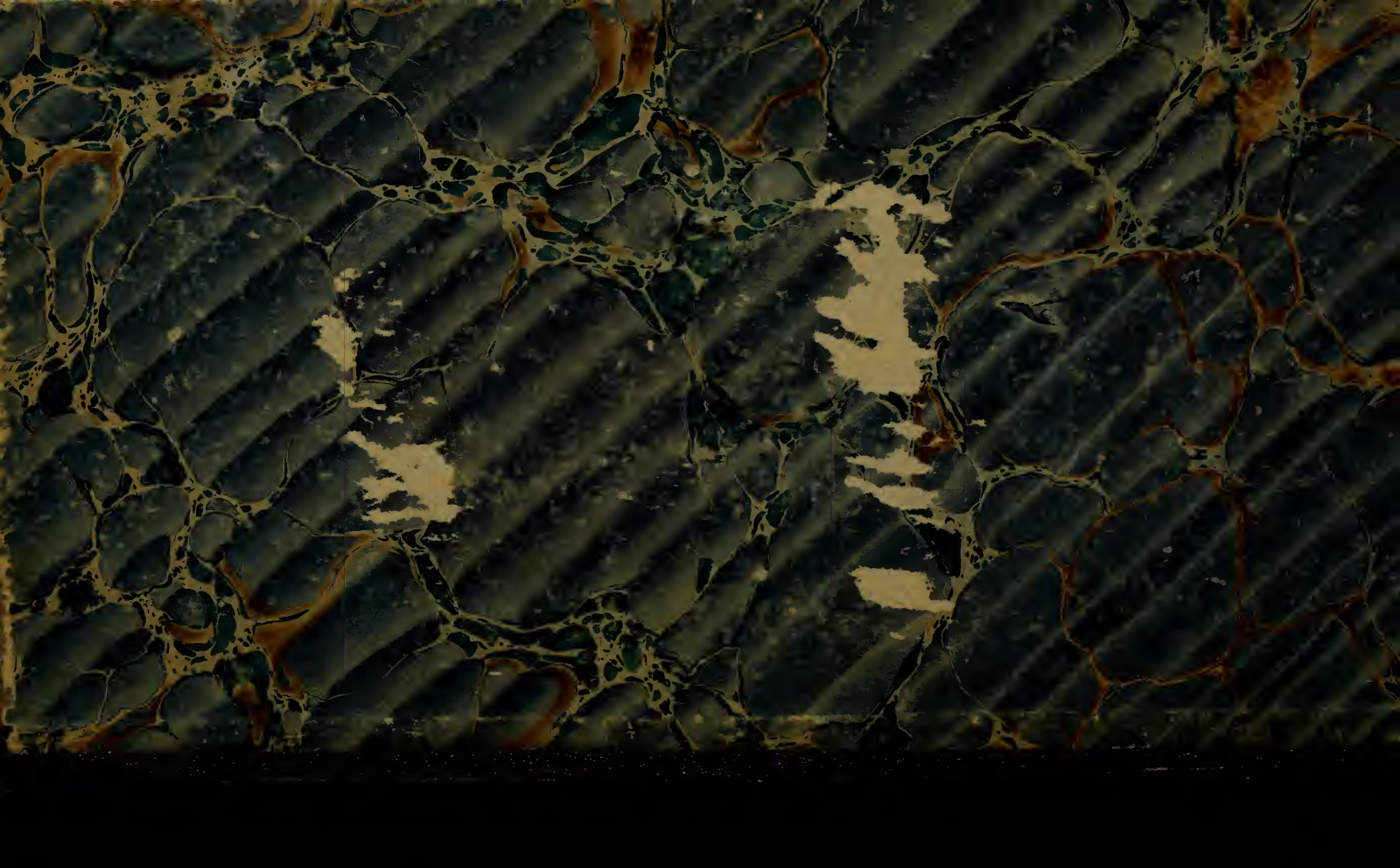

GEOLOGICAL SURVEY

OF

CANADA.

REPORT OF PROGRESS

FOR THE YEAR 1846–7.

Montreal:
LOVELL & GIBSON, PRINTERS, ST. NICHOLAS STREET.
1847.

GEOLOGICAL SURVEY

OF

CANADA.

REPORT OF PROGRESS

FOR THE YEAR 1848-49.

Printed by order of the Legislative Assembly.

TORONTO:
PRINTED BY LOVELL AND GIBSON,
1850.

GEOLOGICAL SURVEY

OF

CANADA.

GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 1*st May*, 1849.

SIR,

I have the honor to request you will do me the favor to place before His Excellency the Governor General, the accompanying Report of the Progress made in the Geological Survey of the Province, during the year 1848–49.

I have the honor to be,

Sir,

Your most obedient servant,

W. E. LOGAN,
Provincial Geologist.

To the Honble. James Leslie,

Provincial Secretary,

&c., &c., &c.

TO HIS EXCELLENCY

THE RIGHT HONORABLE

JAMES, EARL OF ELGIN AND KINCARDINE, K. T.,

BARON BRUCE OF KINROSS AND OF TORRY,

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, 1*st May*, 1849.

MAY IT PLEASE YOUR EXCELLENCY:

Having already placed before your Excellency, on the 17th January last, a Report on the Geology of the country on the north shore of Lake Huron, the examination of which engaged my attention during the chief part of the past season, I have now the honor to transmit the Reports of my Assistants, Mr. Murray and Mr. Hunt, displaying the extent to which, in the course of last year, their labors have advanced the Survey committed to my charge. The Report of Mr. Murray comprehends the result of his examination of various parts of the coast of Lake Huron, independent of those in which he personally aided myself; and that of Mr. Hunt, the analyses of various mineral springs existing in both sections of the Province, and various metallic ores, the latter in addition to those which have been already incidentally mentioned in my own Report.

Independent of the three months occupied on the north shore of Lake Huron, a portion of my time during the past season was employed, in company with Mr. Hunt, in the examination of cer-

tain test facts, bearing on the physical structure of the Green Mountains of Vermont, in their prolongation into Canada, as set forth in the Report of Progress for 1847–48, which I had the honor of transmitting to Your Excellency on the 26th March last. Previous to leaving the Eastern Townships for Lake Huron, and subsequent to my return, farther examinations were made in the vicinity of the St. Francis, preparatory to continuing the investigation of the formations of those Townships, in their extension beyond the Chaudière to the Temiscouata Road; but as it is proposed to prosecute the examination of this part of the country during the approaching season, it is considered expedient to reserve the preparatory and desultory facts ascertained, until they can be combined with others in the district in question, in a future Report.

I have the honor to be,

Your Excellency's

Most obedient servant,

W. E. LOGAN,

Provincial Geologist.

