but with a heat of 120° F. a gentle effervescence ensued. When this ceased there remained a flocculent residue equal to 15·7 p. c., and the undissolved portion gave carbonate of lime 37·6, carbonate of magnesia 62·4.

A portion of ·500 gr. of the same carbonates was now digested with dilute acetic acid at 60° F. for several hours. The soluble portion contained carbonate of lime 40·0 and carbonate of magnesia 60·0, while the undissolved residue equalled 22·5 p. c. It effervesced freely with warm somewhat dilute hydrochloric acid, and left a silicious residue of ·032 grm., while the dissolved portion gave ·007 of carbonate of lime and ·060 of carbonate of magnesia.

In a subsequent experiment in which metallic tubes were used, the formation of this silicate was obviated. The mixture of six parts of carbonate of lime and five parts of crystallized hydrated chlorid of magnesium with a little water, was heated during six hours from 150° to 220° C., then rapidly cooled and exhausted with water. The solution contained rather more than four equivalents of chlorid of magnesium for three of chlorid of calcium, and the mixture of carbonates gave only 15·0 p. c. of carbonate of magnesia. Treated with acetic acid of 3·0 p. c. at 32° F. the mixture effervesced strongly, leaving a residue which no longer effervesced with a farther portion of the same acid. The acetic solution gave 2·72 parts of carbonate of magnesia for 97·28 of carbonate of lime, while the portion undissolved was carbonate of magnesia with 12·6 p. c. carbonate of lime; in another experiment upon the same mixture of carbonates, the residue from acetic acid contained 13·0 p. c. of carbonate of lime.

The results of different trials with mixtures of carbonate of lime and chlorid of magnesium were somewhat variable; while in the last experiment the proportion of carbonate of magnesia formed equalled only 15·0 p. c. of the carbonates, in another trial it was found to be 24·4 p. c. and the residue from acetic acid, instead of 13·0, contained 30·3 p. c. of carbonate of lime, and in a third under similar circumstances 23·6 p. c.

It is evident from the above results that these magnesian carbonates, which retain after the action of acetic acid from 13·0 to 37·0 p. c. of carbonate of lime, are mixtures of a double carbonate of lime and magnesia with a less soluble carbonate of magnesia, from which the double salt may be partially separated by the prolonged action of acetic acid at ordinary temperatures.

It would appear that the carbonate of magnesia unites at the moment of its formation with a portion of carbonate of lime to form the double carbonate. It remained to be seen whether mixtures of the two carbonates would combine directly, and experiments were made with the Styrian magnesite before mentioned, which was mingled in fine powder with carbonate of lime and heated for some hours in sealed tubes to 200° C. with a dilute solution of chlorid of calcium. No combination took place, and the carbonate of lime was afterwards completely removed from the magnesite by cold dilute acetic acid.

The dense insoluble magnesite, as might be conjectured from its occurrence in the products of the previous experiments, exhibits none of that aptitude to combine with carbonate of lime which seems to characterize the newly formed magnesian carbonate before passing into this sparingly soluble condition, a change which from the experiments of De Senarmont, takes place at from 155° to 175° C. The amorphous hydrated carbonate of magnesia formed at low temperatures and readily soluble in dilute acids, is in like manner, when heated under pressure to prevent the loss of carbonic acid, converted into magnesite ; if under these conditions carbonate of lime be present, the two combine to form a double salt, possessing the chemical characters of dolomite.*

In his researches on the double carbonates, H. Deville has described an anhydrous crystalline salt composed of one equivalent each of the carbonates of magnesia and soda. This double carbonate is insoluble in cold water, but readily dissolves in acetic acid. When it is heated with a solution of chlorid of magnesium in sealed tubes to 200° C., chlorid of sodium and sparingly soluble magnesite are obtained. When warmed with a solution of chlorid of calcium, this double carbonate is decomposed and gives rise to a mixture of carbonates of lime and magnesia readily soluble in acetic acid ; at a higher temperature under pressure the two carbonates unite to form a double salt.

Three parts of the finely pulverized carbonate of magnesia and soda were added to two parts of chlorid of calcium dissolved in a little water and rendered slightly acid by hydro-

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* I have shown, from a consideration of the densities of the rhombohedral carbon spars, that supposing them to possess a common atomic volume, we may represent calcite by $15(C_2M_2O_6)$ while dolomite and chalybite are $18(C_2M_2O_6)$ and magnesite and carbonate of zinc (smithsonite) $20(C_2M_2O_6)$. Farther examples of polymerism in mineral compounds are seen in sillimanite and cyanite, in meionite and zoisite (saussurite), and in hornblende and pyroxene. These latter, accepting the late analyses of Rammelsberg, may be represented respectively by $25(SiMO_3)$ and $28(SiMO_3)$, wollastonite being $22(SiMO_3)$; these formulas correspond to three types of homœomorphous isomeric silicates. (See American Journal of Science, [2], xvi, 203, and *Comptes Rendus de l'Acad.* 1855, xli. 79.)

chloric acid. The mixture being placed in hermetically sealed glass tubes, these were heated for some hours in a bath of boiling water with frequent agitation, and then in an oil-bath for eight hours, the temperature being slowly raised from 130° to 220° C. On cooling, the saline liquid in the tubes was found to contain besides chlorids of sodium and calcium, a considerable amount of chlorid of magnesium. A portion of the double salt became coated over by the precipitated carbonate of lime and thus protected from the further action of the chlorid of calcium.

The carbonates from the above experiment were treated with a large excess of dilute acetic acid at 60° F. till effervescence ceased. ·600 gr. of the residue were now digested for two hours with dilute acid at 60° F.; the action was accompanied with a slow and constant disengagement of carbonic acid gas, and the solution gave ·302 grm. of carbonates, of which the carbonate of lime constituted 41·3 p. c. The undissolved portion effervesced with warm hydrochloric acid, which dissolved ·178 of carbonates containing only 12·3 p. c. of carbonate of lime, leaving ·116 grm. of insoluble silicious residue.

In a repetition of the above experiments the carbonates were treated with acetic acid at 32° F. till effervescence ceased, and a portion of the remaining double carbonate was digested for some time with acetic acid at 125° F., which took up 80·0 p. c. of carbonates containing 38·4 p. c. of carbonate of lime. The insoluble portion did not effervesce with hydrochloric acid, which however removed from it a portion of magnesia, but no lime, and left a silicious residue. Another portion was digested for several hours with acetic acid at 60° F., which took up 78·0 p. c. of carbonates containing 40·8 of carbonate of lime. The insoluble residue effervesced freely with warm sulphuric acid, which dissolved a portion of magnesia, but no trace of lime.

Experiments were now made with directly prepared mixtures of the two carbonates. When concentrated solutions of sulphate of magnesia and carbonate of soda are mingled in equivalent proportions, the pasty mass is after a few days repose at ordinary temperatures entirely converted into a mass of crystals of the ter-hydrated monocarbonate of magnesia. $MgO.CO_2+3HO$. The salt thus prepared contained 29.0 per cent of magnesia, which is exactly the quantity indicated by theory. A portion of this crystalline hydro-carbonate (which is readily soluble in dilute acetic acid,) was intimately mingled with a little more than an equivalent of precipitated carbonate of lime and one-fifth of an equivalent of bicarbonate of soda. The mixture made into a paste with water was heated in a close metal tube for two hours, to from 120 to 130°C. and then slowly raised to 180°C. At the end of six hours it was removed, washed with water, and treated with acetic acid of 3.0 p. c. which at 32°F. produced a lively effervescence. The residue from the action of the acid was slowly but completely dissolved with effervescence in hydrochloric acid, and was carbonate of magnesia with but 3.2 p. c. of lime, while the portion dissolved by the acetic acid consisted of carbonate of lime 96.7, carbonate of magnesia 3.3. The crystalline condition of the hydro-carbonate appears then to prevent the formation of a double carbonate. When however a mixture of the chlorids of calcium and magnesium is precipitated in the cold by a slight excess of carbonate of soda and the moist and bulky precipitate of carbonates is treated as above, the double salt is readily formed. But if the precipitate formed in the cold and still suspended in the liquid, is heated for some hours to 130°F. it becomes dense and granular, and when subsequently heated under pressure to 400° F. the combination is imperfect. A mixture of the two carbonates prepared in this way was treated for ten minutes with an excess of acetic acid of 3.0 per cent. at 60° F ; the portion dissolved consisted of carbonate of lime 66.7, carbonate of magnesia 33.3, while the residue contained 39.0 p. c. of carbonate of lime, the remainder being carbonate of magnesia. This was however a mixture, for after digesting it for half an hour with an excess of dilute acetic acid at 60°F. it was in great part dissolved, leaving a residue which was completely soluble in hydrochloric acid, and was carbonate of magnesia without any lime, while the portion dissolved by this second treatment with acetic acid consisted of carbonate of lime 55.4, carbonate of magnesia 44.6.

A solution of the mixed chlorids of calcium and magnesium was precipitated by a slight excess of carbonate of soda in the cold, and the partially washed and pasty mixture of carbonate heated as before under pressure to 180°C. for six hours. The precipitate, which had become very dense and granular contained an excess of carbonate of magnesia. Acetic acid of 3.0 p. c., which rapidly dissolved pure carbonate of lime and even finely pulverized limestone at 32° F., with lively effervescence, attacked the prepared carbonate but slowly even at 60° F. the powder subsiding to the bottom of the vase and only giving off bubbles from time to time, while the admixture with it of a small portion of pure carbonate of lime, suffised to produce a brisk evolution of carbonic acid. These comparative results are decisive as showing the formation of a double carbonate of lime and magnesia. In a preparation of this kind, the portion dissolved by the prolonged action of acetic acid at 32° F. contained 48.4 p. c. of carbonate of magnesia, and that dissolved by the further action of the acid upon the residue at 65°F. contained 47.0 p. c., a residue of carbonate of magnesia free from lime remaining. Another portion treated directly with acetic acid of 3·0 p. c., at 60° F. gave carbonate of lime ·420, carbonate of magnesia ·395 (=48.4 p. c.) and left a residue of ·296 of carbonate of magnesia free from lime. Similar results were obtained from another preparation which contained 52·0 p. c. of magnesian carbonate; a portion of magnesia, apparently in the form of a basic carbonate, seems to be generally present in these products, and hence the first action of a dilute acid dissolves a larger proportion of magnesia than is obtained afterwards. Thus the first portion dissolved by acetic acid from the above preparation contained 51.7 p. c. of magnesian carbonates, while a repetition of the process with the residue gave only 50·0 p. c. of carbonate of magnesia. The action of 500 c.c. of water saturated with carbonic acid, prolonged for two and a half hours, dissolved from a gram of the combined carbonates, ·453 gr. containing 48.5 p. c. of carbonate of magnesia, but the residue from which the more finely divided portion had been removed by the carbonated water, was very slowly attacked by the same solvent, 500 c. c. of which took up ·145 gr.

after four hours, and ·162 gr. after eighteen hours digestion, the dissolved portion in each case containing 47.0 p. of magnesian carbonate.

The foregoing experiments show that when a mixture of carbonate of lime with an excess of carbonate of magnesia is exposed to the requisite conditions, a true dolomite is formed, while the excess of magnesia remains intermingled as a sparingly soluble carbonate.

The whole theory of the formation of dolomites now becomes very simple and easily understood. In my Report for 1857, p. 217, I pointed out two reactions which may give rise to deposits of carbonate of magnesia in lakes or sea basins without an outlet, where an abundant evaporation is going on. The first is the mutual decomposition of bicarbonate of lime and sulphate of magnesia, yielding gypsum and bicarbonate of magnesia which are successively deposited by evaporation. This reaction which is illustrated at length by the experiments detailed in the present Report (pp. 200-204), explains the constant association of magnesian rocks with stratified gypsums. In the second process the action of waters containing bicarbonate of soda upon basins of sea-water, causes, as I have shown in the Report for 1857, already cited, p. 212, the separation of all the lime as carbonate, and the subsequent formation of a very soluble bicarbonate of magnesia, which by further evaporation separates in a hydrated form. Now these alkaline waters generally contain an abundance of bicarbonate of lime, which in this case, as well as in that of the gypsiferous basins, will be precipitated as carbonate and mingled with the carbonate of magnesia. We have then a mixture of the two carbonates, which as we have already shewn, readily combine when heated under pressure, and give rise to the double carbonate which constitutes dolomite. The lowest temperature at which their union can be slowly effected, remains to be determined by experiments.

The contraction which must follow the conversion of mixtures of the two carbonates into the denser double salt gives rise to the porous or cavernous structure of many magnesian limestones, and the rock being thus rendered readily pervious to water any excess of carbonate of lime as well as any calcareous fossils will often be dissolved out.

The intervention of alkaline waters in the production of a large class of magnesian limestones will explain the fact that these are frequently metalliferous, since these waters, although in part derived from the decomposition of rocks at the surface, often arise from buried strata, and bring to the surface, not only iron, but smaller quantities of most of the rarer metals in solution, all of which being precipitated with the carbonate of magnesia, enter into the composition of the dolomite. For some considerations as to the origin and importance of these alkaline waters I may refer to my Report for 1856, pp. 468-472. The formation of alkaline carbonates by the decomposition of feldspathic rocks, gives rise to the production of clays and aluminous silicates on the one hand, and to sea-salt, limestones and dolomites on the other; the study of these relations tends to throw much light upon the history of sedimentary rocks, and many other important points in the chemical history of the earth's crust.*

I have the honor, to be,

Sir,

Your most obedient servant,

T. STERRY HUNT.

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* See my paper in the Canadian Naturalist for January 1860, *On some Points in Chemical Geology.*

APPENDIX.

I.

Levels of the River Rouge.

While ascending the Rouge, an attempt was made to determine the general rise in the stream by a measurement of the precipitous falls and the rapids interrupting the upward navigation in canoes ; and by an estimate in the navigable parts, taking into consideration the rapidity of the current, the breadth of the stream and the depth of water. The following is the result:—

		Rise. Feet.	*Height above Lake St. Peter.* Feet.	
Height of the Ottawa at the mouth of the Rouge over Lake St. Peter (see Report 1845–6, p. 31,) say,........			109.00	Junction of Rouge [& Ottawa.
Rise in the cascades between the mouth of the river and the pool above Mr. Cousin's house....................		164.50	273.50	Cousin's.
—— between the surface of the pool above Cousin's and the smooth water below Moore's house....................		23.16	296.66	Moore's.
—— in *Nataboonochékun* or Big-stone rapids above Moore's..	14.00			
—— in navigable water	0.34			
—— in *Esquigingunmug* or Hind-leg Rapids, below Johnson's	1.16	15.50	312.16	Johnson's.
—— in navigable water	0.50			
—— in the Blackburn Rapids or Island Chute, Lower Fall...	22.50			
Next above	1.66			
Next above	1.00			
Upper Fall	4.00	29.66	341.82	
—— in navigable water.........	0.18			

		Rise. Feet.	*Height above Lake St. Peter.* Feet.	
Rise in a ripple below Fall......	0.50			
—— in *Parskiminechinamug* or Burst-bag Rapids.........	6.50	7.18	349.00	
—— in navigable water........	0.50			
—— in Chaudière Chute........	10.00			
—— in navigable water to pool below Bell Chute..........	0.50	11.00	360.00	Foot of the Bell.
—— in the Bell Chute..........	18.84			
—— in Otter Chute, next above the Bell..................	3.66	22.50	382.50	
—— in navigable water........	0.50			
—— in Marble or Pipe-Stone Chute....................	2.00			
—— in navigable water........	0.50			
—— in a ripple below the mouth of the Maskinongé.........	2.25	5.25	387.75	Mouth of Maskinongé.
—— from the mouth of the Maskinongé to the head of the Mountain Chute at Millway's		90.00	477.75	Head of Mountain Chute.
—— in navigable water between Mountain Chute and Dog Rapid....................	1.50			
—— in the Dog Rapid or Chute .	5.00			
—— in navigable water between the Dog Chute and Iroquois Rapids....................	.25			
—— in Iroquois Rapids.........	15.10			
—— in navigable water to Fitzallan....................	·50	22.35	500.10	Fitzallan.
—— in Bevan's or Cutlog Rapids.	16.50			
—— in Island Chute...........	5.00			
—— in navigable water to foot of Devil's Rapids............	1.00	22.50	522.60	
—— in Devil's Rapids..........	12.50			
—— in navigable water to Devil's River....................	0.75	13.25	535.85	Devil's River.
—— in navigable water to foot of Huckleberry Chute.....	0.75			
—— in Huckleberry or Blacklead Chute....................	14.80			
—— in navigable water to mouth of George's Brook.........	3.00	18.55	554.40	George's Brook.
—— in navigable water to foot of Iroquois Chute.........	2.66		557.06	Foot of Iroquois.
—— in Iroquois Chute.........	13.50	16.16	570.56	Head of Iroquois.