REPORT

OF

ALEX. MURRAY, ESQ., ASSISTANT PROVINCIAL GEOLOGIST,

ADDRESSED TO

W. E. LOGAN, ESQ., PROVINCIAL GEOLOGIST.

MONTREAL, 20*th January*, 1849.

SIR,

Pursuant to your instructions, my attention has been devoted during the past season to extending the investigations of the previous year (1847) by a farther examination of the shores, islands and rivers of Lake Huron.

Subsequent to a short excursion in the early part of May, up the Ouse or Grand River, to ascertain the nature of the rocks, near Galt, in the Township of Dumfries, I proceeded to Penetanguishene, where I joined the party that were to accompany me, on the 18th of the month, and after re-inspecting several points between this and Cabot's Head, and again touching at the Manitoulin Islands, collecting fossils and mineralogical specimens whenever occasion offered, we coasted along the Isle of Coves and Cape Hurd, to the Rivière au Sable (north) and the Sauguine. From the Sauguine we proceeded to Goderich, occupying several days in the examination of the rocks on the Ashfield, Maitland, and Bayfield Rivers, and continued our course to Cape Ipperwash, generally known by the name of Kettle Point, then farther on to Port Sarnia, and by River and Lake St. Clair to Windsor, in the Western District, which we reached in the end of June. From Detroit we passed by steamboat to Sault Ste. Marie, which we left on the 8th July to join you at the Bruce Mines, and assist you in the examination of these mines, and of the Rivers Thessalon and Mississagui. On our way down the St. Mary's River, we determined, agreeably to your desire, the difference of level between the

head and foot of the Neebeesh Rapids, with the view of accurately ascertaining the relative heights of Lakes Superior and Huron, and I may here state the result to be as follows:—

	Ft.
Rise in Little Neebeesh Rapids	0.90
Rise in Upper Sugar Island Rapid, American side	0.51
Allowance for imperceptible currents in a distance of 25 miles, 0.75 inch. per mile,	1.50
Difference between the level of Lake Huron and the foot of Sault Ste. Marie	2.91
Rise in Sault Ste. Marie	18.50
Height of Lake Superior over Lake Huron	21.41

After separating from you on the 5th September, we proceeded to the Hudson Bay Company's Post at La Cloche, and there placing our boat in security, and obtaining canoes, we effected a partial survey of the coast between the Post and the mouth of the Spanish River. This river we subsequently ascended, in conformity with your instructions, and after accomplishing an examination and measurement of about sixty miles of its length, in addition to seven miles on one of its principal tributaries, we farther extended our survey to the streams, lakes and portages which occur on the Indian route, in a north and south line between the river and the coast at La Cloche. Finally, after a brief inspection of the Wallace Mining location, we concluded the season's operations by examining parts of the east coast of Georgian Bay, on our way back to Penetanguishene, where we arrived on the 22nd October.

WESTERN AND HURON DISTRICTS.

General Description of the Coast.

Of the east side of the promontory separating Georgian Bay from the main body of Lake Huron, a general description was given in the Report of last year. The west side is marked by characteristics similar to those which in the same Report were stated to belong to the south side of the great Manitoulin Island. At all parts from Cape Hurd to Rivière au Sable (north) the coast

is low, rocky and rugged, and scantily clothed with a dwarfish growth of evergreen trees. It is deeply indented by numerous bays and creeks, and at intervals, bound by groups of small, low and usually barren islands of limestone. As is the case on the southern shores of the Manitoulins, these bays, though frequently capacious, rarely constitute good harbors, the approach to them being at times extremely dangerous, even for vessels of small draught, owing to the shallows which extend for a long distance out into the lake, consequent upon the low westerly dip of the calcareous strata composing the promontory. Safe and commodious places of resort, however, for vessels navigating the lake, are not altogether wanting, and among these probably the best is the harbour of Tobermory, near Cape Hurd, well known to most persons who have frequented this part of the coast. Boats can find shelter in many places, either in coves or creeks, or among the islands, and at the mouth of the Rivière au Sable (north), there is an excellent boat harbour, but a sand-bar at the entrance effectually prevents the admission of vessels drawing over three feet.

Losing its rocky nature, a decided change takes place in the character of the coast, at the Rivière au Sable (north), about the mouth of which, and for several miles south, sand dunes prevail; and farther on, a beach of sand, strewed over in parts with boulders, extends some distance beyond the Sauguine. Between the two rivers there is no harbour of any description, and with strong northerly or westerly winds, it is next to impossible to effect a landing, in consequence of the barriers of boulders which lie along the shore at considerable distances from the land, the shallowness of the approach, and the heavy surf which rolls in from the lake. Bordering the lake along the sandy tract there is no amelioration in the timber, which consists for the most part of a mixture of inferior evergreens, with small white birches and cedars, until approaching the Sauguine, where a gradual but evident improvement in the nature of the soil is indicated by the more frequently recurring presence of good sized pines, accompanied with maple, elm and birch. The mouth of the Sauguine affords a good harbour for boats and small craft, but as is the case with all the rivers of the coast, a bar is formed across its entrance, over which a heavy sea breaks when the wind is at all strong from any point

between south west and north: its entrance, under such circumstances, is difficult, and attended with considerable danger. At a very short distance up from its junction with the lake, the river becomes rapid and is no farther navigable except for canoes or small boats, and rapids occur at intervals to the highest part we reached, which might be about five miles from the mouth. In these five miles the river flows between banks of clay, gravel and sand, frequently rising boldly to heights of between twenty and a hundred feet over the water; the surface of the country on both sides is flat or gently undulating, and while in many parts it bears a heavy growth of pine timber, in others it yields maple, elm, ash, and other hardwood trees of good size. About two miles from the mouth, on the right bank of the river, there is an Indian settlement, from which a portage has been cut across the peninsula to the Indian Village of Neewash, at the head of Owen's Sound. The territory to the North of the portage being exclusively an Indian Reserve, remains in its primeval state of wilderness; and with the exception of a building which was raised some years ago by a fishing company at Gaheto, or Fishing Island, there is not a single dwelling house on any part of the coast all the way to Cape Hurd, a distance of nearly sixty miles.

Following the coast south from the Sauguine, the land is low, with a beach alternately of sand and boulders, for about six or seven miles, beyond which occasional ledges of rock appear, until reaching the Little Pine River, which enters the lake to the south of Point Douglas. Beyond the Little Pine River the land becomes more elevated, and the character of its forest proclaims a still further improvement in the soil. At the outlet of a stream, dignified, though a mere brook, with the name of the Big Pine River, in which the epithet Big, however, is probably intended to qualify the wood rather than the water, the surface is thickly grown over with pine of large size, and before reaching Point Clark, some nine miles farther, the interior appears to consist chiefly of excellent hardwood land. A beach of fine sand skirts the shore for the whole distance. From Point Clark, the coast which, from the mouth of the Rivière au Sable (north), has a general bearing about S.W. by W., turns due south, and maintaining this course to Port Frank, in the Township of Stephen, a distance of fifty miles, presents to

the lake, in almost all parts, steep and lofty cliffs of clay, the summit of which spreads back into an extensive level country, producing a luxuriant vegetation of the heaviest description of hardwood trees. At Port Frank the trend of the coast changes to south west, and again with the adjacent country becomes sandy, presenting innumerable sand dunes, which extend several miles back, and in many instances rise to the height of a hundred feet and more over the surface of the lake. This character prevails to the mouth of the Rivière au Sable (south), and beyond it to within a short distance of Cape Ipperwash or Kettle Point, which is about fifteen miles from Port Frank. Kettle Point displays a few flat rocks coming to the water's edge, but beyond it a fine sandy beach, with high cliffs of clay rising at a short distance back, hold the coast line to within two miles of the entrance of the St. Clair River, where the country again appears to assume an arenaceous character.

In the direction in which we proceeded along this coast, settlements first appear a short distance to the south of Point Clark, the forest being here and there indented with extensive clearings which increase in size and number, approaching Goderich. South from Goderich the principal settlement we observed was at Bayfield River, but the rest of the coast between that river and Port Sarnia, on the St. Clair, is as yet but thinly peopled. Kettle Point and the neighbourhood are still, I understand, in the possession of the Indians, and are in consequence but little cultivated.

With the exception of Goderich harbour, at the mouth of the Maitland River, and the basin at the exit of Rivière au Sable (south), there is not a single place of security for any description of vessel between the River Sauguine and the St. Clair. Small boats, I was informed, could enter Big Pine Brook, but no craft of larger size. There are no islands, no coves, no accessible brooks or streams, and with strong winds from the south, west or north, it is difficult, if not impossible, to land boats with safety. At many points the water is very shallow and large boulders often lie at a long distance out in the lake, while a very heavy sea breaks every where along the coast.

Distribution of the Rock Formation.

The rocks exhibited upon that part of the Lake Huron now under consideration, are portions of the whole suite of fossiliferous deposits between the Trenton Limestone (using the New York nomenclature,) at the base, and the Hamilton Group at the summit, both inclusive; the superposition, in ascending order, being as follows:

1. Trenton Limestone,
2. Utica Slate,
3. Loraine Shale,
4. Medina Sandstone and Marl,
5. Niagara Limestone,
6. Onondaga Salt Group, or Gypsiferous Limestone and Shale,
7. Corniferous Limestone,
8. Hamilton Group,

1. *Trenton Limestone.*

As already remarked in former Reports, the Trenton Limestone occupies the whole of the Peninsula between Matchedash and Nottawasaga Bays, and the group of islands lying off its extremity, consisting of the Giant's Tomb, Hope, Beckwith and Christian Islands. At the head of Matchedash Bay, near the entrance to the Cold Water River, the limestones are found with a narrow band of green sandstone below them, resting unconformably upon gneiss, and from that spot a nearly straight line drawn down the Bay to the Giant's Tomb, would mark the lower boundary of the formation, the limestone being seen out-cropping at intervals on the south west shore, while the islands and mainland on the opposite side display nothing but the older rock in its various granitic and syenitic aspects. The upper members of the Trenton formation were found about eight miles west from Nottawasaga River at McGlashan's Mills, at Hurontario in the Township of Nottawasaga, at the little islands, called the Hen and Chickens, and on the coast in the N.W. corner of the Township of Nottawasaga, where they were seen to pass below the Utica slate. The transverse breadth of the formation is thus about thirty miles, and its thickness, supposing the dip to be to the south-westward at the rate of thirty feet in a mile, would be 900 feet. But it is not unlikely that it may be affected by very gentle undulations and it would therefore be scarcely safe to state the

probable amount at more than 600 to 700 feet. That arenaceous portion of the formation, distinguished by the New York geologists as the Calciferous sand-rock, is usually found at the base, and beds more or less silicious occur at intervals throughout the whole thickness. Green calcareous and argillaceous shales are also frequently met with, usually holding numerous fossils, and alternating with beds of good limestone; the pure limestones are sometimes of a buff color and very fine texture, in which case fossils are scarce, those in such instances most prevalent, being small fucoids generally replaced by calcareous spar, running through the beds vertically to the plane of stratification. Other beds are gray in color, granular and crowded with fossils. Among these beds some hold the tail of a trilobite *(Isotelus gigas)* in great abundance, while others are almost exclusively composed of the remains of a species of *Leptena*. The fossils observed to prevail throughout the formation were several species of *Leptena*, *Cypricardia*, several spiral univalves, ortheceratites, trilobites, chiefly *Isotelus gigas*, encrinites, corals and fucoids.

In the variations in mineral quality in different parts of the formation, some beds are so very arenaceous and hard as to be altogether unfit for burning into lime, or where not too silicious for such a purpose, the lime assumes when slacked such a dark yellow color as to unfit it for white-washing, while it permits but a small admixture of sand in forming mortar. Other beds on the contrary are uncommonly free from silicious matter, and are then often bituminous, and sometimes have a slightly argillaceous aspect. The lime from these beds is of excellent quality.

2. *Utica Slate.*

Black bituminous shales come to the surface on the coast of Nottawasaga Bay, in the fourth concession of Collingwood, with beds of close-grained, dark-brown bituminous limestone interstratified. The limestones contain fossils, but by no means in such abundance as the shales, which are uncommonly productive, the prevailing fossil being the tail of the *Isotelus gigas*, which greatly predominates, but is accompanied by *Triarthus beckii*, *Orthis*, *Lingula*, *Orthoceras and Graptolithus.*

3. *Loraine Shale.*

The first exposure of the formation we met with on our route along the coast was near Cape Boucher, in Nottawasaga Bay, where cliffs rising abruptly to the height of 150 feet, present sections of buff or drab-colored argillaceous shales, interstratified with thin beds of gray yellow-weathering sandstone. It next makes its appearance at Point Rich, and continues exposed, in a high nearly vertical cliff, thence to Point William, where we found blue and drab-colored argillaceous shales, with thin alternations of calcareous sandstone and thin beds of limestone. The upper part of the formation was observed in a cliff about 100 feet high at the head of Owen's Sound, immediately over the steam-boat wharf, where the base of the precipice displayed shales of a similar character to those at Point William, which were overlaid by hard beds of gray or brownish yellow-weathering silicious limestone capping the summit. Portions of the formation are seen at Cape Commodore, on the islands opposite to Colpoy's Bay, at Cape Croker, and other parts of the coast, until reaching Cabot's Head, where they were observed to pass below the Medina rocks, as noticed in the Report of last year. If a straight line were drawn from Point Rich to Cape Croker, to represent the outcrop of the base, the formation would have a breadth of about twenty miles at Owen's Sound, which, at the supposed slope of thirty feet in a mile, would give a thickness of about 600 feet.