Levels of Lakes on George's Brook.

	Rise. Feet.	Height above Lake St. Peter. Feet.	
Height of the Rouge at the mouth of George's Brook.............		554.40	
Rise to Lake Simon.............	31.60	586.00	Lake Simon.
—— to 2nd Small Lake..........	83.75	669.75	
—— to Lake of Three Mountains.	2.25	672.00	Lake of Three Mountains.
—— to Green Lake.............	76.00	748.00	Green Lake.

Levels of Lakes N. W. of Lake of Three Mountains.

	Rise. Feet.	Height above Lake St. Peter. Feet.
Height of Lake of Three Mountains		672.00
Rise to 1st. Lake to N. W........	58.00	730.00
—— to 2d " "	16.00	746.00
—— to 3rd " "	13.00	759.00
—— to 4th " "	73.00	832.00

Levels of Lakes East Side of the River Rouge.

	Rise and Fall. Feet.	Height above Lake St. Peter. Feet.	
Height of Rouge below Iroquois Chute.....................		557.06	
Rise to Small Lake on Portage to Trembling Lake............	195.00	752.06	
Fall to Long Lake..............	15.00	737.06	Long Lake.
—— to Great Beaver Lake.......	11.25	725.81	Great Beaver L.
—— to Trembling Lake.........	82.00	643.81	Trembling Lake.
—— to pool below cascade at the outlet of Trembling Lake...	29.00	614.81	

II.

List of Localities shewing traces of Copper ore in the Lower Silurian rocks of Canada East, more particularly in the magnesian group of Quebec occurring at the summit of the Hudson River formation, and intermediate between what has occasionally been called the Richelieu shales and the Sillery sandstones. The localities are given going from west to east, and the list is intended, not to shew workable quantities, but the distribution of the metal in the magnesian rocks.

1.	St. Armand,	Lot	59	or	60.—	On the road at Cook's Corner at the base of the magnesian limestones, but in clay slate: Copper pyrites in a vein of white quartz running with the stratification.
2.	Sutton,	Lot	9,	Range	9.—	The property of Oramel Stutson: Copper pyrites in small quantity in a bed of iron ore.
3.	"	"	5	"	4.—	Green carbonate of copper associated with feldspar, quartz, and rutile, in a vein cutting nacreous slates.
4.	"	"	2,	"	9.—	Green carbonate investing joints in a bed of iron ore.
5.	"	"	9,	"	7.—	The property of Mr. D. Farnsworth: Green carbonate investing joints in a bed of iron ore.
6.	"	"	5,	"	4.—	Copper pyrites in small quantity in a bed of iron ore.
7.	Potton,	"	17,	"	5.—	Copper pyrites in a vein of quartz two or three inches thick.
8.	"	"	14,	"	10.—	North side of Owl's Head Mountain: Copper pyrites in what appears to be sandstone.
9.	Brome,	"	16,	"	11.—	Spots of green carbonate in dolomite.
10.	"	"	6,	"	4.—	Spots of green carbonate in slate.
11.	"	"	1,	"	3.—	The property of Mr. Reed Sweet: Filmy spots of green carbonate in a bed of iron ore.
12.	"	"	2,	"	3.—	Filmy spots of green carbonate in a bed of iron ore.
13.	"	"	6,	"	3 & 4.—	Spots of green carbonate in a thin vein of quartz in a bed of iron ore.
14.	Bolton,	"	17,	"	9.—	Green carbonate in soapstone and serpentine.

15.	Orford,	Lot 1,	Range 9.	—At the south end of the east face of Carbuncle Hill, west side of the Brompton Lake: Copper pyrites in thin quartz veins, one of them about four inches wide.
16.	Ascot,	" 17,	" 7.	—Copper pyrites in a quartz vein of one foot in nacreous slate.
17.	"	‘ 19,	" 7.	—Copper pyrites in a small vein in railroad cutting near Sherbrooke station.
18.	Windsor,	" 6,	" 12.	—Spots of green carbonate in railroad cutting.
19.	Upton,	Lot 14,	Range 20.	—Copper pyrites in dolomitic limestone.
20.	"	" 51,	" 20.	—Copper pyrites in dolomitic limestone.
21.	"	" 51,	" 21.	—The property of Mr. Ouimet: Copper pyrites in dolomitic limestone and breccia or conglomerate.
22.	"	" 50,	" 21.	—Copper pyrites in dolomitic limestone.
23.	Acton,	" 32,	" 3.	—The property of Mr. Cushing: Pyritous, variegated and vitreous sulphurets and green carbonate, in a breccia or conglomerate, near dolomite. This is the Acton Mine deposit.
24.	"	" 32,	" 5.	—The property of Mr. C. Gauthier. Variegated sulphuret in dolomitic limestone.
25.	"	" 31,	" 4.	—Variegated sulphuret in dolomitic limestone.
26.	Wickham,	" 26,	Range 12.	—Copper pyrites in dolomitic limestone.
27.	"	" 13,	" 12.	—Copper pyrites in dolomitic limestone.
28.	"	" 19,	" 10.	—Copper pyrites in dolomitic limestone.
29.	"	" 14,	" 10.	—Copper pyrites in dolomitic limestone.
30.	"	" 15,	" 10.	—Variegated sulphuret with calc spar in dolomitic limestone.
31.	Wendover,	" 1,	" 1.	—Variegated and vitreous sulphurets, in brecciated or conglomerate slate.
32.	Shipton,	" 16,	" 5.	—Green carbonate in potstone or compact chlorite, near serpentine.
33.	Somerset,	" 14 & 15	" 8.	—Copper pyrites in conglomerate limestone.
34.	Halifax,	" 6,	" 7.	—The property of the Megantic Mining Company: Copper pyrites in a vein of quartz in dolomitic limestone.
35.	"	" 6,	" 9.	—Variegated sulphuret.
36.	"	" 4,	" 9.	—Variegated sulphuret.
37.	"	" 6,	" 11.	—Variegated sulphuret.
38.	Inverness,	" 4,	" 2.	—The property of the Megantic Mining Company: Variegated sulphuret in a two feet vein of quartz in nacreous slates.
39.	"	" 2,	" 4.	—Copper pyrites in dolomitic limestone.
40.	Ireland,	" 4,	" 11.	—The property of Mr. Bailey: Variegated sulphuret.

41.	Ireland,	Lot 9,	Range 9.	—Copper pyrites in dolomitic limestone.
42.	Leeds,	" 6,	" 15.	—The property of Mr. Warkup: Variegated sulphuret.
43.	"	" 4,	" 4.	—The property of Mr. Ewert: Copper pyrites in dolomitic limestone.
44.	"	" 6,	" 2.	—The property of Mr. Harris: Variegated sulphuret.
45.	"	" 12,	" 11.	—Variegated sulphuret in a two feet vein of quartz.
46.	"	" 18,	" 12.	—The property of Mr. Regan: Vitreous and variegated sulphurets and green carbonate in quartz courses in nacreous slate.
47.	"	" 15,	" 14.	—The property of Mr. Nutbrown: Pyritous, variegated and vitreous sulphurets in a vein with quartz, bitter spar, chlorite, and talc, with a little native gold.
48.	"	" 17,	" 15.	—The property of the English and Canadian Mining Company: Pyritous, variegated and vitreous sulphurets with green carbonate in nine quartz courses and three beds in nacreous slates, at present being worked by the Company.
49.	"	" 16 & 17,	" 13.—	The property of the English and Canadian Mining Company; Pyritous, variegated and vitreous sulphurets.
50.	"	" 14 & 15,	" 14.—	
51.	"	" 16 & 18,	" 15.—	
52.	"	" 13	" 14.	—Pyritous, variegated and vitreous sulphurets.
53.	"	" 8 to 11,	" 10.—	Pyritous, variegated and vitreous sulphurets.
54.	"	" 11 to 13,	" 11.—	
55.	"	" 10, 11, 13	" 12.—	
56.	St. Giles, Sy.	" 1, 2, 3,	Conces.	—St. Margaret; the property of Mr. Cromwell: Pyritous, variegated and vitreous sulphurets and green carbonate, in eight quartz courses in nacreous slates.
57.	S. Joseph, Sy.	" ? ,	" ? .	—One mile west of River Chaudiere, opposite the road leading to Frampton, on the property of Mr. Ignace Tardi: Variegated sulphuret associated with quartz and chlorite in red and green slates near patches of red dolomitic limestone.
58.	"	" ? ,	" ? .	—East side of the Chaudiere, 4 miles above the church of St. Joseph on Calway's farm: Spots of green carbonate in red limestone.
59.	St. Mary, Sy.	" ? ,	Conces. 3.	—Front of concession, on a line with a point one mile above St. Mary's Church: Pyritous and vitreous sulphurets and green carbonate in red and green nacreous slates near ferruginous dolomite.

60. Lauzon Sy. Lot ?, Conces. ? .—On the Etchemin, two miles below St. Anselm Church; Native copper in red slate.

61. " " ?, " ? .—On the Etchemin, four miles above its mouth: Copper pyrites in red limestone.

62. " " ?, " ? .—At the Narrows on the Chaudiere, about ten miles above its mouth: Copper pyrites in calcareous sandstone.

63. " " ?, " ? .—At St.Nicholas, one mile below the church, on the bank of the St. Lawrence: Green carbonate in red slate.

64. " " ?, " ? .—One mile above Point Levi, in the cliff over the St. Lawrence: Green carbonate in red shale.

65. Sillery, " ? " ? .—One mile below Cap Rouge: Copper pyrites in sandstone and red slate.

66. Quebec. .—In the cut made for the water-pipe, Coteau St. Geneviève: Vitreous Sulphurets in or near limestone conglomerate.

67. Cape Chat. .—At the mouth of the Great Capucin River, four miles above the Cape: Copper pyrites in a two inch bed of quartz in red shale.

III.

Localities shewing copper lodes and traces of copper ore on the Missisaugui River, Lake Huron.

1. Head of islands below Hudson Bay Company's Post: Specks of copper pyrites disseminated in greenstone.
2. Half a mile above H. B. Co's Post: Specks of copper pyrites in granite dykes; the bearing of the dykes is N. 24 E. and S. 24 W.
3. Little island below the first or lowest fall: specks of copper pyrites disseminated through the rock of the island.
4. A mile below the Pakowagaming River: Small calcareous veins with small spots of copper pyrites; the general bearing of the veins is N. 70 W.
5. A mile and a half above the Pakowagaming: A vein of quartz and bitter spar with small spots of copper pyrites; the bearing of the vein is S. 71 W.
6. Second fall: A vein of two inches of quartz and bitter spar with copper pyrites cutting green stone; the bearing is N. 50 W.
7. East end of Lake Wabiquekobing: A vein of quartz two feet wide with small spots of copper pyrites cutting greenstone; the bearing of the vein is N. 84 W.
8. North portage to Lake Wabiquekobing within twelve or fourteen chains of the Missisaugui; A vein of quartz from one to two feet thick with small spots of copper pyrites cutting greenstone; the bearing of the vein is N. 15 W.

9. Fourth fall: A vein of quartz and bitter spar one foot wide with copper pyrites in small spots, cutting quartzite; the bearing of the vein is N. 55 W., running nearly parallel with a greenstone dyke which comes to the river obliquely.
10. Upper end of the portage at the fourth fall: Small veins of quartz, one of them about a foot thick, with small spots of copper pyrites cutting quartzite; the bearing is N. 72 W.; this vein varies in width and at some parts is two feet, and it is occasionally stained with the green carbonate of copper.
11. At the Grand Portage: A complication of veins with a general bearing of about N. 60 W. The largest, which was at the foot of the portage, was from one to three feet in width, and consisted of red stained quartz, with copper pyrites in spots and strings, and green carbonate in stains; Red nuctuous scaly hœmatitic iron discolored the rock and the vein. A vein of bitter spar marked with copper pyrites occurs near the head of the Grand Portage, cutting slate and quartzite. All the main veins are nearly parallel with the narrow cut through which the river runs, and most of them intersect greenstone, but run also into the slates, the slate conglomerates and the quartzites.
12. At the turn of the river three miles above the Grand Portage: A calcareous vein of from two to three feet wide holds spots of copper pyrites and cuts greenstone in a bearing S. 70 W.; it is seen for only a little way on the right bank, and not at all on the opposite side of the river, where there is a brook falling into the river through sand.
13. At the eighth fall: Several veins of quartz intersecting slate conglomerate; the main ones are from one to two feet wide and they bear from N. 67 W. to N. 77 W. Numerous small veins reticulate from the main veins; some greenish stains were detected but the indications of copper were very indistinct.

IV.

Catalogue of Animals and Plants, collected and observed in the Valley of the River Rouge and the neighbouring Townships, in the Counties of Argenteuil and Ottawa. By Mr W. S. M. D' Urban, Assistant to Sir W. E. Logan in* 1858.

VERTEBRATA.

CLASS MAMMALIA.

Order Cheiroptera.

1. *Vespertilio subulatus*, Say.—Rouge, August 8th and 10th. There are probably several species of bats in the district, but this is the only one of which a specimen was obtained.

* The list of plants having been taken by Mr. D'Uurban to England for the purpose of reference in regard to some points, was unfortunately lost on its return in the Hungarian, and there has not been time to prepare another.

ORDER CARNIVORA.

2. *Ursus Americanus*, Pallas.—Although no bears were actually seen by us, yet the evidence afforded by recent traces of them, and the information received from settlers and others, induced me to believe that they were numerous in the district.

3. *Mustela martes*, Linn.—The pine marten does not appear to be plentiful. One specimen was seen at Hamilton's Farm on the Rouge, about fiffy miles from its mouth.

4. " *Canadensis*, Schreber.—Said to be common about Hamilton's Farm; I saw a specimen which had been shot there.

5. " *vison*, Gmel.—Abundant throughout the district.

6. *Mephitis chinga*, Tiediman.—Common about the settlements in Grenville, &c.

7. *Lutra Canadensis*, Sabine.—Many were seen in the lakes throughout the district.

8. *Vulpes fulvus*, Desm.—Reported to be common.

ORDER RODENTIA.

9. *Castor fiber*, Linn.—Appears to be nearly extinct in the parts we explored, but seen by Sir. W. Logan between two and three miles east of Hamilton's Farm, and said to be numerous about forty miles above it.

10. *Fiber Zibethicus*, Cuvier.—Very numerous throughout the district.

11. *Arctomys monax*, Linn.—Said to be common about clearings in Grenville. A specimen was given to me which had just been killed in that township.

12. *Tamias Lysteri*, Ray.—Township of Montcalm and about Hamilton's Farm; rare.

13. *Sciurus Hudsonius*, Pennant.—Very numerous throughout the district.

14. *Hystrix dorsata*, Linn.—This species is believed to occur in the district.

15. *Lepus Americana*, Erxlebein.—Common.

ORDER RUMINANTIA.

16. *Cervus alces*, Linn.—This animal seems to be tolerably numerous above Hamilton's Farm, but none were seen in the district we passed through.

17. " *Virginianus*, Gmel.—Tracks of this deer were frequently met with, and two were reported to have been seen near sixteen Island Lake.

18. " *tarandus*, Linn.—One was shot on Hamilton's Farm while we were camped there. Traces of them were observed on Trembling Mountain.

Besides the animals above enumerated, I may mention the racoon, *Procyon lotor*, said by the Indians to occur in the district; a wild cat, *Lynx Canadensis*, is supposed to have been heard in the township of Montcalm; a flying squirrel, *Pteromys volucella?* is said to occur, and near the Lake of Three Mountains I had a momentary view of a small *Arvicola*.

CLASS AVES.

Order Raptores.

1. *Buteo* ——— ?—A buzzard was frequently seen hovering around our camps, but I was unable to obtain a specimen.
2. *Pandion haliætus*, Linn.—On the 21st of May I shot the female of a pair of this species which had their nest on the summit of a large dead pine tree on an island in a small lake situated in the 8th and 9th ranges of Montcalm. Sir William Logan has called this sheet of water Eagle Nest Lake. An osprey was afterwards seen on several occasions when ascending the Rouge.
3. *Falco sparverius*, Linn.—Sixteen Island Lake; very numerous on Hamilton's Farm in August, and last seen on the 7th of October.
4. *Astur palumbarius*, Linn.—Hamilton's Farm, in the end of August and beginning of September.
5. " *fuscus*, Gmel.—Near Gate Lake, May 16th; very numerous at Hamilton's Farm in the end of August.
6. *Circus cyaneus*, Linn.—Hamilton's Farm, end of August and in September.
7. *Syrnium nebulosum*, Linn.—Observed near Trembling Lake.
8. *Otus brachyotus*, Linn.—I saw a specimen of this species which had just been shot on Hamilton's Farm, and was informed that it is not uncommon there after harvest.
9. *Bubo Virginianus*, Gmel.—Numerous throughout the district.

Order Insessores.

10. *Chordeiles Virginianus*, Briss.—A single bird seen at Hamilton's Farm in August.
11. *Chætura pelasgia*, Linn.—Common throughout the district. They were last seen by me at Hamilton's Farm on the 25th of August.
12. *Hirundo purpurea*, Linn.—Common at Grenville Village, May 13th, but not afterwards met with.
13. " *bicolor*, Vieill.—Townships of Grenville and Montcalm, middle and latter part of May. Noticed near Hamilton's Farm about the middle of August.
14. " *fulva*, Vieill.—Townships of Grenville and Harrington, from May 14th to 24th, and last seen at Hamilton's Farm, August 21st.
15. " *rustica*, Linn.—Common in Grenville and Harrington, May 14th and 15th; Wentworth, June 4th; Hamilton's Farm, July 15th to the middle of August.
16. *Muscicapa tyrannus*, Linn.—Bevan's Lake; near the Indian Village at the Devil's rapids on the Rouge; about Hamilton's Farm.
17. " *acadica*, Gmel.—Observed near Bevan's Lake, July 1st; Hamilton's Farm, August 25th.

18. *Sylvicola coronata*, Lath.—About Sixteen Island and Eagle Nest Lakes; Hamilton's Farm; Trembling Lake. Very numerous from May 19th till September 9th.
19. " *virens*, Lath.—Common about Sixteen Island Lake, May 24th.
20. " *Blackburniæ*, Lath.—Numerous about Sixteen Island and Eagle Nest Lakes, May 22nd and 24th, in company with the last two species.
21. " *æstiva*, Gmel.—Observed in the township of Grenville, May 24th and about Hamilton's Farm August 23rd and 25th.
22. " *Canadensis*, Linn.—Hamilton's Farm; Trembling Lake; Lake of Three Mountains. From August 28th to September 23rd.
23. " *maculosa?* Lath.—Mouth of Devil's River, July 20th.
24. *Certhia familiaris*, Linn.—Throughout the whole district.
25. *Troglodytes hyemalis*, Vieill.—Seen occasionally at numerous localities up to September 26th.
26. *Parus atricapillus*, Linn.—First observed, August 17th, when we were camped about a mile below Hamilton's Farm, occasionally seen till the end of September.
27. *Regulus satrapa*, Lich.—First observed August 28th, at Hamilton's Farm
28. *Sialia Wilsoni*, Swains.—Grenville, October 14th.
29. *Turdus migratorius*, Linn.—Throughout the district up to October 15th.
30. " *mustilinus*, Gmel.—Not uncommon throughout the district up to the end of September.
31. *Sciurus aurocapillus*, Lath.—Very numerous throughout the district.
32. *Alauda alpestris*, Linn.—Hamilton's Farm, end of September.
33. *Emberiza socialis*, Wils.—About all clearings visited, up to October 18th.
34. *Niphœa hyemalis*, Linn.—Throughout the district.
35. *Fringilla melodia*, Wils.—About clearings throughout the district.
36. " *Pennsylvanica*, Lath.—Very common in the woods throughout the district.
37. *Erythrospiza purpurea*, Gmel.—Balsam Lake, June 14th; Hamilton's Farm July 15th.
38. *Coccoborus ludovicianus*, Linn,—Clearings about Gate Lake, May 16th and 17th.
39. *Agleaius Phœniceus*, Linn.—Grenville; Sugar-bush or RoundLake; Bevan's Lake; near Hamilton's Farm.
40. *Icterus Baltimorus*, Linn.—Said to have been heard singing at Balsam Lake, June 14th.
41. *Quiscalus versicolor*, Vieill.—Grenville, May 14th.
42. *Corvus Americanus*, Aud.—Common throughout the district.
43. *Garrulus cristatus*, Linn.—Abundant everywhere. They were seen in flocks of thirty or forty at Hamilton's Farm.
44. " *Canadensis*, Linn.—Abundant throughout the district.
45. *Vireo olivaceus*, Linn.—Common throughout the district,up to August 25th.
46. *Bombycilla Carolinensis*, Briss.—Observed only about clearings.

47. *Sitta Canadensis*, Linn.—Throughout the district, from May 26th till September 20th.
48. *Trochilus colubris*, Linn.—Occasionally seen from May 27th till August 12th.
49. *Alcedo alcyon*, Linn.—Very abundant the whole way up the Rouge till October 11th. Rarely seen on the lakes.
50. *Picus pileatus*, Linn.—One shot on Sixteen Island Lake, May 27th, and another seen on the Rouge, August 8th.
51. " *villosus*, Linn.—Grenville, Harrington and Wentworth.
52. " *pubescens*, Linn.—Throughout the district.
53. " *varius*, Linn.—Sixteen Island Lake, May 27th; Trembling Lake, September 13th.
54. " *articus*, Swains.—One specimen observed in Harrington, October 15th.
55. " *auratus*, Linn.—Hamilton's Farm, end of August and beginning of September.
56. *Coccyzus erythropthalamus*, Wils.—Sugar-bush Lake, June 25th; Indian Village on the Rouge, July 16th.

ORDER RASORES.

57. *Ectopistes migratoria*, Linn.—Throughout the district, from spring till the beginning of October. Not common.
58. *Tetrao umbellus*, Linn.—Abundant throughout the district.

ORDER GRALLATORES.

59. *Fulica Americana*, Gmel.—A pair seen, September 14th, in a small lake near the Lake of Three Mountains.
60. *Totanus macularius*, Wils.—Common all along the Rouge and in the numerous lakes of the district.
61. " *solitarius*, Wils.—Along the Rouge from August 12th to September 13th.
62. " *vociferus*, Wils.—One specimen seen on Trembling Lake, September 11th.
63. *Microptera Americana*, Aud.—Said to have been heard in the swamps about Hamilton's Farm, September 2nd.
4. *Ardea nycticorax*, Linn.—A pair seen flying over head, when we were camped near Gate Lake, May 17th.
65. " *lentiginosa?* Swains.—Bevan's Lake during July.

ORDER NATORES.

66. *Anas obscura*, Gmel.—Sixteen Island and Bevan's Lakes; Rouge, and the small lakes on either side of it.
67. " *sponsa*, Linn.—One seen on Bevin's Lake, October 16th.
68. " *discors*, Linn.—One observed on Trembling Lake, September 11th.
69. *Fuligula marila?* Linn.—Sixteen Island Lake, May 20th.
70. " *clangula*, Linn.—Sixteen Island Lake in May; Devil's River, July 20th.
71. *Mergus serrator*, Linn.—Rouge, and almost every lake we visited.
72. " *cucullatus?* Linn.—Lake of Three Mountains, September 23rd and 25th.

73. *Larus argentatus*, Brunnich.—A large gull, supposed to be of this species, was frequently seen at the end of May, on Sixteen Island Lake.

74. *Colymbus glacialis*, Linn.—Seen in almost every lake visited by us.

75. *Podiceps Carolinensis?* Lath.—I observed a grebe on Balsam Lake, June 14th, which appeared to be of this species.

The rice bunting, *Dolichonyx orizivora*, and the red-headed woodpecker, *Picus erythrocephalus*, were observed about Point Fortune on the Ottawa, but were not met with in the woods.

CLASS REPTILIA.

Order Chelonia.

1. *Chelydra serpentina*, Schw.—*Emysaurus serpentina*, Linn.—I was given a shell of this species by G. W. Albright, Esq., P. L. S., who obtained it on the Devil's River. The carapace is one foot long and nine inches broad.

2. *Glyptemys insculpta*, Agassiz.—*Emys insculpta*, Leconte.—I was shown the shell of a specimen of this species, which had been obtained on a small sandy island in the Rouge in Arundel, and I also obtained a fragment of a shell at the mouth of the Devil's River.

Order Ophidia.

3. *Eutainia sirtalis*, Baird & Girard. *Tropidonotus sirtalis*, Holbrook.—Abundant in the Townships of Grenville, Harrington, De Salaberry, and at Hamilton's Farm.

No other Ophidian reptile was seen, but reports of a water snake, said to inhabit the lakes, came to my knowledge.

Order Batrachia.

4. *Rana Catesbiana*, Shaw.—*R. pipiens*, Holbrook.—Abounds in every lake and pond throughout the district.

5. " *nigricans*, Agassiz.—Abundant at Balsam, Sixteen Island and Sugar-bush Lakes in May and June.

6. " *pipiens*, Gmel. *R. halecina*, Holbrook et aliorum.—Abundant in Sugar-bush Lake in June.

7. *Hyla versicolor?* Leconte.—Said to have been heard about Sixteen Island Lake.

8. *Bufo Americana*, Leconte.—Common throughout the district.

9. *Plethodon erythronota*, Green.—Abundant in the townships of Wentworth and Montcalm in May.

10. *Spelerpes bilineata*, Green.—Township of Montcalm.

11. *Triton?* (undetermined).—One specimen taken in Sixteen Island Lake June 2nd.

A "lizard" was reported as inhabiting a small stream crossing the portage between Gut and Gate Lakes.

CLASS PISCES.

ORDER ACANTHOPTERI.

1. *Perca flavescens*, Cuvier.—Numerous in Sugar-bush, Bevan's and Bark Lakes, Montcalm; in a small lake on lot 11, range 3, of the same township, and also in a lake about three miles east of Hamilton's Farm.

ORDER MALACOPTERI.

2. *Pimelodus cœnosus*, Richardson.—Very abundant in the same lakes (with the exception of the last) as the perch.
3. *Esox boreus* ? Agassiz.—The specimen preserved, was caught in the small lake on lot 11, range 3, Montcalm, and agrees very well with the description of *E. boreus* in Agassiz's "Lake Superior," p. 317, with the exception, that the lateral line is very indistinct, instead of being "very distinct." Pike were numerous in the same lakes as the cat-fish and perch and in the Rouge as far up as we ascended.
4. *Salmo fontinalis*, Mitchill.—Abounds in nearly all the lakes and streams in the district. In those lakes where cat-fish, pike and perch occur, no trout were caught.
5. *Salmo*.—A species of trout, which I have been unable to determine, was found in Sixteen Island, Trembling and Three Mountain Lakes.
6. *Coregonus*.—I saw several specimens of a *Coregonus* which had just been taken in Bevan's Lake, October 15th, but was unable to preserve a specimen
7. *Catastomus*.—Two species of "sucker" were said to have been taken in Sixteen Island Lake whilst I was absent, and were spoken of as the "mullet" and "black sucker."
8. *Leuciscus*.—A large fish known as the carp, usually about seventeen inches in length and about two pounds in weight, was abundant in all the lakes and in the Rouge and Devil's Rivers. On the sides, the scales have a beautiful bronze or golden lustre, and the basal half and margin of each is black. The fin-rays are as follows: Br. 3, D. 9. C. 20. V. 8. P. 16. This fish may be *Cyprinus Corporalis*, Mitchill, but does not agree satisfactorily, with any species I have seen described.
9. " *pulchellus*, Storer.—This was the most abundant fish in all the lakes and rivers throughout the district.

10. *Leuciscus frontalis*, Agassiz.—Abundant in streams flowing into the small lake on lot 11, range 3, Montcalm. The specimens collected agree exactly with the figure and description of this species in Agassiz's "Lake Superior," except that instead of fourteen, they have sixteen rays in their pectoral fins.

11. " ? —A small species which I cannot find described, though evidently very distinct, was common in the same stream with the last.

All the lakes swarmed with the young of various *Leucisci*, which are called dace and chub. Several species besides those above mentioned were met with in Trembling and Three Mountain Lakes, but I had no means of preserving specimens.

ARTICULATA.

CLASS INSECTA.

ORDER COLEOPTERA.

Besides the 114 species of Coleoptera enumerated in the following catalogue, many others were collected, but were unfortunately lost by the accidental fracture of the bottle which contained them.

I have added a list of 34 species, not observed in this district by myself, but brought by Mr. Robert Bell from the Augmentation of Grenville on the north, and the neighbourhood of L'Original on the south bank of the Ottawa.

1. *Cicindela longilabris*, Say.—Hamilton's Farm on the River Rouge, 2nd September.
2. " *vulgaris*, Say.—Very abundant on sand-banks, River Rouge, August.
3. " *Baltimorensis*, Herbst. (*repanda*, Say.)—Common on sand-banks, River Rouge, July and August.
4. *Lebia viridis* ? Say.—Huckleberry Rapids, River Rouge, DeSalaberry, 30th July.
5. *Patrobus longicornis*, Say.—Sixteen-Island Lake, &c., Montcalm, May and June.
6. *Platynus sinuatus*, Dej.—Under dead logs, Sixteen Island Lake, &c., township of Montcalm, May and June.
7. " *retractus*, Lec.—With the last species.
8. " *obsoletus*, Say.—With the last two species.
9. *Pœcilus lucublandus*, Say.—Under stones near the town of Grenville, 13th May.
10. *Pterostichus fastidatus*, Dej.—Under bark of decaying logs, Sixteen Island Lake, Montcalm, end of May; Lake of Three Mountains, end of September.
11. " *patruelis*, Dej.—River Rouge.
12. " *caudicalis*, Say.—Under stones near Grenville, 13th May.
13. " *orinomum*, Leach (*vitresis*, Esch.)—Township of Montcalm, June.
14. " *Luczotii*, Dej. (var. præc?)—Sixteen Island Lake, Montcalm, May and June.