Fossils are found in vast abundance, but unequally distributed through the formation. In the section near Cape Boucher they consist chiefly of stems of encrinites and pentacrinites and also fucoids, shells of all kinds being very scarce. At Point William shells are more plentiful, but not in great abundance, while at Cape Croker and Cape Montresor various species of shells occur in great numbers, in addition to encrinites, corals and fucoids. In the hard beds at the top of the formation, in Owen's Sound, we met with numerous fossils; they were principally small shells and corals, and the forms having been replaced by silica, while the imbedding matrix is calcareous, they were weathered out in relief on the exposed surfaces, being precisely in the condition in which similar remains were found in the upper beds of the same series last season, at Cabot's Head and in the Grand Manitoulin Island.

The species of *Pterinea (P. carinata)* which appears to be peculiarly characteristic of this series of rocks, is found more or less abundantly in different parts throughout the whole vertical thickness, and in great numbers at Point William, Cape Croker and Cape Montresor.

Concretionary nodules of calcareous quality, usually assuming spheroidal or sub-spheroidal shapes, are thickly scattered through the shales in some parts of the formation, and were observed in particular among the rocks in the neighbourhood of Cape Boucher.

The materials of economic importance observed associated with the Loraine shales, were stones fit for building, for tiles and flagging, with limestone and clay. For building, the hard beds at the top of the series, are of tolerably good quality, when the layers are not too thin, which however they frequently are, and some of the calcareo-arenaceous bands might be used for a rough description of tiles and flagging; but the material is of an inferior quality for either purpose. There are very few beds fit for burning into lime; an occasional one, however, is met with among the blue and drab shales. When not too calcareous, the clays derived from the disintegration of the shales constitute material of good quality for brick making. Gypsum is reported to have been found in the formation near Cape Commodore, but the only specimens of it met with by me occurred in small isolated masses of no economical importance, being such as are known to exist in the formation elsewhere.

4. 5. *Medina Sandstone and Niagara Limestone.*

A bold precipitous escarpment marking the outcrop of the Niagara limestones, was traced along the coast during the season of 1847, from Cabot's Head to Colpoy's Bay. Southward from the bight of this bay, the escarpment leaves the coast, but maintaining some degree of parallelism with it, sweeps round towards the heights over Cape Commodore, whence it runs nearly due south, keeping two to three miles distant from the west shore of Owen's Sound, until reaching the line between the Townships of Derby and Sydenham, about three miles south of the village of the latter name at the head of Owen's Sound, where it strikes to the south-eastward and crosses the Owen's Sound road. The sub-

jacent formation was not exposed at any part that we visited south of Colpoy's Bay, being concealed by detritus and forest trees, but the soil at the base of the Niagara escarpment was frequently observed to be of a red color and marly quality, leaving little doubt that it was derived from the immediate proximity of the marls of the Medina group.

The upper part of the Niagara limestones, which constitutes the south shores of the Manitoulin Islands, strikes from Horse or Fitzwilliam Island across to the Isle of Coves, then to Cape Hurd, whence it holds the coast and adjacent islands to Chiefs' Point and the Rivière au Sable (north); from this, striking into the interior, it is no more seen on the lake. Rocks belonging either to the summit of this or to the base of the succeeding superior formation were seen at Galt, on the Grand River, and beds belonging to the Niagara Group, were observed occasionally coming to the surface, on the road between Galt and Dundas, but the country north of Galt, and between it and the mouth of the Rivière au Sable (north), has not yet been examined, and I am unacquainted with the details of the grographical boundary of the summit of the formation in the interval, which is nearly a hundred miles.

Numerous fossils were observed in the Niagara limestones, but the variety was not great except among the corals, which were of many different species. The most characteristic shell was a *Pentamerus*, which extended through the whole formation, but was most abundant near the top; *Euomphalus* and other spiral genera were met with; a large bivalve of a new genus occurred in great numbers at Galt, associated with *Pentamerus*.* Among the thin-bedded limestones at the base of the formation (corresponding probably with the Clinton group portion of it,) some surfaces were thickly covered with organic remains, an *Atrypa* and a small turbinated shell chiefly prevailing. Trilobites, orthoceratites, corals and fucoids also, though in less abundance, were observed in this por-

* Since Mr. Murray's examination of the rocks at Galt, Mr. Hall, of New York, has visited the spot, and in addition to the new bivalve, above mentioned, to which he proposes to give the name of *Megalamus Canadensis*, he hasmet with other shells, two which he recognises as belonging to the Onondaga Salt Group, or Gypsiferous Limestone, and he is disposed to class the Galt rocks with that formation.—W. E. L.

tion, but principally in one place near Cape Chin, on the south side of Dyer's Bay.

The Niagara group is fruitful in excellent materials for building and lime burning. At Galt white limestone occurs of a beautiful and enduring quality for architectural purposes, for which it is extensively quarried from beds nearly horizontal, varying from one to three feet thick, and blocks may be obtained of almost any required size without much difficulty; the stone burns also to an excellent lime. At Owen's Sound, about two miles S. by E. from the village, there are unworked strata of white or pale grey limestone; the upper beds are from two to four feet thick, the lower ones occasionally over twelve feet, being all very massive; the upper beds could be quarried to an almost boundless extent, and would yield an excellent building material; the lower beds are likewise fit for building purposes, but being at the base of an abrupt escarpment could not be extensively quarried; large loose masses, however, skirt the escarpment, and these might be made available for a great length of time. All the beds would stand the weather well; many of them have occasionally been burnt by the settlers, and are said to make an excellent quality of lime. Materials of much the same sort would be found all the way to Cabot's Head. On the Rivière au Sable (north), about a mile and a half or two miles from its mouth, there are some pale greenish-blue limestone beds, one of them darker than the rest, which would all be fit for building purposes; the stone appears to resist the disintegrating influences of the weather well, but it turns under them to a blackish color. The beds are from eight to eighteen inches, and even two feet thick; they are divided by parallel joints into rhomboidal forms, and would afford blocks of any required size. At Chiefs' Point there is a limestone which presents a white or pale gray color on fracture; it has a rough pitted exterior surface, and weathers to a dark brown approaching to black; the beds are massive, ranging from two to four feet in thickness; parallel joints intersect them, and they could easily be quarried, and afford a very substantial building stone: most of the the beds are supposed to be fit for burning into lime. Lyell Island and the Fishing Islands give a stone precisely similar to that of Chiefs' Point

and under exactly similar circumstances; and so indeed does nearly the whole coast to Cape Hurd, on which the rocks, running on the strike, are exposed nearly the whole way. Hitherto the only trial that has been made of this part of the formation is on one of the Fishing Islands, where a house, to which allusion has already been made, was constructed some years ago by a fishing company for the superintendent.