15. *Lophoglossus scrutator*, Lec.—Under stones near Grenville, 13th May.
16. *Rembus major*, Lec.— " " " "
17. *Chlænius impunctifrons*, Say — " " " "
18. *Cychrus* (*Sphæroderus*) *Brevoorti*, Lec.—Under dead logs, Bevan's Lake, Montcalm, 4th July.
19. *Notiophilus punctatus*, Lec.—On rocks, Huckleberry Rapids, River Rouge, DeSalaberry, 27th July.
20. *Bembidium impressum*, Fabr.—On wet sand, River Rouge, 13th August.
21. " *punctatostriatum*, Say —Very abundant on wet sand, River Rouge July and August.
22. " *patruelis*, Dej.—Abundant on wet sand, River Rouge, 13th August.
23. " *lucidum*, Lec.—Under stones near Grenville, 13th May.
24. *Agabus striatus* ? Say.—In Sixteen Island Lake, Montcalm, end of May.
25. *Coptotomus interrogatus*, Fabr.—In Sugar-bush Lake, Montcalm, 23rd June.
26. *Hydroporus proximus*, Aubé.—With the last species.
27. *Haliplus immaculaticollis*, Harris.—With the last two species.
28. " *cribarius*, Lec.—Very abundant in Sugar-bush Lake, Montcalm, 23rd June.
29. *Gyrinus* (several species not determined)—In various Lakes.
30. *Dineutes* (not named)—Very abundant, Sugar-bush Lake, Montcalm, 23rd June.
31. *Philhydrus cinctus*, Say.—In a small stream crossing the portage between Gate and Gut Lakes, Wentworth, and in Sugar-bush Lake, Montcalm.
32. *Necrophorus lunatus*, Lec.—Huckleberry Rapids, River Rouge, De Salaberry, 27th July.
33. " *pygmæus*, Kirby.—Township of Montcalm, 20th June.
34. *Silpha marginata*, Fabr.—Abundant under putrid fish, Sixteen Island Lake, Montcalm, 1st June.
35. *Homalota* (not determined)—Township of Montcalm, June.
36. *Tachyporus* (not determined) " " "
37. *Tachinus fumipennis*, Say.—In bear's dung, Chain Lake, Montcalm, 17th June.
38. " *conformis*, Dej.—Township of Montcalm, June.
39. *Philonthus cyanipennis*, Fabr.—In a fungus on a rotten tree, River Rouge, 13th August.
40. " (not determined)—Under stones near Grenville, 13th May.
41. *Stenus* (not determined)—Numerous on wet sand, River Rouge, Arundel, July.
42. " (not determined)—Numerous on wet sand, River Rouge, near Hamilton's Farm, 13th August.
43. *Oxytelus Pennsylvanicus*, Er.—Common in our tents throughout the district.
44. *Anthobium dimidiatum*, Mels.—Township of Montcalm, June.
45. *Platysoma parallelum*, Say.— " " "
46. *Carpophilus niger*, Er.— " " "
47. *Epuræa*, (not determined) " " "
48. *Cucujus clavipes*, Oliv.—One specimen taken as it pitched on the mane of a horse, Township of Harrington, 15th May.

49. *Pediacus planus*, Lec.—Very abundant in the tents, Huckleberry Rapids, end of July.
50. *Dermestes lardarius*, Linn.—Observed about the provisions, Sixteen Island Lake, Montcalm.
51. *Anthrenus castaneæ*, Mels.—Township of Montcalm, June.
52. *Platycerus depressus*, Lec.—Near Huckleberry Rapids, River Rouge, De-Salaberry, July.
53. *Onthophagus Hecate*, Pz.—Near Huckleberry Rapids, River Rouge, De-Salaberry, 2nd August.
54. *Geotrupes Egeriei*, Germ. (*microphagus*, Say.) Woods near Hamilton's Farm, 31st August.
55. *Aphodius fimetarius*, Fabr.—Abundant in cow-dung, Hamilton's Farm, August.
56. *Dichelonycha subvittata*, Lec.—Abundant throughout the district, June to August.
57. *Osmoderma scabra*, Beauv.—River Rouge, July and August.
58. *Nichius piger*, Fabr.—On blossoms of *Viburnum opulus*, Sugar-bush Lake, and on white clover blossoms, and bleeding stumps of yellow birch, Bevan's Lake, Montcalm, end of June and beginning of July.
59. *Ancylocheira maculiventris*, Say.—Near Silver Mountain, River Rouge, 12th August.
60. *Cryptohypnus silaceipes*, Germ.—Under stones near Grenville, 13th May.
61. *Dolopius fucosus*, Lec.—Township of Montcalm, June.
62. " *stabilis*, Lec.— " " "
63. *Corymbites triundulatus*, Randall.—Township of Montcalm, end of May.
64. *Pyractomena angulata*, Say.—Common, Sugar-bush Lake, Montcalm, 23d to 26th June.
65. *Ellychnia corrusca*, Linn.—Under stones near Grenville, 13th May.
66. " *lacustris*, Lec.—Abundant in the woods of Harrington, middle of May; Hamilton's Farm, and Lake of Three Mountains, August and September.
67. *Digrapha terminalis*, Say.—Bevan's Lake, 29th June, and 5th July, and Hamilton's Farm, 31st August.
68. *Eros coccinatus*, Say.—Sixteen-Island Lake, &c., Montcalm, end of May.
69. " *molis*, Lec.—Huckleberry Rapids, River Rouge, DeSalaberry, 2nd August.
70. *Podabrus modestus*, Say.—About clearings, Bevan's Lake, Montcalm, 2nd July.
71. *Telephorus rotundicollis*, Say.—Abundant " " "
72. " *carolinus*, Fabr.— " " " "
73. " *fraxini*, Say.—Township of Montcalm, June.
74. *Anobium foveatum*, Kirby.—Abundant in a rotten tree, Bevan's Lake, 4th July.
75. *Cis* (not determined)—Township of Montcalm, June.
76. *Pedilus collaris*, Say.— " " "
77. *Mordella nigricans*, Mels.— " " '

78. *Meloe rugipennis*, Lec.—Hamilton's Farm, 31st August, and Grenville, 14th October.
79. *Cistela* (not determined)—Very abundant on leaves of bass-wood, Sugar-bush Lake, Montcalm, 26th June.
80. " (not determined)—River Rouge.
81. *Nyctobates* (not determined)—Under logs on grass-land, Hamilton's Farm August.
82. *Upis reticulatus*, Say.—(*ceramboides*, Linn.)—With the last species.
83. *Bolitophagus cornutus*, Pz.—Larvæ and Pupa in a boletus, Huckleberry Rapids, DeSalaberry, 3rd August.
84. *Apion* (not determined)—Township of Montcalm.
85. *Sitona lepidus*, Sch.—Near Hamilton's Farm.
86. *Hylobius* (near *pineti*)—Sixteen Island Lake, 1st June.
87. " *pales*, Herbst.—Township of Montcalm, June.
88. *Tomicus* (not named) " " "
89. *Saperda tridentata*, Oliv.—Base of Silver Mountain, Rouge, 10th Aug.
90. *Monohammus confusor*, Kirby.— " " " "
91. " *scutellatus*, Say.—Numerous, Bevan's Lake, 7th July; and abundant the whole way up the Rouge, to the end of August.
92. *Encyclops cœruleus*, Say.—One specimen taken on blossoms of *Viburnum opulus*, Sugar-bush Lake, Montcalm, 26th June.
93. *Acmœops proteus*, Kirby.—Township of Montcalm, June.
94. *Evodinus monticola*, Randall.—Sixteen-Island Lake, 30th May; and abundant on blossoms of *Viburnum opulus*, Sugar-bush Lake, end of June.
95. *Leptura Canadensis*, Oliv.—Abundant on blossoms of *Spirœa salicifolia*, River Rouge, July and August.
96 " *vittata*, Oliv.—Near Huckle-berry Rapids, DeSalaberry, 15th July.
97 " *pubera*, Say.—Abundant on blossoms of *Viburnum opulus*, Sugar-bush Lake, Montcalm, 25th June.
98. " *proxima*, Say.—Near Huckleberry Rapids, DeSalaberry, 26thJuly.
99. " *mutabilis*, Lec.—On blossoms of *Viburnum opulus*, Sugar-bush Lake, end of June.
100. *Donacia palmata*, Oliv.—In blossoms of *Nuphar advena*, (Yellow Water-lily), Sugar-bush Lake, end of June.
101. " *subtilis*, Kunze.—In a small Lake near Lake of Three Mountains, 14th September.
102. " *pusilla*, Say.—Sugar-bush Lake, Montcalm, end of June.
103. " *flavipes*, Kirby.— " " "
104. *Syneta tripla*, Say.—Township of Montcalm.
105. *Chrysomela scalaris*, Lec.—Abundant on alders throughout the district, from the end of June to the end of September.
106. " *spirœ*, Say.—Very abundant, Sugar-bush Lake, 25th June.
107. " *interrupta*, Fabr.—Abundant on alders, Sixteen-Island and Sugar-bush Lakes, Montcalm, May and June. Larva abundant on alder leaves, June 25.

108. *Chrysomela Vitellinæ*, Linn.—Abundant on oak and poplar leaves, Sixteen Island and Sugar-bush Lakes, May and June.

109. *Systena pontalis*, Fabr.—Township of Montcalm, June.

110. *Phyllobrotica decorata*, Say. (*Olivieri*, Kirby,)—Very abundant on *Scutellaria galericulata* and *laterifolia*, River Rouge, July and August.

111. *Adoxus vitis*, Fabr.—Amongst dead leaves, Gate Lake, Wentworth, 16th May.

112. *Chrysochus auratus*, Fabr.—Abundant on *Apocynum androsæmifolium* and *cannabinum*, Bevan's Lake, Huckleberry Rapids, &c., July.

113. *Galleruca sagittariæ*, Kirby.—Township of Montcalm, June.

114. *Coccinella picta*, Randall.— " " "

The following are the thirty-four species of Coleoptera from L'Orignal and the Augmentation of Grenville, collected by Mr. R. Bell.

Cymindis reflexa, Lec.
Calathus gregarius, Say.
Platynus capripennis, Say.
Pterostichus erythropus, Dej.
" *adjunctus*, Lec.
Amara angustata, Say.
" *impuncticollis*, Say.
Anisodactylus Baltimorensis, Say.
" *Harrisii*, Lec.
" *rusticus*, Say.
Harpalus Pennsylvanicus, Geer.
" *herbivagus*, Say.
Chlænius sericeus, Forst.
" *tricolor*, Dej.
Acilius fraternus, Harris.
Silpha Surinamensis, Latr.
Pæderus littorarius, Grav.
Hister perplexus ? Lec.
Ips quadrisignatus, Say.
Cytilus varius, Fabr.
Lachnosterna fusca, Frolich.
Osmoderma eremicola, Knoch.
Photuris Pennsylvanica, Geer.
Trichodes Nuttalii, Kirby.
Thanasimus dubius, Fabr.
Tenebris molitor, Linn.
Ipthinus Pennsylvanicus, Geer.
Orthosoma unicolor, Drury.
Saperda vestita, Say.
Chelymorpha cribaria, Fabr.
Haltica collaris, Fabr.
Chrysomela trimaculata, Fabr.
Helodes trivittata, Say.
Hippodamia 13-punctata, Linn.

Order Lepidoptera.

With the exception of the *Rhopalocera*, the greater portion of the *Lepidoptera* collected are still undetermined. Some of the *Heterocera* enumerated below were named for me at the British Museum by Mr. Francis Walker, to whom I am much indebted.

Rhopalocera.

115. *Papilio turnus*, Linn.—Abundant throughout the whole district, from May 30th till the end of July.

116. " *asterias*, Fab.—A large black butterfly, seen on the 17th June at Balsam Lake I supposed to be of this species.

117. *Colias philodice*, Godt.—Grenville Village, June 5th; along the Rouge from the 30th June till the middle of September; again seen at Grenville, October 14th and 18th.

118. *Pieris oleracea*, Harris.—Abundant throughout the whole district, from the middle of May till the end of June. A few seen at Hamilton's Farm, end of August.

119. *Danais Archippus*, Fab.—A single specimen seen flying across the Rouge a little above Silver Mountain on the 12th of July.

120. *Debis Portlandia*, Boisd.—First seen on the 2nd July, at Bevan's Lake. Abundant in the woods along the Rouge as far as Silver Mountain till the first week in August. As this is generally supposed to be a southern species, it is not a little remarkable that it should be so abundant to the north of the Ottawa.

121. *Hipparchia nephele ?* Kirby.—Abundant amongst grass on Hamilton's Farm, from the 22nd August till the beginning of September.

122. *Limenitis Arthemis*, Drury.—Very abundant throughout the district, from the 26th June till the end of July, a few lingering till the middle of August.

123. *Cynthia cardui*, Linn.—One specimen met with at Hamilton's Farm on the 21st August.

124. *Vanessa Atalanta*, Linn.—I observed a butterfly which appeared to be of this species, at Sugar-bush Lake on the 24th of June.

125. " *Antiopa*, Linn.—Grenville Village, May 13th ; a few seen in the township of Montcalm in June and near Silver Mountain on the 12th of August.

126. " *Milberti*, Godt., *furcillata*, Say.—Grenville Village, May 14th; Rouge, July 10th, and occasionally seen at Hamilton's Farm, up to the 31st August.

127. " *J. album*, Boisd.—Common throughout the district, from May 19th till the end of September. One observed near Grenville on the 18th of October.

128. *Grapta Progne*, Fab.—Abundant everywhere, from the 14th May till the middle of September.

129. " *C. album*, Godt.—I took several specimens of a *Grapta* along the Rouge which I believe to be of this species.

130. *Argynnis Dalphnis* (?), Cramer.—First seen, July 2nd, and last, September 12th. Abundant. I am of opinion that Boisduval was in error in considering *A. Aphrodite*, Fab. and *A. Cybele*, Fab., as the same species. There are at least three closely allied species of *Argynnis* inhabiting Canada, but nothing short of breeding each from the larva will satisfactorily separate them. My specimens are all too small for *A. Cybele*, Fab.

131. *Argynnis Myrina*, Cramer.—From June 5th till August 31st. Common.

132. " *Bellona*, Fab.—The only specimen met with, was captured in Arundel on the 30th June.

133. *Melitæa Tharos*, Cramer.—Sugar-bush Lake, June 29th; Bevan's Lake, July 2nd; Devil's River, July 14th.

134. *Thecla* (?)—I observed a large *Thecla* at Huckleberry Rapids, July 30th, but did not succeed in capturing it.

135. *Lycæna Americana*, Harris.—Numerous on grass land at Hamilton's Farm, from the 21st to the 31st August.

136. *Polyommatus pseudargiolus*, Boisd.—Numerous in Grenville and about Sixteen Island Lake in May. Worn specimens were seen about Bevan's Lake as late as the 2nd of July.