6. 7. *Gypsiferous Limestone and Shale, and Corniferous Limestone.*

There are no hard rock exposures of any kind on the coast south from the Rivière au Sable (north) for upwards of seventeen miles, or on the Sauguine River so far as we ascended it. The first discovery of such strata *in situ*, on our route in that direction, was at a point about seven miles nearly S. W. from the mouth of the latter stream, where an outcrop occurs displaying buff-colored limestone, holding numerous organic remains, of which the forms were frequently replaced by hornstone. The beds were in no case at this place exposed above two feet over the level of the lake, and their approach to horizontality was so near that the eye could scarcely detect a slope. They came out at intervals along the shore, the surface of one bed being sometimes exposed for a considerable distance, and occupied altogether a space of four or five miles, beyond which another concealment occurs, continuing to within three miles of Point Douglas, where yellowish colored calcareous sandstone skirts the coast line. Proceeding along the beach towards Point Douglas, we found this sandstone associated with calcareous beds holding a large amount of hornstone, with black bituminous shales and blue and drab-colored limestones, one bed among which appeared to be hydraulic. The whole of these strata were devoid of fossils, but imperfect crystals of celestine or sulphate of strontian occurred, with quartz and calc-spar, lining drusy cavities or cracks in the rock, and numerous imbedded balls of hornstone were met with. A black band overlies the sandstone, and is of a coarse granular texture, appearing to be composed principally of an aggregation of imperfect crystals of calc-spar, while the black color results from the presence of bituminous matter, which exists in greater or less

proportion in all the beds. Ascending in the section, which at Point Douglas displays a thickness of twelve feet, thin calcareous beds of a dark brown color occur, separated by very thin layers of black bituminous shale; and over them the upper part of the cliff is occupied by thin bands of blue limestone and pale yellowish calcareous beds, sometimes over a foot in thickness, much marked by small brownish lenticular crystals of calc-spar. Between two of the beds there is a suture-like division; the two beds when separated present surfaces covered with inter-fitting tooth-like projections, the sides of which often display a fasciculated columnar structure, and a film of bituminous matter lies between the surfaces, and invests all the projections. One part or another of the non-fossiliferous section thus exposed at Point Douglas continues to occupy the coast to the southward, exhibiting gentle undulations, to a spot about half a mile beyond the Little Pine Brook where fossiliferous beds, holding much hornstone, are seen overlying the highest of the strata already mentioned, in detached isolated patches, for upwards of a mile, beyond which no ledge is exposed for upwards of twenty-five miles.

Where the line between the Townships of Ashfield and Colborne meets the lake, a little south of Maitland River, ledges come from beneath the high clay cliffs which face the water, and these ledges are seen at intervals along the shore for about a mile. The greatest section exposed does not afford a vertical thickness of more than six feet; the rocks resemble a part of those of Point Douglas; they are destitute of fossils, and consist, in ascending order, of gray calcareous and bituminous sandstones, cherty limestones, brown calcareous beds striped with thin bituminous shales, and pale yellow calcareous layers, sometimes three feet thick, with lenticular crystals of calc-spar, or cavities from which such have disappeared. Probably in the same relation to these rocks as the fossiliferous to the unfossiliferous of the vicinity of Point Douglas, there occur at the falls on the Ashfield River, about a quarter of a mile above the village, a set of thick-bedded dark gray calcareous sandstones and buff-colored silicious limestones, both holding organic remains, which are more numerous in the latter. Beds similar to those on the Ashfield coast and river, probably a continuation of the same, were observed for the last time in a

cliff on the Maitland River near Goderich. The following is a section of them in descending order:

	ft.	in.
1. Thin-bedded dark gray bituminous limestone holding organic remains; a suture-like bituminous division with tooth-like and occasionally columnar-sided projections, separate two of the beds	24	0
2. Measures concealed by clay and debris	12	0
3. Pale gray or drab-colored fine grained sandstone, with ferruginous spots and stripes and mottled with blue and yellow; no fossils	2	0
4. An irregular bed composed of an aggregation of imperfect crystals of calc-spar	0	1
5. Dark brown fine-grained sandstone striped with bituminous layers, very soft and easily disintegrated until after exposure to the air, when it becomes hard	2	6

At the bridge across the Maitland River, about half a mile from the village of Goderich, and at a short distance below the place where the above section was measured, the following unfosssiliferous rocks were found exposed in a continuation of the same cliff:

	ft.	in.
2. Dark gray bituminous and silicious limestone	4	0
Brecciated, cherty and bituminous limestone	2	0
3. Pale yellowish calcareo-arenaceous bed, with ferruginous stripes and spots	1	10
4. Bed composed of an aggregation of imperfect crystals of calc-spar	0	6
5. Soft yellowish colored sandstone with bituminous and ferruginous spots	3	0
6. Dark gray or brownish colored bituminous limestone containing small lenticular crystals of calc-spar or cavities of the same form, some beds shewing a large quantity of hornstone and thin partings of black bituminous shale	4	0

The lower and non-fossiliferous portion of the rocks thus described bears a strong resemblance in their mineral character and general appearance to that series of beds at the summit of the Gypsiferous formation of New York, which is known there as the Water-lime group, except that the beds do not contain organic remains, the total absence or very great scarcity of which is a feature that belongs, both in New York and the bordering part of Canada in the Niagara District, to the remainder of the formation. This analogy is farther supported by the fossiliferous portion of the Huron sections, in which several of the fossils seem to correspond with

those figured by Hall and Vanuxem, as characteristic of the Corniferous limestone and the Onondaga limestone, which constitutes a passage to the Corniferous, and is in the western part of New York and its continuation into Canada, the formation overlying the Gypsiferous. These fossils are *Paracyclas elliptica*, *Delthyris undulatus*, *Atrypa affinis*, with a *Cyathophyllum* and a *Syringopora* belonging to the Onondaga limestone, neither of which have been specifically named, accompanying *Favosites gothlandica;* other species of *Delthyris* and *Atrypa* occur, with *Strophomena* and *Cypricardia*, and univalves resembling the genus *Platiceras* of Conrad. In addition to the corals mentioned, others are present, and there are also several species of Trilobites.

The Corniferous limestone extends over the greater proportion of all the western parts of the peninsula between Lakes Huron and Erie, but thick deposits of drift cover it up throughout the chief portion of the area it occupies. The only exposure of it met with in our excursion, in addition to those already mentioned, near the Sauguine, at Little Pine Brook, and on the Ashfield and Maitland Rivers, were at the Malden quarries near Amherstburgh, at the very western extremity of the western district, where it displays thick beds of a pale yellowish limestone of a bituminous quality, abounding in fossils, and where, in addition to those kinds of remains already mentioned, it holds the bones of fishes.

As it appears probable from what has been said, that the fossiliferous rocks south of the Sauguine belong to the base of the Corniferous limestone, it may be inferred that the whole of the sand and clay covered space between them and the Rivière au Sable (north) is occupied by the Gypsiferous group, the upper members alone of which are brought into view on the shore of Lake Huron, and by a series of a gentle undulations carried to Point Douglas and the other parts of the coast to Goderich. When the flatness of the strata, and the thick coating of the superficial arenaceous and argillaceous deposits in those parts of the country, are considered, it is not surprising that the mineral which in other parts renders the formation of economic importance should not have been met with. But as the district becomes settled and cleared, there is little doubt many fortunate exposures of it will be found between the mouth of the Sauguine and those spots where it is

already turned to use on the Grand River. The position there occupied by the available masses of gypsum is in the middle of the formation, and wherever they have been observed in Canada, they are associated with green calcareo-argillaceous shales and thin beds of limestone. Below these shales and limestones, red marls are known to exist in Canada not far from the Falls of Niagara, and also in New York, where that part of the formation becomes of importance as the salt-bearing rock of Onondaga. That the red marls are probably continued, in front of the Niagara limestones, to the coast of Lake Huron between the mouths of the Sauguine and Au Sable, appears to be indicated by the fact that Captain Bayfield on his map of the lake has represented a bottom of red clay to exist in soundings of 354 feet, at a spot bearing about W. by S. seventeen or eighteen miles from the mouth of the Sauguine, or about twenty five miles in the same direction, from a point where the level of the lake would intersect the supposed probable outcrop of the marl on the land ; and though it would require a slope of no more than fourteen feet in a mile to reach the red clay in the submerged locality, while the general inclination of the exposed strata is estimated at thirty feet in a mile, the difference is too small, and such a change in in the dip as would be required to compensate it, too common an occurrence to make it any difficulty. With a slope of thirty feet in a mile, the total thickness of the formation, where it attains the mouth of the Sauguine, would be 300 feet.

The opinion that the economic masses of gypsum will be found to accompany the formation to which they belong to the coast of Lake Huron, is supported by the fact that such are known to exist in its farther extension on Burnt Island, not far northward of Michillimakinac, the rocks constituting the group of islands in the vicinity of which have been ascertained to belong to the gypsiferous series ; and the value of gypsum in its applications to the soil renders it little doubtful that its presence will have a material effect upon the prosperity of such settlements as may be found to possess available quantities in their vicinity ; but as the mineral is distributed in detached and isolated masses, varying greatly in size and extent, and not in continuous sheets among the strata, the discovery of workable parts can only be expected

as the result of careful and persevering research, continued for some time.

In addition to gypsum, hydraulic lime is a material of economic value likely to result from this formation; a bed of it at Point Douglas has already been alluded to, which in the experiments tried with it, hardened rapidly under water, after having been burnt and pulverised, and the statements of a previous report shew that considerable quantities of it exist in the formation, near Paris on the Grand River. Good common material for building purposes and limestone for burning are met with in both the Gypsiferous and Corniferous formation. At Goderich, about half a mile above the bridge across the Maitland River, a dark brown sandstone, soft in the bed, but hardening on exposure, has been used for coarse building purposes, and found useful in the construction of limekilns. At the same place there are limestones in the upper part of the bank, which make a good substantial building stone, but are unfit for any ornamental part of an edifice, in consequence of a tendency to become iron-stained. The body of the gaol and court house at Goderich is built of such a stone, but the facings of the structure, I was informed, were brought from Malden. Rocks of a similar character to those above mentioned occur at the rapids on the same river near Papp's farm, about five miles from Goderich on the London road: the strata being nearly flat, are capable of being easily quarried. At Malden, near Amherstburgh, a limestone of a whitish gray, and sometimes of a buff color, is extensively quarried for building stone; the beds, which lie nearly flat, are from one to two feet thick, in no case require more than two or three feet of soil to be stripped from them, and in some parts are attainable at the very surface. They give a very handsome building stone, and at the base of some of the sections exposed there is a compact layer of a buff color, somewhat resembling lithographic stone in its appearance; but for lithographic purposes it seems to be too brittle. All the beds burn to a good white lime. When the beds of the Corniferous formation hold too much of the hornstone, (from the large disseminated quantities of which it derives its appellation,) to yield building materials, the rock then becomes applicable as road metal for which it is will adapted; the hornstone prevails chiefly in the lower part of the formation.

7. *Hamilton Group.*

In a low cliff on the west side of Cape Ipperwash or Kettle Point, there is displayed a vertical amount of about twelve to fourteen feet of black bituminous shale, which splits into very thin laminæ, and weathers to a dull lead color, marked in many places by extensive brown stains from oxyd of iron, while patches of the exterior in such parts as are not washed by the water of the lake, are encrusted with a yellowish sulphurous looking powder.* Many nodules and crystals of iron pyrites are enclosed in the shales, and many peculiar spherical concretions. On the east side of the Point the upper beds of the section are concealed by debris, but the lower come out from beneath the bank, exposing their surfaces a little above the level of the water, studded by the spherical concretions, over an area of several square acres. The resemblance these concretions bear in many instances to inverted kettles has probably been the origin of the name commonly applied to the Point; they are of all sizes from three inches to three feet in diameter, and while many of them are nearly perfect spheres, others are flattened a little, generally on the under side; sometimes they present one sub-spherical mass on the top of another, the upper of which is smaller than the under, giving a rude resemblance to a huge acorn; the masses split open with facility, both vertically and horizontally, and when double forms occur they are readily divided horizontally. These concretions are all composed of a dark gray crystalline limestone, presenting in many cases a confused aggregation of crystals in the centre, from the nucleus formed by which slender elongated prisms radiate very regularly throughout the mass to the circumference. In the nucleus are sometimes met with small disseminated specks of blende, but these were not observed to extend to the radiating prisms, which both in their terminations on the exterior of the sphere, and in their filiform aspect in the radii on fractured surfaces, give the mass very much the semblance of a fossil coral, for which it might readily be mistaken.