137. *Pamphila.*—One specimen of a species resembling *P. paniscus* of Europe was captured near Bevan's Lake, July 2nd. Specimens of a dingy grey species and of two or three other *Pamphilas* were taken in various localities in June, July and August. I cannot find descriptions of any of these and some of them are probably new.

Heterocera.

138. *Sphinx.*—Two species of *Sphinx* were captured in July, in Arundel and DeSalaberry, allied to *S. Kalmiæ*, A. & S. and *S. gordius*, Cramer, but not agreeing satisfactorily with Dr. Harris's descriptions of these species given in the Amer. Jour. Sci. Vol. 28.

139. *Smerinthus.*—Two larvæ belonging to this genus were obtained at Hamilton's Farm on the 3rd and 4th September, of which the following are descriptions.—No. 1. Pale green, whitish on the back, with oblique stripes of white and dark green on the sides.—No. 2. Green, with oblique tuberculated stripes on the sides and two tubercles on each of the second and third segments.

140. *Trochilium.*—On the 25th June, at Sugar-bush Lake, I captured a beautiful and apparently undescribed species of *Trochilium*, sitting on the blossoms of *Viburnum opulus* (high-bush cranberry). The anal tuft is deep orange; antennæ black; expansion of the wings 11 lines; length of the body 5 lines.

141. *Ctenucha Latreillana*, Kirby.—One specimen taken in Arundel, July 16th.

142. *Crocota brevicornis*, Walker.—Township of DeSalaberry; Hamilton's Farm, July and August.

143. *Medaria mendica*, Walker.—Near Bevan's Lake, July.

144. *Arctia Parthenos*, Harris.—I took a fine *Arctia* on the Devil's River, July 19th, agreeing in every respect with the

description and figure of this species in Agassiz's "Lake Superior," with the exception that it has *five*, instead of *three* cream-coloured spots on the costal edge of the anterior wings.

145. *Hypercompa Lecontei*, Boisd.—Montcalm, Arundel and DeSalaberry, during the month of July.

146. *Halesidota aunulifascia*, Walker.—Cocoons, apparently of this species, were found near Sixteen Island Lake, May 22nd.

147. *Orgyia leucostigma*, A. & S.—Hamilton's Farm, end of August and beginning of September.

148. *Telea Polyphemus*, Hübner.—Throughout the whole district.

149. *Thyatira scripta*, Gosse.—Montcalm and Arundel, end of June and beginning of July.

150. " *cymotaphoroides*, Guén.—Montcalm and Arundel, June and July; Trembling Lake, September 7th.

151. *Graphiphora C. nigrum*, Linn.—One specimen taken in DeSalaberry, July 24th, and another at Hamilton's Farm, August 28th.

152. " *Dahlii*, Hübner.—One specimen taken in Wentworth, May 17th.

153. *Euplexia lucipara*, Linn.—Common in Montcalm in June.

154. *Plusia mortuorum*.—Hamilton's Farm, end of August.

155. *Angerona crocataria*, Fab.—Common in Arundel and Montcalm in July.

156. *Sicya solfatarina*, Guén.—Not uncommon in DeSalaberry, end of July.

157. *Ellopia æqualiaria*.—Montcalm, June.

158. *Nematocampa filamentaria*, Guén.—DeSalaberry, July 22nd.

159. *Endropia tigrinaria*, Guén.—Very abundant in Montcalm at the end of June.

160. *Melanippe Gothicata*, Guén.—Extremely numerous in Montcalm during the month of June.

161. *Scotosia undulata*, Linn.—Common in Montcalm, end of June and beginning of July.

162. *Pyralis* n. sp?—DeSalaberry, June 27th. Mr. Walker supposes this to be a new species, and the following is a description of it.—Anterior wings, dull pink, crossed by two black tranverse lines, the first of which, situated near the base, is straight and has a yellow spot on its inner side, occupying the angle which it forms with the costa; the second, situated beyond the middle, is bent, forming an obtuse angle before it reaches the costal margin, where it has a yellow crescent-shaped spot on the outer side. Posterior wings, dusky-white at the base, with a broad, pale black, sub-marginal band and crossed by two black tranverse lines. Expansion of the wings 12½ lines; length of body 4 lines.

163. *Bleptina surrectalis*, Guén.—DeSalaberry, August 4th.
164. *Anania octomaculata*, Linn.—One specimen taken in Montcalm, July 2nd.
165. *Hydrocampa.*—A species of *Hydrocampa* was abundant near Hamilton's Farm, August 15th.
166. *Botys verticalis*, Linn.—DeSalaberry, not uncommon about the first of August.
167. *Eubulea.*—A small species apparently closely allied to the European *E. sambercalis*, Schiff., was very numerous on the blossoms of the rasberry (*Rubus strigosus*), near Bevan's Lake, at the begining of July.
168. *Tortrix.*—Several pupæ of a *Tortrix*, which I collected on the Devil's River, produced the perfect insect, but I have been unable to determine either this or any other of my *Micro-Lepidoptera.*

MOLLUSCA.

CLASS GASTEROPODA.

Order Pulmonifera.

1. *Tebennophorus Carolinensis*, Bosc.—Throughout the district.
2. *Succinea obliqua*, Say.—Occurred plentifully at Hamilton's Farm, and sparingly in wild parts of the district.
3. *Helix albolabris*, Say.—Wentworth ; Montcalm ; Harrington.
4. " *exoleta*, Binney.—Wentworth ; DeSalaberry ; Harrington.
5. " *monodon*, Rackett.—Arundel ; Hamilton's Farm ; near the Lake of Three Mountains.
6. " *concava*, Say.—Wentworth ; Montcalm ; Arundel. Abundant.
7. " *pulchella*, Müller.—Under stones at Carillon, but not elsewhere met with.
8. " *Sayii*, Binney.—Near Doran's Lake, Grenville.
9. " *labyrinthica*, Say.—Wentworth ; Montcalm ; Arundel. Common.
10. " *alternata*, Say.—Abundant throughout the district.
11. " *striatella*, Anthony.—Very abundant throughout the district.
12. " *arborea*, Say.—Plentiful throughout the district.
13. " *chersina*, Say.— " " " "
14. " *lineata*, Say.—Abundant throughout the district.
15. *Bulimus marginatus*, Say.—Sugar-bush Lake and near Gate Lake.
16. *Achatina lubrica*, Müll.—Bevan's and Gate Lakes. Common.
17. *Vertigo Gouldii*, Binney.—Sixteen Island Lake.
18. *Pupa* (undetermined).—With the last species.
19. *Carychium exiguum*, Say.—One specimen found near Sixteen Island Lake.

(*Fresh Water.*)

20. *Physa heterostropha*, Say.—Sugar-bush Lake, and near Grenville Village.
21. " *aurea*, Lea.—Small Lake near Hamilton's Farm.

22. *Physa elliptica*, Lea.—In a small lake one mile west of the Indian Village in Arundel.
23. " *elongata*, Say.—Near Grenville Village.
24. *Limnæa exigua*, Lea. (young).—In a small lake near Hamilton's Farm.
25. " *galbanus*, Say.—Abundant in shell marl from the bottom of Eagle Nest Lake.
26. " *plicata*, Lea.—Sugar-bush Lake. Abundant.
27. " *reflexa*, Say.—Near Grenville Village.
28. " *umbilicata*, Say.—With the last species.
29. *Planorbis trivolvis*, Say.—In the small lake one mile west of the Indian Village in Arundel.
30. " *bicarinatus*, Say.—Eagle Nest Lake and a small lake neaar Hmilton's Farm.
31. " *campanulatus*, Say.—Near Grenville Village and in numerous lakes throughout the district.
32. " *parvus*, Say.—In shell marl in Eagle Nest Lake, and living in the lake one mile west of the Indian Village, Devil's Rapids, and in the lakes near Hamilton's Farm.
33. " *deflectus*, Say.—Sixteen Island and Sugar-bush Lakes.

Order Prosobranchiata.

34. *Paludina decisa*, Say.—Very abundant the whole way up the Rouge and its tributary the Devil's River. Those collected are of a reddish-brown color, very unlike the light green of specimens from L'Orignal, opposite the mouth of the Rouge, and from the St. Lawrence near Montreal.
35. *Valvata tricarinata*, Say.—A few specimens found in shell marl from the bottom of Eagle Nest Lake.

CLASS LAMELLIBRANCHIATA.

1. *Unio complanatus*, Lea.—This was the only species of *Unio* met with. It inhabits nearly every lake in the district, and was abundant in the Rouge as far as we ascended it. It was extraordinarily abundant in the shallow stream by which the waters of Bevan's and Bark Lakes are discharged into the Rouge; in fact they were crowded together as closely as they could lie, in the same manner as a bed of mussels on the sea shore.
2. *Margaritana rugosa*, Barnes.—One fine specimen obtained in the fourth small lake west of Balsam Lake, lot 11, range 3, Montcalm.
3. *Anodonta cygnea* (?), Linn.—This species was found in almost every lake we visited.

4. *Anodonta edentula*, Say.—One specimen obtained from the lake on lot 11, range 3, Montcalm.
5. " *fragilis*, Linn.—Sixteen Island, Eagle Nest, and Bevan's Lakes.
6. " *Footiana*, Lea.—With the last species.
7. *Cyclas similis*, Say.—Sixteen Island and Sugar-bush Lakes; lake one mile west of the Indian Village; in shell marl in Eagle Nest Lake.
8. " *partumeia* (?), Say.—Ponds near Eagle Nest Lake; Sugar-bush Lake; small lake near Hamilton's Farm.
9. " *dubia* (?), Say.—In shell marl, Eagle Nest Lake; living in the small lake near Hamilton's Farm.

V.

Catalogue of Animals and Plants collected and observed, on the south-east side of the St. Lawrence from Quebec to Gaspé, and in the Counties of Rimouski, Gaspé and Bonaventure. By Mr. Robert Bell, Jr., Assistant to Mr. James Richardson, Geological Explorer under Sir W. E. Logan, in 1858.

VERTEBRATA.

CLASS MAMMALIA.

Order Cheiroptera.

1. *Vespertilio subulatus*, Say.—Restigouche, Matapedia and Patapedia Rivers.

Order Insectivora.

2. *Sorex Forsteri*, Richardson.—Counties of Rimouski and Bonaventure.

Order Carnivora.

3. *Ursus Americanus*, Pallas.—Throughout the district.
4. *Mustela martes*, Linn.— " "
5. " *vison*, Gmel.— " "
6. " *vulgaris*, Linn.— " "
7. " *Canadensis*, Schreber.— " "
8. *Mephitis Chinga*, Tiedimann.— " "
9. *Lutra Canadensis*, Sabine.— " "
10. *Canis fulvus*, Desm.— " "
11. " *lupus*, Linn.—Said to come no farther north than the St. John River.
12. *Lynx Canadensis*, Linn.—Gaspé, and probably throughout the whole district.

Order Rodentia.

13. *Castor fiber*, Linn.—Throughout the district.
14. *Fiber zibethicus*, Cuv.,— " "
15. *Mus musculus*, Linn.—In settled parts throughout the district.
16. *Pteromys volucella*, Desm.—Gaspé.
17. *Tamias Lysteri*, Ray.—Rimouski and Gaspé.

18. *Sciurus Hudsonius*, Penn.—Throughout the district
19. *Hystrix dorsata*, Linn.— " "
20. *Lepus Americanus*, Erxl.— " "

ORDER RUMINANTIA.

21. *Cervus alces*, Linn.—Rimouski, Bonaventure and western part of Gaspé.
22. " *tarandus*, Linn.—Among the Shickshock Mountains.

CLASS AVES.

Determined by Mr. D'Urban.

ORDER RAPTORES.

1. *Haliœtus leucocephalus*, Linn.—Along the St. Lawrence from Green Island to Martin River, in June and July; seen on the Restigouche in August.
2. *Astur fuscus*, Gmel.—Capucin, August 8th.
3. *Surnia funerea*, Gmel.—Green Island, middle of October.
4. *Syrnium nebulosum*, Gmel.—Marsouin River, end of July.

ORDER INSESSORES.

5. *Chordeiles Virginianus*, Briss.—Chat River, June 18th; Ste. Anne, June 28th to July 17th; at the mouth of the Matapedia, August 28th.
6. *Hirundo bicolor*, Vieill.—Chat River, June 18th; Ste. Anne, June 30th; Martin River, July 20th.
7. " *fulva*, Vieill.—Metis, beginning of June.
8. " *rustica*, Linn.—Trois Pistoles, May 30th; Metis, June 10th; Long Point, June 15th.
9. " *riparia*, Linn.—Ste. Anne, June 28th.
10. *Sylvicola coronata*, Lath.—Green Island Village, May 25th.
11. *Troglodytes hyemalis*, Vieill.—Patapedia River, September 5th.
12. *Parus atricapillus*, Linn.—First seen on the Patapedia River, September 5th, and afterwards in various localities.
13. *Regulus satrapa*, Lich.—Rivière du Loup, May 18th.
14. *Turdus migratorius*, Linn.—In settled parts, throughont the district.
15. *Anthus Ludovicianus*, Lich.—Rivèire du Loup to Rimouski, from May 10th to June 5th.
16. *Alauda alpestris*, Linn.—Rimouski Village, beginning of October.
17. *Plectrophanes nivalis*, Linn.—Kamouraska, beginning of November.
18. *Emberiza socialis*, Wils.—Various localities from Rivière du Loup to Cape Chat.
19. *Niphœa hyemalis*, Linn.—Throughout the district.
20. *Carduelis tristis*, Linn.—Along the coast from St. Fabien to Martin River, from May 31st to July 19th; on the Restigouche, September 2nd.
21. *Fringilla Pennsylvanica*, Lath.—About clearings along the whole coast.
22. *Erythrospiza purpurea*, Gmel.—St. Fabien, May 30th; Ste. Anne, July 18th.
23. *Agelaius Phœniceus*, Linn.—Ste. Anne, July 17th.

24. *Quiscalus ferrugineus*, Lath.—Metis River, and between Metis and Rimouski, September and October.
25. *Corvus Americanus*, Aud.—Along the whole coast, and on the Restigouche, but not seen in inland parts.
26. *Garrulus cristatus*, Linn.—Lake Matapedia, August 19th.
27. " *Canadensis*, Linn.—Throughout the district.
28. *Bombycilla Carolinensis*, Briss.—Metis, June 8th; Ste. Anne, in July; Marsouin River, August 2nd.
29. *Trochilus colubris*, Linn.—Metis, middle of August.
30. *Sitta Canadensis*, Linn.—Matapedia Lakes, August 19th.
31. *Alcedo alcyon*, Linn.—Throughout the district; observed from May 19th to the end of September.
32. *Picus pileatus*, Linn.—Green Island Seigniory.
33. " *villosus*, Linn.—Bic, Ste. Anne, Marsouin and Martin Rivers.

ORDER RASORES.

34. *Ectopistes migratoria*, Linn.—From Metis to Ste. Anne; about Lake Matapedia, and along the Restigouche, from Jnne 18th to August 31st.
35. *Tetrao umbellus*, Linn.—Near Rimouski. This species was not met with in Gaspé, and is believed by the Indians not to extend so far to the north-east.
36. " *Canadensis*, Linn.—Throughout the district.

ORDER GRALLATORES.

37. *Strepsilas interpres*, Linn.—Green Island Village, October 26th.
38. *Tringa pusilla*, Wils.—Rivière du Loup and Green Island in May; Chat and Martin Rivers in July.
39. *Tringa* (undetermined).—Mouth of Marsouin, August 4th.
40. *Totanus solitarius*, Wils.—Matapedia and Restigouche Rivers in August.
41. " *vociferus*, Wils.—Rivière du Loup, May 20th.
42. *Scolopax Noveboracensis*, Gmel.—Green Island, May 25th.
43. *Ardea nycticorax*, Linn.—Dalhousie, N. B., August 25th; Patapedia River, September 9th; Metis Lake, October 1st.

ORDER NATORES.

44. *Anser Canadensis*, Linn.—Rimouski, beginning of June; Cape Chat, June 17th, and near Green Island and Cacouna in the end of October.
45. " *leucopsis*, Bechst.—Rimouski and Green Island in October.
46. *Fuligula fusca*, Linn.—Coast of Rimouski and Gaspé in June and July.
47. " *perspicillata*, Linn.—Green Island and various localities further down.
48. " *clangula*, Linn.—Bic and Green Island in October, and Metis Lakes, September 18th.
49 " *histrionica*, Linn.—Ste. Anne River in July; Restigouche in August, and Patapedia in the beginning of September.

50. *Mergus serrator*, Linn.—Along the whole coast and on every river visited; first seen at Ste. Anne, June 30th.
51. *Phalacrocorax carbo*, Linn.—Between Bic and Green Island, middle of October.
52. *Larus atricilla*, Linn.—Whole coast.
53. *Uria Grylle*, Linn.—Hare Island; Green Island; Ste. Anne and near Martin River.
54. *Colymbus glacialis*, Linn.—Metis Lakes; Marsouin River and Rimouski.
55. " *septentrionalis*, Linn.—Skins of this bird were procured by Mr. Richardson in Anticosti.

CLASS REPTILIA.

1. *Tropidonotus sirtalis*, Linn.—Throughout the district.
2. *Rana pipiens*, Gmel.— " "
3. *Salamandra erythronota*, Green.— " "
4. *Bufo Americana*, Leconte.— " "

CLASS PISCES.

Order Acanthopteri.

1. *Gasterosteus* (not determined).—Metis River, above the high falls.
2. " *pungitius*, Linn.—In numerous localities along the coast, from Rivière du Loup downwards.
3. " *biaculeatus*, Mitch.—With the preceding species, but more abundant. Found also in Lake Matapedia.
4. *Cottus Virginianus*, Willughby.—Coast of Gaspé and Rimouski.
5. " *gracilis*? Heck.—Restigouche River and Metis Lakes.
6. *Scomber vernalis*, DeKay.—Ascends the St. Lawrence to Rimouski.

Order Malacopteri.

7. *Salmo salar*, Linn.—Ascends all the rivers in the peninsula which are free from mill-dams.
8. " *fontinalis*, Mitch.—In every stream and lake throughout the district.
9. " *trutta*, Linn.—Abundant for a short distance up the clear streams of Gaspé.
10. *Osmerus viridescens*, Lesueur.—Whole coast below Green Island.
11. *Alosa præstabilis*, DeKay.—Coast of Rimouski, middle of May.
12. " *tyrannus*, DeKay.—Rimouski Village.
13. *Clupea virescens* (?), DeKay.—Whole coast as far up as the salt water extends.
14. " *elongata*, Lesueur.—Whole coast also.
15. *Mallotus villosus*, Cuvier.—With the last two species; extremely abundant.

Order Anacanthini.

16. *Ammodytes Americanus*, DeKay.—Coast of Gaspé.
17. *Morrhua Americana*, Storer.—Ascends the river as far as Trois Pislotes.
18. " *æglefinus*, Cuvier.—Taken with cod on the Gaspé coast.
19. " *pruinosa*, DeKay.—Caught at the mouths of various rivers from the Chat upwards.

20. *Motella cimbria* (?), Parnell.—Ste. Anne.
21. *Zoarcus viviparus*, Cuvier.—Off the mouth of Marsouin River.
22. *Hippoglossus vulgaris*, Cuvier.—Ascends the river to Green Island.
23. *Platessa vulgaris*, Flem.— Several of the fishing stations on the Gaspé coast.
24. *Cyclopterus lumpus*,—Linn.—Ste. Anne; Green Island.

Order Plagiostomi.

25. *Spinax acanthias*, Cuvier.—Les Islets.
26. *Raia radiata*, Don.—Ste. Anne.

MISCELLANEOUS.

27. *Coregonus*.—Herring Trout, probably *C. clupeiformis*, are abundant in the Metis Lakes and River.
28. *Cyprinus*.—Lake Matapedia and the Restigouche River.
29. *Catastomus*.—Black Suckers occur in the Restigouche and the larger lakes of the district.
30. *Anguilla*.—Probably *A. acutirostris*, about the mouths of the rivers all along the coast.
31. *Salmo*.—An important species of *Salmo*, known as "Toag," abounds in the lakes of Rimouski County, but as no specimens were preserved nothing certain can be said about it.

ARTICULATA.

CLASS INSECTA.

Order Coleoptera.

Determined by Dr. J. L. Leconte of Philadelphia.

1. *Cicindela longilabris*, Say.—Green Island Seigniory; between Metis and Lake Matapedia; Ste. Anne.
2. " *vulgaris*, Say.—Ste. Anne; Ruisseau de la Grande Vallée; between Metis and the mouth of the Matapedia.
3. " *duodecimguttata*, Dej.—Metis River; between Metis and the Matapedia; Ste. Anne.
4. " *Baltimorensis*, Herbst. (*repanda*, Say.)—Rimouski; Metis River; Capucin.
5. *Brachinus*, (not determined).—Abundant on Metis River.
6. *Cymindis reflexa*, Lec. (*marginata*, Kirby).—Rivière du Loup; Rimouski; Metis; Matanne.
7. *Calathus gregarius*, Say.—St. Simon; from the mouth of the Marsouin to the Shickshock Mountains, fourteen miles up that river; Mount Commis on the Metis River.

8. *Platynus sinuatus*, Dej.—Point Levi ; St. Simon ; Marsouin River.
9. " *extensicollis*, Say.—Metis River.
10. " *melanarius*, Dej.—Point Levi, opposite Quebec.
11. " *tenuis*, Say.—Berthier and Ste. Anne.
12. " *cupripenne*, Say.—Point Levi, St. Simon and Ste. Anne.
13. " *retractus*, Lec.—Berthier, Rivière du Loup, and Ste. Anne.
14. " *picipennis*, Kirby, (*lenum*, Lec.)—Berthier, Marsouin River, and between Metis and the Matapedia.
15. " *lutulentus*, Lec.—Point Levi.
16. " *placidus*, Say.—Berthier, Matanne, and Ruisseau de la Grande Vallée.
17. *Pœcilus lucublandus*, Say.—Very abundant at Point Levi, Berthier, Rivière du Loup, Green Island Village, St. Simon and Metis.
18. *Pterostichus erythropus*, Dej.—Point Levi.
19. " *patruelis*, Dej.—Green Island Seigniory.
20. " *mandibularis*, Kirby.—Between the mouth of the Marsouin and the Shickshock Mountains.
21. " *caudicalis*, Say.—Berthier and Green Island Seigniory.
22. " *corvinus*, Lec.—Point Levi.
23. " *orinomum*, Leach. (*vitreus*, Esch.)—Abundant from Rivière du Loup to Ste. Anne; Mount Commis near the Metis.
24. " *Luczotii*, Dej. (var. præc.?)—Metis and Ste. Anne.
25. " *adjunctus*, Lec.—Rivière du Loup to Ste. Anne.
26. *Amara libera*, Lec.—Rivière du Loup.
27. " *pallipes*, Kirby, (*depressa*, Lec.)—Rimouski.
28. " *impuncticollis*, Say.—Berthier and Ste. Anne.
29. " *fallax*, Lec.—Green Island Seigniory and Matanne.
30. " *interstitialis*, Dej.—Rimouski and Matanne.
31. *Anisodactylus Harrisii*, Lec.(*agricola*,vide Harris.)—Point Levi and Berthier.
32. *Harpalus viridiæneus*, Beauv.—Very abundant at Green Island Seigniory, between Metis Lake and the Matapedia, Matanne, and Ste. Anne.
33. " *pleuriticus*, Kirby.—Abundant from Berthier to Rimouski.
34. " *megacephalus*, Lec.—Rivière du Loup.
35. " *rufimanus*, Lec.—Ste. Anne.
36. *Chlœnius sericeus*, Say.—Point Levi, Berthier, and St. Simon.
37. " *chlorophanus*, Dej.—Metis River.
38. " *tricolor*, Dej.—Berthier.
39. *Cychrus* (*Sphæroderus*) *Brevoortii*, Lec.—Rivière du Loup, St. Simon, Mount Commis twenty miles up Metis River, Ste. Anne and Marsouin River.
40. *Carabus serratus*, Say.—Rivière du Loup to Matanne, and between Metis and the Matapedia River.
41. " *Lapilayi*, Lec.—Rivière du Loup and Green Island Seigniory.
42. *Calosoma calidum*, Fabr.—L'Islet, Rimouski, Metis, Matanne, and Ste. Anne.

43. *Elaphrus Californicus*, Mann. var. *punctatissimus*, Lec.—St. Simon.
44. *Patrobus longicornis*, Say.—Berthier, Metis, and mouth of the Matapedia.
45. " *angicollis*, Randall.—Metis River.
46. *Bembidium dilatatum*, Lec.—Metis River.
47. " *lucidum*, Lec.—Point Levi.
48. *Dytiscus confluens*, Say. (*O. Oligbukii*, Kirby.)—Mouth of Metis River.
49. *Agabus striatus* (?), Say.—Rivière du Loup, Green Island Seigniory, and Ste. Anne.
50. *Necrophorus velutinus*, Fabr.—Metis River.
51. *Silpha lapponica*, Herbst.—Very abundant at Ste. Anne.
52. *Staphylinus villosus*, Grav.—Rimouski, Metis, Matanne, and Ste. Anne.
53. *Omosita colon*, Fab.—In vast numbers in fields manured with capeling.
54. *Pediacus planus*, Lec.—Between Metis and Matapedia.
55. *Byrrhus picipes*, Kirby.—Ste. Anne.
56. *Platycerus depressus*, Lec.—Ste. Anne.
57. *Aphodius fossor*, ("absolutely the same as the European," Leconte, in lit.)—Rivière du Loup and Ste. Anne.
58. " *fimetarius*, Fabr.—Abundant from Metis to the Matapedia.
59. " n. sp. (?)—Metis.
60. *Lachnosterna fusca*, Frohlich.—Point Levi and Rivière du Loup.
61. *Dichelonycha subvittata*, Lec.—Ste. Anne.
62. *Ancylochira maculiventris*, Say.—Metis River, and between Metis and the Matapedia.
63. *Ellychnia corrusca*, Dej.—Capucin, Ste. Anne, and Ruisseau de la Grande Vallée.
64. *Meloe rugipennis*, Lec.—Between Metis and the mouth of the Matapedia.
65. *Serropalpus substriatus*, Hd.—Metis River.
66. *Upis reticulata*, Say.—Metis.
67. *Tomicus* (not named).—Between Metis and the Matapedia.
68. *Physocnemum ligneum*, Fabr.—Green Island Seigniory.
69. *Monohammus confusor*, Kirby.—Metis.
70. " *scutellatus*, Say.—Metis and Ste. Anne.
71. *Chrysomela scalaris*, Lec.—Metis.
72. *Galleruca* (not named).—Between Metis and the Matapedia.
73. *Coccinella novemnotata*, Fabr.—Rimouski and Metis.

Order Lepidoptera.

Determined by Mr. D'Urban.

(*a*) Rhopalocera.

74. *Papilio turnus*, Linn.—From Cape Chat to Martin River, from June 18th till the end of July. Extremely abundant.
75. *Colias philodice*, Godart.—Cape Chat and Ste. Anne, from the middle of June till the middle of July; between Metis and Lake Matapedia, August 17th; along the Restigouche during the latter half of August; last seen September 1st.

6. *Pieris oleracea*, Harris.—St. Simon, May 28th; Ste. Anne, from June 20th to the middle of July. Common.
77. *Limenitis Arthemis*, Drury.—Ste. Anne, July 16th; Marsouin River, July 26th.
78. *Cynthia cardui*, Linn.—Seigniory of Grand Metis, August 16th; Dalhousie N. B., August 25th.
79. *Vanessa J. album*, Boisd.—Junction of the Patapedia and Awaganasees, September 12th.
80. " *Antiopa*, Linn.—Metis and near Rimouski, September 29th.
81. *Grapta Progne*, Fab.—From Rivière du Loup to Ste. Anne, from May 18th till July 19th; Lake Matapedia, August 17th; along the Restigouche and Patapedia Rivers till September 12th.
82. *Grapta C. aureum*, Cramer (?)—Mouth of Awaganasees Brook, September 12th.
83. *Argynnis Aphrodite*, Fab.—First observed at Ste. Anne on the 20th of June and very abundant there for the next month; Marsouin River, July 26th; between Metis and Lake Matapedia and along the Resti gouche in August, and last seen at the mouth of the Awaganasees, September 12th.
84. " *myrina*, Cramer.—Ste. Anne, end of June and beginning of July; between Metis and Lake Matapedia, August 16th.
85. " *Bellona*, Godart.—Mouth of Matapedia River, August 27th.
86. *Melitœa Tharos*, Cramer.—Ste. Anne, beginning of July.
87. *Polyommatus pseudargiolus*, Boisd.—Rivière du Loup, May 19th, and thence as far down as Chat River, till June 18th.
88. *Hesperia* ——— (?) —Metis, August 13th; Lake Matapedia, August 17th.

(*b*) Heterocera.

89. *Orgyia* ——— (?) —Matapedia River, August 20th.
90. *Ctenucha Latreillana*, Kirby.—Ste. Anne, June 28th. Abundant.
91. *Phragmatobia fuliginosa*, Linn.—Matanne, June 12th.
92. *Mamestra* ——— (?) —Ste. Anne.
93. *Plusia* ——— (?) —Common in Gaspé and on the Restigouche.
94. *Pyralis* ——— (?) — Mouth of the Matapedia River.
95. *Crambus* ——— (?) —Very abundant in meadows at Ste. Anne, and at the mouth of the Matapedia.

Five undetermined species of Geometric Moths.

CLASS CRUSTACEA.

Order Decapoda.

1. *Cancer irroratus*, Say.—Whole coast below Green Island.
2. *Hyas fissirostra*, Say sp.—With the preceding species.
3. *Pagurus Bernhardus*, Fabr.—Coast of Gaspé and Rimouski.
4. *Homerus Americanus*, Milne-Edw.—Rare on the coast of Rimouski and on the north coast of Gaspé, but abundant in Gaspé Bay, on Anticosti and in the Bay of Chaleur.

5. *Astacus Bartonii*, Bosc.—Metis, Matapedia and Restigouche Rivers.
6. *Crangon vulgaris*, Fabr.—Coast of Gaspé and Rimouski.
7. " *sculptus* (?), Bell.—Off Cape Chat.
8. *Hippolyte* (not determined)—Near Metis.
9. *Orchestia* (not determined)—Whole coast.

CLASS ANNULATA.

Order Tubicolæ.

Determined by Dr. J. W. Dawson.

1. *Spirorbis porrecta*,—North coast of Gaspé.
2. " *sinistrosa*,— " "
3. " *carinata*,— " "
4. " *vitrea*,— " "
5. " *cancellata*,— " "
6. " *spirillum*.—On littoral *Algae*, whole coast below Rivière du Loup.
7. *Serpula* (*vermilia*) *serrula*, Stimpson.—North coast of Gaspé.

MOLLUSCA.