*The substance is soft, dull, earthy, of a sulphur yellow, and in addition to possessing the exterior aspect, gives the blow pipe reactions of *Humboldtine* or oxalate of iron. It instantly blackens in the flame without any sulphurous odor and becomes magnetic, leaving, by the continuance of the heat, a bright red stain.

The shale is fossiliferous, and among the remains a fucoid resembling the *Fucoides cauda galli* of Vanunem is very abundant, chiefly in the lower beds. Stems of plants, supposed to be species of *Calamites*, in some instances seven to eight feet long with a breadth of three inches, are frequently seen about the middle of the section, and in these are sometimes remarked patches of a thin coating of coal, which no doubt when freshly exposed, invested the whole plant. In one place a *Lingula* (but neither of the two species represented by Mr. Hall as belonging to the Genesee slate,) was found associated with plants, in addition to what appears to be a number of minute orbicular microscopic shells.

The whole of the beach where these bituminous shales occur, appears to have been overrun by fire, which is rumoured by the Indians and others acquainted with that section of country, to have originated spontaneously, and to have continued burning for several consecutive years. That rocks containing so much bituminous matter, once ignited, should not cease to burn for months or even years, is very probable; but it is difficult to ascertain satisfactorily whether the fire was the result of natural causes or of accident. Spontaneous combustion is known to be of frequent occurrence near collieries, where bituminous shale is thrown up in heaps as refuse resulting from the working of the coal, when the shale is of a crumbling nature, and is accompanied by iron pyrites, a mineral present in most coal seams. It is not in my power to explain the phenomenon clearly, but it is supposed to be connected with the decomposition of the pyrites; but in the case of Kettle Point the same materials, bituminous shale and pyrites are present together, and it is not unreasonable to suppose that their action on one another may have originated the ignition. We observed that on digging a foot deep or more into the shingle, a faint and almost colorless vapor immediately arose from the opening, which, gradually increasing in volume and density, in the space of two or three minutes, became a distinct smoke, emitting an odor very similar to that produced by the combustion of a sulphurous coal, and evolving at the same time a considerable heat. The shingle of the beach, which is almost exclusively derived from the forma-

tion, is of a bright red color wherever the fire has extended, the bituminous matter having entirely disappeared.

The black color and inflammable nature of the bituminous shales of Kettle Point have suggested to some persons, as in the case of the bituminous shales of the Utica slate in other parts of the Province, the possibility of their proximity to available coal seams. But the formation to which they belong is well known in the State of New York, where useless and expensive experiments were made in it, before the institution of the State Geological Survey, in a vain search for mineral fuel; the formation has the name of the Hamilton Group, at the base and at the summit of which there are black bituminous shales, in the former case called the Marcellus, and in the latter the Genesee slate, either of them corresponding with the general condition of the Kettle Point shales; but between the Hamilton Group and the coal areas south east of Lake Erie, on the one hand, and north west of Lake St. Clair on the other, there occurs an important group of sandstones (called the Chemung and Portage Group); no trace of these sandstones any more than of the Carboniferous Group, has yet been met with in Western Canada.

Drift.

A great accumulation of drift was observed on the margin of the lake and on the banks of the rivers south of the Rivière au Sable (north,) consisting of clay, gravel, sand and boulders. Allusion has already been made to their distribution on the coast, and from this they extend into the interior, and cover the greater part of the country between Lakes Erie and Huron. The clay in the cliffs overlooking the latter, was found to be very calcareous, containing sometimes so much as 30 per cent. of carbonate of lime and constituting a rich marl, which would be of advantageous application, in an agricultural point of view, to the sandy portions of the district. The clay often contains numerous pebbles and boulders of limestone, quartz, granite and allied species derived from the ruins of rocks similar to those found in place in one part or other of the shore around the lake. Those of limestone were often discovered to hold fossils peculiar to the Corniferous formation, especially in the Township of Plympton, where they were numerous but usually water worn. The sands met with on the coast

consisted of fine grains of white quartz; equally fine grains of mica, feldspar and limestone were distributed in smaller proportions, and a slightly ferruginous mixture gives it a pale yellow color.

The strong calcareous quality of the clay which would give it value as a manure, renders it unfit for bricks or pottery. But clays suited for such purposes are found in abundance in some parts of the interior, such as in the vicinity of London and of Thorold, where it is supposed to overlie the calcareous clay.

Such brooks and rivulets as issued from marshes or swamps, often gave indications of iron ochre or bog iron ore by ferruginous incrustations on the banks or on the bottom, and in my excursion up the Grand River, numerous loose masses of bog iron ore were found strewed over the surface in the Township of Dumfries near Galt, where, if it should be found in available quantity, it cannot fail to be of considerable importance to this thriving town, in which an extensive iron foundry is already established.

SURVEY OF THE SPANISH RIVER.

General Description.

The Spanish River joins Lake Huron in lat 46° 12′ N., long. 82° 27′ W. from Greenwich, falling into an extensive and beautiful bay land-locked by islands and projecting points from the main land. A bold and elevated promontory connected with the main by a long narrow isthmus, in some parts not over five chains across, separates the bay from the body of the lake, the communication to the eastward being through a narrow but deep channel called the Petit Detroit, between the southern extremity of the peninsula, and the eastern end of a large island, the north coast of which, stretching to the westward, runs nearly parallel to the general trend of the main shore.

From the Petit Detroit to La Cloche the distance along the coast may be divided into two general courses, namely S. 70 E., eleven miles and thirty chains to Point Sagamook, the extremity of a low peninsula of the main land, and N. 74 E., three miles and thirty chains to the mouth of La Cloche River. The outline of the coast is irregular, being indented by deep bays and coves, which in some parts are perfectly land-locked by groups of long, low, and narrow

islands running parallel with the main shore, and affording excellent places of shelter for all classes of vessels under almost any circumstances. Our topographical survey of the coast was confined to one of the land-locked bays between the Petit Detroit and Point Sagamook, the west entrance to which is four miles and twenty chains in the bearing S. 78 E., from the former place, while the east entrance bears N. 50 W., from the latter; the length of the channel between the islands and the main land is four miles and twenty chains in the bearing S. 78 W.