CLASS GASTEROPODA.

Order Pulmonifera.

(*Terrestrial.*)

1. *Helix alternata*, Say.—Common from Quebec along the whole coast into Gaspé; it appears to be diffused over the whole peninsula.
2. " *albolabris*, Say.—From Quebec to Metis; Lake Matapedia; along the Restigouche River from Dalhousie to the mouth of the Patapedia. I never met with this species in the County of Gaspé.
3. " *monodon*, Rackett.—Point Levi; along the banks of the Restigouche from Dalhousie to the mouth of the Patapedia.
4. " *Sayii*, Binney.—Restigouche River, about five miles above the mouth of the Matapedia.
5. " *concava*, Say.—Point Levi; abundant.
6. " *hortensis*, Müll.—From all that I could ascertain regarding this species, it appears to have diffused itself over a strip of country several miles in width, bordering on the St. Lawrence and extending from Metis to Gaspé Bay.
7. " *arborea*, Say.—Throughout the whole district; very abundant. Occurs on the Island of Anticosti.
8. " *striatella*, Anthony.—With the last species and equally abundant.
9. " *lineata*, Say.—Numerous localities on the coast, from Berthier to Marsouin River.
10. " *labyrinthica*, Say.—Rivière du Loup and Green Island.

11. *Helix pulchella*, Müll.—Berthier, mouth of Magdalen River and Dalhousie, N. B.
12. " *asteriscus*, Morse.—Valley of the Marsouin River.
13. " *chersina*, Say.—Trois Pistoles; Capucin; Ste. Anne; along the vallies of the Marsouin, Magdalen and Matapedia Rivers, and at the mouth of the Patapedia.
14. *Helix* (undetermined).—A young shell of one of the larger species, but differing from any of the preceding; Rivière du Loup.
15. *Succinea avara*, Say.—Matanne; mouth of Magdalen River; several localities on the Restigouche.
16. " *ovalis*, Gould.—Metis, Matanne and Ste. Anne.
17. " *obliqua*, Say.—Throughout the district.
18. *Achatina lubrica*, Müll.—Rivière du Loup; Trois Pistoles; Metis Lakes and along the Restigouche.
19. *Bulimus harpa*, Say sp.—Metis; mouth of Magdalen River, and very abundant in the Marsouin Valley.
20. *Vitrina pellucida*, Drap.—Rivière du Loup; Trois Pistoles; Ste. Anne; Restigouche River ten miles above its junction with the Matapedia.
21. *Pupa* (*Vertigo*) *simplex*, Gould.—Valley of the Marsouin; along the Restigouche and at Metis.

(*Fresh Water.*)

22. *Physa heterostropha*, Say.—Throughout the district; very abundant.
23. " *aurea*, Lea.—Several localities in the County of Rimouski.
24. " *elongata*, Say.—Green Island Village; Metis; Ste. Anne.
25. " *ancillaria*, Say.—Rimouski Village.
26. " *marginata*, Say.—Near Rimouski Village.
27. *Limnæa stagnalis*, Lam.—Extremely abundant in the Metis Lakes, and in the lakes on the Rimouski River.
28. " *caperata*, Say.—Lakes Metis and Matapedia, and the Metis and Restigouche Rivers. Abundant.
29. " *umbrosa*, Say.—Ste. Anne; a creek about two miles below Chat River; Metis and Restigouche Rivers.
30. " *catiscopium*, Say.—Rimouski, Restigouche, and Dartmouth rivers.
31. " *apacina*, Lea.—Living in the St. Lawrence at Point Levi; in the Metis, Rimouski and White Rivers.
32. " *acuta*, Lea.—Upper Lake Metis; abundant in Marl Lake, Anticosti.
33. " *umbilicata*, Say.—Metis and Ste. Anne.
34. " *reflexa*, Say.—Upper Metis Lake.
35. " *pallida*, Adams.—Large Lake Matapedia; near Cape Chat.
36. " *modicella*, Say.—Green Island Village; Rimouski; Ste. Anne.
37. " *parva*, Lea.—Rivière du Loup.
38. " *decollata*, Say.—Large Lake Matapedia; Rimouski Village.
39. " *alternata*, or new.—Point Levi.

40. *Planorbis trivolvis*, Say.—Rimouski, Metis and Restigouche Rivers.
41. " *campanulatus*, Say.—Lakes Metis and Matapedia.
42. " *bicarinatus*, Say.—Restigouche River.
43. " *parvus*, Say.—Throughout the district.
44. " *deflectus*, Say.—Large Lake Matapedia.

ORDER PROSOBRANCHIATA.

(*Fresh Water.*)

45. *Amnicola porata*, Say.—Little Lake Matapedia.
46. *Valvata tricarinata*, Say.—Matapedia Lakes.
47. " *humeralis*, Say (or a new species).—Matanne; small lake at the head of Awaganasees Brook; Little Lake Matapedia.
48. " *sincera*, Say.—Marl Lake, Anticosti. Abundant.

NOTE.—Many of the above species of land and fresh water Gasteropoda were kindly determined for me by W. G. Binney Esq., of Burlington N. J. and Dr. Isaac Lea, of Philadelphia.

(*Marine.*)

49. *Fusus scalariformis*, Gould.—Peter River; Ste. Anne; Marsouin.
50. " *gracilis* Aldèr.—Trent; Ste. Anne; Marsouin.
51. " *tornatus*, Gould.—Rimouski Village; near Ste. Anne.
52. " *decemcostatus*, Say.—Near Cape Gaspé (collected by Sir W. E. Logan in 1844.)
53. " *rufus*, Gould.—Ruisseau de la Grande Vallée.
54. " *Bamffius*, Flem.— " "
55. *Bela cancellata*, M. & A.— " "
56. *Pleurotoma bicarinata* (?), Couth.— "
57. *Buccinum undatum*, Linn.—Whole coast below Rivière du Loup.
58. " *Donovani*, Gray.—Several localities below St. Flavie.
59. *Nassa trivittata*, Say.—Gaspé Bay and Bay of Chaleur.
60. " *obsoleta*, Say.—Vicinity of Cape Gaspé.
61. *Purpura lapillus*.—Lam.—Whole coast below Metis.
62. *Trichotropis borealis*, Sowerby.—Ste. Anne and near Cape Chat.
63. *Velutina haliotoides*, Müll.—Ste. Anne and Marsouin.
64. *Lamellaria perspicua*, Lovèn.—Ruisseau Vallée.
65. *Natica heros*, Say, *ampullaria*, Lam.—In sandy bays on the Gaspé coast; at Dalhousie, Bay of Chaleur.
66. " *clausa*, Brod. & Sow.—Several localities between Bic and Marsouin.
67. " *triseriata*, Say.—Magdalen Bay.
68. " *flava* ? Gould.—Rimouski; Les Islets; Claude.
69. " *helicoides*, Johnston.—Marsouin.
70. *Chemnitzia*.—One or more species of *Chemnitzia* dredged off Marsouin.
71. *Aphorhais occidentalis*, Gould.—Bic; Ste. Anne; Claude; Marsouin.
72. *Rissoa minuta*, St.—Green Island and Long Point.
73. *Lacuna vincta*, Turt.—Whole coast below Rimouski.
74. *Littorina littoralis*, F. & H., *palliata*, Gould.—Whole coast below Rivière Ouelle.

75. *Littorina rudis*, Gould, (including *tenebrosa*).—With the preceding species.
76. *Margarita cinerea*, Gould.—Ste. Anne ; Ruisseau Vallée ; Peter River and Marsouin.
77. " *undulata*, Sow.—Ste. Anne ; Ruisseau Vallée.
78. " *helicina*, Müll.—Trent ; Les Islets ; Ste. Anne.
79. *Skenea costulata*, F. & H.—Marsouin.
80. *Diadora Noachina*, Gray.—Capucin ; Ste. Anne ; Marsouin.
81. *Crepidula fornicata*, Lam.—Dalhousie, Bay of Chaleur.
82. *Acmœa testudinalis*, Hanley.—Whole coast below Rivière du Loup, also in Bay of Chaleur.
83. " *cœca*.—Marsouin.
84. *Chiton marmoreus*, Fabr.—Bic, and whole coast of Gaspé.

CLASS LAMELLIBRANCHIATA.

(*Marine.*)

1. *Pholas crispata*, Linn.—Bic ; Rimouski ; near the Trent.
2. *Saxicava rugosa*, Lam.—Les Islets ; Ste. Anne ; Cape Chat ; Marsouin Claude.
3. *Mya arenaria*, Linn.—Whole coast below Rivière Ouelle, and in Bay of Chaleur.
4. " *truncata*, Linn.—Numerous localities on the coast of Rimouski and Gaspé.
5. *Glycymeris siliqua*, Lam.—Cape Chat ; Ruisseau Vallée ; and Marsouin.
6. *Osteodesma hyalina*, Couth.—Ste. Anne.
7. *Machœra costata*, Gould.—Rimouski.
8. *Solen ensis*, Linn.—Bic ; Rimouski, and numerous localities on the coast of Gaspé.
9. *Tellina proxima*, Brown.—Ste. Anne ; Ruisseau Vallée ; Marsouin.
10. " *Grœnlandica*, Beck.—Whole coast below Bay St. Paul (fifty-five miles below Quebec), and in the Bay of Chaleur.
11. *Mactra ovalis*, Gould.—Bic ; Rimouski ; Metis, and in sandy bays everywhere on the Gaspé coast.
12. *Mesodesma arctatum*, Gould.—Whole coast below Green Island. Extremely abundant.
13. *Venus gemma*, Tott.—Green Island.
14. *Aphrodite Grœnlandica*, St.—Bic ; Rimouski ; Metis ; Ste. Anne ; Ruisseau Vallée.
15. *Cardium Islandicum*, Linn.—Bic ; Rimouski ; Metis ; Ste. Anne.
16. *Cardita borealis*, Con.—Marsouin ; Capucin ; Ste. Anne ; Ruisseau Vallée.
17. *Astarte sulcata*, Costa.—Bic, and various localities on the Gaspé coast.
18. " *elliptica*, Brown.—Marsouin.
19. " *compressa*, Mont.—Marsouin.
20. *Lucina flexuosa*, Gould.—Ste. Anne ; Ruisseau Vallée and Marsouin.
21. *Lima subauriculata*, Mont .—Ste. Anne.
22. *Mytilus edulis*, Linn.—Whole coast below Kamouraska.

23. *Modiola discors*, Linn.—Ste. Anne ; Marsouin.
24. " *plicatula*, Lam.—Vicinity of Gaspé Bay.
25. " *glandula*, Tott.—Ste. Anne ; Ruisseau Vallée ; Marsouin.
26. " *pectinula*, Gould.—Ruisseau Vallée ; Marsouin.
27. " *nexa*, Gould.—Ruisseau Vallée.
28. *Nucula myalis*, Couth.—Numerous localities on the Gaspé coast.
29. " *tenuis*, Turt.—Capucin ; Ste. Anne ; Ruisseau Vallée.
30. *Pecten Magellanicus*, Lam.—Ste. Anne ; Claude and Gaspé Bay.
31. " *Islandicus*, Müll.—Whole coast below Metis.
32. *Anomia ephippium*, Linn.—Ste. Anne ; Marsouin.

(*Fresh Water.*)

33. *Unio complanatus*, Lea.—Living in the St. Lawrence as far down as Berthier. Valves both of this species and of *U. radiatus* were frequently found on the beach the whole way to Gaspé. They had probably drifted from the fresh water of the St. Lawtence, as no species of *Unio* was found in any of the rivers or lakes of our present district.
34. *Margaritana arcuata*, Barnes sp.—Green and Rimouski Rivers, and both the Matapedia Lakes.
35. *Anodonta subcylindracea*, Lea.—Grand Lac (ten miles south of Rimouski Village) ; Lake Matapedia ; small lake six miles S. W. of Metis.
36. " new species.—Berthier.
37. " *edentula*, Say.—Lake Matapedia.
38. " *fragilis*, Lam.—Metis Lakes.
39. " *implicata*, Say.—Berthier.
40. *Cyclas similis*, Say.—Metis Lakes and a small lake six miles S. W. of Metis.
41. " *dubia* (?), Say.—Throughout the district.
42. " (undetermined).—Ste. Anne.

CLASS BRACHIOPODA.

1. *Hypothyris psittacca*, King.—Ste. Anne ; Ruisseau Vallée ; Marsouin. Abundant.

CLASS POLYZOA.

Order Cheilostomata.

The Polyzoa dredged at Marsouin on the north coast of Gaspé, were kindly determined by Dr. J. W. Dawson, Principal of McGill College. The following is his communication in full.

The Polyzoa in Mr. Bell's Collections are numerous and fine, but much time and care would be required for their accurate determination. The appearances presented in various stages of growth and preservation, are so perplexing, and the characters given for the species of authors, of so little value, that little can be done with a collection of dead cells, except to indicate the described species with which they seem to be identical. The following species were all attached to dead shells and stones, from a depth of about thirty fathoms.

1. *Hippothoa catenularia*, Jameson.
2. " *divaricata*, Elliot.
3. " *expansa.*] New species. Description. Cells oval, depressed, and expanded at the sides, not contracted at the base, branching dichotomously. When magnified the surface presents indistinct transverse wrinkles and delicate longitudinal lines. Aperture, small, round, with a slight sinus. Texture hyaline, but less delicate than *H. divaricata.*

   All the three species above mentioned are found associated on small pebbles and shells.
4. *Lepralia pertusa*, Thompson.—Very abundant.
5. " *Peachii*, Johnston.—Very abundant also.
6. " *trispinosa*, Johnston.—Abundant.
7. " *hyalina* ? *, Johnston.—Rare.
8. " *punctata*, Hassal.—Rare.
9. " *puncturata*, Busk.—A little group of three cells on a shell of *Mactra ovalis* have the precise characters of this species, obtained by Busk from the English Crag. It appears still to live, though as a rare species, in the Gulf of St. Lawrence.
10. " *Belli*. New species. Description. In large patches. Young cells granular, semi-hyaline, confluent; mouth immersed, sinuated, with a vibraculum or avicularium inside the middle of the lower lip; ovi-cells rounded, granulous like the cells. Old cells white, opaque, flat above, and separated by a deep sinuous furrow. Cells having a strong tendency to form rows radiating from the centre of the patch. I can find no described species possessing the above characters. It is allied to *L. concinna*, Busk, but differs in essential points from his description and figure.
11. " *plana*. New species. Description. Cells flat, confluent, shallow; walls deeply and irregularly furrowed; mouth rounded above, straight below, often with a narrow sinus in the middle. Young cells hyaline; old cells, opaque and deeply furrowed in a stellate manner. Forms very thin and flat expanding crusts. *L. adpressa*, Busk, from Chiloe, resembles it more nearly than any other species known to me.
12. *Membranipora Lacroixi*, Busk, or a nearly allied species.
13. " *lineata* *, Busk, *Flustra lineata*, Fabricius, "Fauna Groenlandica."

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* The species marked thus were found by Fabricius in Greenland.

14. *Cellepora pumicosa* *, Ellis.—On Sertularia.
15. " *cervicornis*, Borlase.
16. " *ramulosa*, Linn.,—or allied species.
17. *Carbasea papyrea*, Gray.—The frond is narrower than in British examples, but the cells are of the same form.
18. *Diastopora obelia*, Fleming, or closely allied species.
19. *Tubulipora flabellaris.** Fabricius.
20. " *hispida.** Johnson.—It is the *Madrepora verrucaria* of Fabricius.
21. " *phalangea* ? * Couch—Of the form of *T. flabellaris*, but dotted with pores and having larger tubes, which are grouped in bundles. Perhaps it is *T. densa*, Stimpson. Its colour is often light blue. Fabricius seems to have seen it and placed it with *T. flabellaris.*
22. *Cellularia* (species undetermined.)

Many more species were dredged but have not yet been determined.

RADIATA.

CLASS ECHINODERMATA.

Order Asteroidea.

1. *Ophiocoma bellos*, Link.—Ste. Anne and Marsouin ; abundant.
2. " *Gordsiri* ? Forbes.—Marsouin.
3. *Astrophyton scutatum*, Link.—Green Island; Gaspé Bay ; St. Nicolas (north shore). Said to be common on the coast of Rimouski.
4. *Cribella oculata* (?) Pennant.—Near Ste. Anne.
5. *Solaster papposa*, Linn.—Marsouin.
6. *Asteracanthion polaris*, Müll.—Very abundant along the whole coast below Rimouski.
7. " *rubens*, Linn.—Les Islets.

Order Echinoidea.

8. *Echinarcahnius Atlanticus.*—On muddy and sandy bottoms, along the whole coast below Rimouski.
9. *Echinus granularis*, Lam.—Whole coast below Rivière du Loup.

Order Holothuridea.

10. *Cucumaria communis*, Forbes.—Between Cape Chat and Ste. Anne ; abdt.
11. *Psolus phantapus*, Linn.—Various localities between Metis and Ste. Anne.

CLASS ACALEPHÆ.

Order Hydroidea.

1. *Sertularia polyzonia* *, Johnston.—Dredged off Marsouin.
2. " *argentea* *, Ellis.— " "
3. " *filicula*, Ellis.— " "
4. " *latiuscula*?, Stimpson, or a closely allied species.

None of the above have ovicapsules.

Six or more different Sponges, some of them beautiful forms, were collected.

* Found by Fabricius in Greenland.

PLANTS.

I am indebted to Mr. D'Urban, late of the Geological Survey, for preparing the following catalogue of Plants collected by me in the eastern peninsula of Lower Canada. Numerous species, about which Mr. D'Urban was in doubt, were kindly determined by George Barnston Esq., of the Hudson's Bay Company.

Ranunculaceæ.

1. Anemone Pennsylvanica, Linn.—F. F.*, August 12th, Metis.
2. Thalictrum cornuti, Linn.—F. F., July 16th, Ste. Anne.
3. Ranunculus repens, Linn. " " "
4. " acris, Linn. " " "
5. " (undetermined).—No flower, September 1st, River Restigouche.
6. Caltha palustris, Linn.—F. F., June 5th Rimouski.
7. Aquilegia Canadensis, Linn.—F. F., May 16th, L'Islet.

Nymphœaceæ.

8. Nuphar advena, Ait., (a very small form.)—F. F., August, west end of Lake Matapedia.

Sarraceniaceæ.

9. Sarracenia purpurea, Linn.—F. F., June, Ste. Anne.

Fumariaceæ.

10. Corydalis aurea, Pursh.—F. F., August 30th, Restigouche River.

Cruciferæ.

11. Sinapis arvensis, Linn.—F. F., July 11th, Ste. Anne.

Violaceæ.

12. Viola cucullata, Ait.—F. F., May 30th, St. Simon.

Cistaceæ.

13. Hudsonia tomentosa, Nutt.—F. F., August 31st, River Restigouche.

Parnassiaceæ.

14. Parnassia Carolinianum, Michx.—F. F., August 30th.

Caryophyllaceæ.

15. Silene inflata, Smith.—F. F., July 6th, Ste. Anne.
16. Mœhringia lateriflora, Linn.—F. F., July 23rd, Portage between Martin and Marsouin rivers.
17. Spergula arvensis (?), Linn.—No flower, August 12th, Metis.

Oxalidaceæ.

18. Oxalis acetosella, Linn.—Very abundant up the River Marsouin.
19. " stricta, Linn.—Going to seed, August 30th, River Restigouche.

Anacardiaceæ.

20. Rhus Toxicodendron, Linn.—Fruit ripe, August 31st, River Restigouche.

Sapindaceæ.

21. Acer spicatum, Linn.—Abundant everywhere on low land; just out of flower, July 5th, Ste. Anne. In seed, Sept. 11th, mouth of the Awaganasees Brook.
22. " saccharinum, Wang. (Hard Maple).—On rich soil only.

* F. F. in full flower.

Leguminosæ.

23. Trifolium repens, Linn.—Abundant round clearings, &c., throughout the district.
24. Desmodium Canadense, D. C.—F. F., August 12th and 31st, River Restigouche.
25. Vicia Cracca, Linn.—F. F., July 11th, Ste. Anne.
26. Lathyrus palustris, Linn.—F. F., August 4th, mouth of the Marsouin.
27. Oxytropus Lamberti, (?) Pursh.—F. F., August 31st, River Restigouche.

Rosaceæ.

28. Prunus pumila, Linn.—Fruit nearly ripe, August 31st, River Restigouche.
29. " Pennsylvanica, Linn.—Abundant throughout the Counties of Rimouski and Bonaventure.
30. " Virginiana, Linn.—Fruit ripe, Sept. 1st, River Restigouche.
31. Agrimonia Eupatoria, Linn.—In seed, August 21st, fifteen miles up the River Matapedia.
32. Potentilla anserina, Linn.—F. F., August 4th, mouth of the River Marsouin.
33. Fragaria Virginiana, Ehrhart.—Grass land throughout the district. Fruit ripe beginniug of July, Ste. Anne.
34. Rubus triflorus, Rich.—Fruit ripe, July 12th, Ste. Anne; mouth of the Awaganasees.
35. " strigosus, Miche.—Extremely abundant on burnt land and about fences throughout the district.
36. Rosa blanda, Ait.—In blossom, July 5th and 20th at Ste. Anne, and August 12th at Metis.
37. Cratægus tomentosa, Linn.—River Restigouche.
38. Pyrus Americana, D. C.—Moderately abundant throughout the district.

Onagraceæ.

39. Epilobium augustifolium, Linn.—F. F., July 16th, Ste. Anne.
40. " coloratum, Muhl.—In seed, July, three miles up the River Marsouin.
41. Œnothera biennis, Linn.—F. F., July 11th, Ste. Anne; August 30th, mouth of the River Matapedia.
42. Circæa Alpina, Linn.—In flower, July 31st, mouth of the River Marsouin.

Saxifragaceæ.

43. Mitella nuda, Linn.—Seed ripe, July, 3 miles up the River Marsouin.

Umbelliferæ.

44. Heracleum lanatum, Michx.—F. F., July 16th, Ste. Anne.
45. Sium lineare, Mich.—F. F., August 12th, Metis.

Cornaceæ.

46. Cornus Canadensis, Linn.—F. F., July 5th, Ste. Anne.
47. " stolonifera, Michx.—F. F., June, Ste. Anne.

Caprifoliaceæ.

48. Linnea borealis, Gronov.—F. F., June, Ste. Anne, and abundant everywhere.
49. Lonicera ciliata, Muhl.—In fruit, July 30th, Marsouin river.
50. Diervilla trifida, Mænch.—F. F., August 30th, River Restigouche.

51. Sambucus Canadensis, Linn.—Abundant on low land.
52 Viburnum opulus, Linn.—F. F., July 16th, St. Anne.

Compositæ.

53. Eupatorium purpureum, Linn.—F. F., Sept. 3rd, mouth of the River Patapedia.
54. " ageratoides, Linn.—F. F., July 31st, mouth of the River Marsouin, and August 30th, River Restigouche.
55. Aster miser, Linn, Ait.—F. F., August 12th, Metis.
56. " simplex, (?) Willd.—" " "
57. " longifolius,(?)Lam.—" " "
58. Diplopappus umbellatus, Torr. and Gr.—F. F., June 30th, mouth of the River Matapedia.
59. Solidago bicolor, Linn.—Going out of flower, August 30th, River Restigouche.
60. " Canadensis, Linn.—F. F., August 12th, Metis.
61. Achillea millefolium, Linn.—F. F., July 11th, Ste. Anne, and mouth of the Awaganasees, September.
62. Leucanthemum vulgare, Lam.—F. F., July 4th, Ste. Anne, and August 30th, River Restigouche.
63. Cirsium Muticum, Michx.—F. F., August 30th, mouth of the River Matapedia.
64. " pumilum (?), Spreng.—Out of flower, August 30th, River Restigouche.
65. Hieracium Canadense, Michx.—F. F., August 30th, River Restigouche.
66. Nabalus racemosus, Hook. ("variety with truncate and obcordate leaves." G. B.)—August 30th, River Restigouche.

Lobeliaceæ.

67. Lobelia Kalmii, Linn.—F. F., August 30th, River Restigouche.

Campanulaceæ.

68. Campanula rotundifolia, Linn.—F. F., August 4th, mouth of the River Marsouin, and August 30th, River Restigouche.

Ericaceæ.

69. Vaccinium Pennsylvanicum, (?) Lam.—In great profusion on hills which had been burnt over.
70. Chiogenes hispidula, Torr. aud Gr.—In great abundance throughout the district.
71. Andromeda polifolia, Linn.—F. F., July 16th, Ste. Anne.
72. Pyrola rotundifolia, Linn.— " " "

Plantaginaceæ.

73. Plantago maritima, Linn.—F. F., August 4th, mouth of the River Marsouin.

Primulaceæ.

74. Primula farinosa, Linn.—Abundant all along the southern shore of the Gulf. F. F.., end of May and June.

Lentibulaceæ.

75. Utricularia vulgaris (?) Linn.—Metis.

Scrophulariaceæ.

76. Chelone glabra, Linn.—F. F., August 12th, Metis.
77. Veronica Americana, Schweinitz.—Nearly out of flower, July 12th, Ste. Anne.
78. Pedicularis Canadensis, Linn.—F. F., August 10th, Matan.

Labiatæ.

79. Lycopus Virginicus, Linn., (a very coarse form).—In flower, August 30th, River Restigouche.
80. Brunella vulgaris. Linn.—In flower, July 11th. Ste. Anne.
81. Scutellaria nervosa, Pursh.—In flower, August 12th, Metis.

Borraginaceæ.

82. Mertensia maritima (?), Don.—In flower, beginning of July, Ste. Anne.

Apocynaceæ.

83. Apocynum androsæmifolium, Linn.—F. F., August, between Metis and Lake Matapedia.

Asclepiadaceæ.

84. Asclepias cornuti, Decaisne.—Abundant all along the Restigouche.

Oleaceæ.

85. Fraxinus sambucifolia, Lam., (Black Ash).—In valleys, and along the shores of the Lakes.

Polygonaceæ.

86. Rumex acetosella, Linn.—Coming into flower, July 16th, Ste. Anne.

Urticaceæ.

87. Ulmus Americana, Linn., (Swamp Elm).—Very abundant, and of large size, along the River Restigouche.

Cupuliferæ.

88. Corylus rostrata, Ait., (Hazel-nut).—Marsouin River.

Betulaceæ.

89. Betula papyracea, Ait., (White Birch).—The most abundant deciduous tree throughout the eastern peninsula, and reaching a large size.
90. " excelsa, Ait., (Yellow Birch).—Most abundant round Lake Matapedia, and in the valleys of the Rivers Marsouin and Restigouche; generally associated with Hard Maple on rich soil.
91. Alnus incana, Willd., (Alder.)—Everywhere bordering the streams and rivers, forming dense thickets.

Salicaceæ.

92. Populus tremuloides, Michx., (Common Poplar).—Abundant on high lands.
93. " balsamifera, Linn., (Balsam Poplar, Balm of Gilead).—Abundant on the borders of rivers and lakes.

Coniferæ.

94. Pinus resinosa, Ait., (Red Pine).—Abundant, but of small size, along the upper part of the River Patapedia.
95. " strobus, Linn., (White Pine).—Abundant everywhere.

96. Abies balsamea, Marshall, (Balsam Fir).—Very abundant.
97. " nigra, Poir., (Black Spruce).—The principal, and in many places the sole tree covering the hilly country of the eastern peninsula.
98. " alba, Michx., (White or "Sea Spruce" of the Indians).—The commonest tree along the coast and rivers.
99. Larix Americana, Michx., (Tamarack).—Rather scarce, but occurring in every variety of situation throughout the district.
100. Thuja occidentalis, Linn., (White Cedar).—Very abundant in the vallies of all the rivers, reaching a very large diameter, but no great height.
101. Taxus baccata, Linn., var. Canadensis, (Ground Hemlock).—Abundant amongst trees on low ground.

Alismaceæ.

102. Sagittaria variabilis, Engelm.—F. F., August 15th, Metis.

Orchidaceæ.

103. Platanthera flava, Gray.—F. F., September 1st, River Restigouche.
104. " psycodes, Gray.—F. F., August 17th, West end of Lake Matapedia.
105. Spiranthes decipiens, (?) Hooker.—Coming into flower, July 30th, Marsouin River.
106. Corallorhiza Macræi, Gray.—Going to seed, July 31st, three miles up the River Marsouin.

Iridaceæ.

107. Iris versicolor, Linn.—F. F., July 4th, Ste. Anne.
108. Sisyrinchium Bermudianum, Linn., (variety mucronatum, Gray).—In flower, July 16th, Little Ste. Anne.

Smilaceæ.

109. Trillium erectum, Linn., (very large).—Fruit ripe, July 31st, three miles up the Marsouin River.

Liliaceæ.

110. Smilacina stellata, Desf.—F. F., June, Ste. Anne.
111. " bifolia, Ker.—In seed, but not ripe, July 20th, Marsouin River.
112. Clintonia borealis, Raf.—Throughout the district.

Melanthaceæ.

113. Streptopus roseus, Michx.—F. F., June, Ste. Anne.
114. Tofielda glutinosa, Willd.—Seed ripe, August 30th, River Restigouche.

Cyperaceæ.

115. Eriophorum vaginatum, Linn.—Ste. Anne.

Gramineæ.

116. Phleum pratense, Linn., (Timothy).—Table-topped Mountain, 3800 ft. above the sea; upper part of Magdalen River; grows luxuriantly along roadsides, in openings in the woods &c.
117. Calamagrostis Canadensis, Beauv.—Shickshock Mountains.
118. Elymus Canadensis, Linn.—River Restigouche.

119. Avena striata, Michx.—(Trisetum purpurascens, Torr.) Shickshock Mountains.

Equisetaceæ.

120. Equisetum pratense, Ehrh.—Metis.

Filices.

121. Asplenium felix-fœmina, R. Br.—Mouth of the Awaganasees Brook.
122. Aspidium spinulosum, Swartz.— " " "
123. Osmunda regalis, Linn.—Round Metis Lake, &c.
124. Botrychium Virginicum, Swartz.—Fertile fronds ripe, July 28th, River Marsouin.

Lycopodiaceæ.

125. Lycopodium lucidulum, Michx.—In fruit Sept. 1st, River Restigouche.
126. " dendroideum, Michx.— " " "
127. " clavatum, Linn.,— " " "
128. " complanatum, Linn.,— " " "

Musci.

129. Polytrichum commune. Linn.—Collected on the River Marsouin.
130. Hypnum splendens, Hedw.— " " "
131. " Schreberi, Willd.— " " "
132. " Crista-Castrensis, L.— " " "
133. " reptile, Michx.— " " "

Lichenes.

134. Peltigera aphthosa (?) Hoffen, infert. River Marsouin.
135. Sticta pulmonaria, Ach.— " "