Our measurements of the Spanish River commenced at a point on the north side of the bay at its mouth, bearing about N. by E., from the Petit Detour, with a distance, following round the headlands, of about three miles, or about two and a half miles in a straight line. The total distance measured along the course of the river, following all its sinuosities, was a little under sixty miles, and the general bearings and distances between each of its principal bends, from our starting point to the highest part we reached, leaving out minor turns, were found to be as follows:

	Bearing.	M.	Ch.
1.	S. 85 E.	12	42
2.	N. 3 W.	1	64
3.	N. 67 E.	1	68
4.	N. 86 E.	3	14
5.	N. 30 E.	4	21
6.	N. 28 E.	2	24
7.	N. 86 E.	5	10
8.	S. 75 E.	3	45
9.	N. 21 E.	3	75
10.	N. 56 E.	8	02
11.	N. 86 W.	5	00

The course of the stream above the termination of our measurements is represented by the Indians to be nearly due west for about sixteen or eighteen miles, and then turning abruptly north to maintain a northerly bearing for a long distance into the interior, where it takes its origin from two large lakes.

Four important tributaries were met with in our ascent, the two lower flowing in from the north on the right bank at the upper extremity of the third and fifth distances given above, the two higher from the west on the left, at the ends of the eighth and tenth

distances; and in addition to the water derived from these, a large supply is poured in from numerous rivulets and brooks, some of which are streams of considerable size.

For two miles at the mouth, the river is on the average half a mile wide, but the space is much silted up by alluvial deposit, bearing a luxuriant growth of reeds and other aquatic plants, and through the marsh thus formed, numerous narrow channels exist, some of which are deep enough to float vessels drawing five feet of water. Just above this the breadth contracts to six chains, but expanding again a little higher up, the next ten miles maintain a breadth of between ten and thirty chains, including a number of islands, which altogether occupy a considerable area in that part of the stream. In this distance, which completes the first of the courses or bearings stated above, the water is so still that no current is perceptible. The current is first observed in the succeeding course; it increases in velocity to the lowest of the four principal tributaries mentioned, which is called the Rivière au Sable; and about four miles above this tributary the main stream becomes rapid, and a strong current is felt in the ascent for about a mile. Just below the first tributary, the breadth of the river is nine chains, and above the second it is five chains, which it maintains as far as the upper extremity of the sixth stated course. To this point a distance of thirty and a half miles from the mouth, the river is navigable to craft not drawing over five feet, the only difficulty being in the mile of rapid water four miles above the Rivière au Sable, through which however we found little difficulty in paddling our canoes. Farther ascent is interrupted by a rocky step in the valley, over which a beautiful sheet of water is precipitated in a fall of twenty seven feet, including the rapid immediately at its foot. In addition to this fall, four others were met with in our ascent, at each of which it was necessary to make a *portage;* strong rapids likewise occurred occasionally, and the stream was found to run swiftly from the lowest fall to the highest point we reached, where the breadth was about three chains. The following table shews the heights of the falls and their distances in miles and chains as measured along the course of the river from our starting point at the mouth.

	M.	Ch.		Feet.
1st Cascade.....	30	43	.....Height	27
2nd. "	34	67	..... "	20
3rd. "	43	31	..... "	20
4th. "	50	38	..... "	50
5th. "	51	02	..... "	10
				—127

To which may be added as an allowance for the rise in those parts navigable to our canoes :

	Ft.	In.
Rise in 13 miles at 2 inches per mile, say	2	3
Rise in 17 " 4 " "	5	9
Rise in 30 " 6 " "	15	0
	——	23
		—

Total height at the end of the measured distance over the level of Lake Huron..... 150

The total distance measured on the Rivière au Sable, following all the windings of its tortuous course, was rather over seven and a half miles, at the end of which its breadth was about two chains, and the following three bearings and distances, will serve to shew its general upward direction :

	M.	Ch.
1. N. 16 W.....	4	10
2. W.....	1	40
3. S.....	0	25

This tributary is said to take its rise at a great distance to the north-westward of the point we reached, in that part of the country which holds the sources of the Mississagui, and not far from Green Lake, passing in its course, to the northward of all the waters of the Serpent River, and it is reputed to be very rapid and difficult to navigate in canoes, though as we were informed these have occasionally proceeded by the stream to Green Lake; but in consequence of the number and length of the portages and other difficulties, the route is seldom followed. Within the limits of the portion we scaled, there are no less than ten falls, the total height of which amounts according to our estimate, to 202 feet, besides several strong rapids.

The second tributary is not accessible to canoes, its channel being obstructed by fallen, drifted trees, but we were enabled to

reach a considerable lake, through which it flows, by following a portage used by the Indians as part of a short route to the ultimate northerly bend which has been spoken of as occurring on the main river, sixteen to eighteen miles above our measurements. This portage leaves the main river at the upper end of the sixth stated course, and maintaining a general direction N. 50 W. and crossing an eastward branch of the tributary, at the distance of about two miles, strikes a pond on the main tributary stem, about a mile farther on, which is connected by a sluggish stream of about a mile in the same bearing as the portage, with the lake already spoken of, whose contour is indented by long narrow bays and inlets, while its surface is dotted with various sized islands. The length of the lake running E. and W. is about two miles, and its greatest breadth N. and S. about a mile and a half. From the pond below the lake, the stream rushes rapidly through a narrow gorge for about a quarter of a mile in a direction parallel with the portage, and then falls in a succession of leaps close over each other about fifty feet in total height; and continuing to flow with great velocity to the south-eastward, to the vicinity of its junction with the branch already mentioned, it then turns to the southward, pointing towards the confluence with the main river.

The third tributary is said to take its rise near White Fish Lake, a considerable distance to the eastward, and at its junction with the main stream has nearly as great a breadth, being rather over three chains across; the Indians report it to be navigable for canoes for a long distance. According to the description given by them, the fourth tributary flows from a lake at no great distance to the eastward of the main stream, at its confluence with which it is a chain wide.

A portage route is established by the Indians across the mainland from the Spanish River to La Cloche. The northern end is on a small brook which flows into the river at the eastern extremity of the first stated course; this brook is ascended for a short distance, and beyond it two lakes are crossed, which with the carrying places complete the route. The total distance in a straight line from the main river to La Cloche is S. 10 E. four miles twenty-six chains, but pursuing the travelled track it is as follows.

	Bearing.		M.	Ch.
Ascent of Brook	S. 18	W.....	0	36
Across 1st Portage	S. 4	W.....	0	55
" 1st Lake	S. 11	E.....	0	28
" 2nd Portage	S. 12	E.....	0	18
" 2nd Lake	S. 27	E.....	2	12
" 3rd Portage	S. 10	W.....	0	50
			4	39

The two lakes occurring on this route, which may be called the Great and Little La Cloche Lakes, were topographically surveyed. The smaller or northern one conforms in some degree to the bend in the Spanish River, at the junction of the first and second stated course. Its length is 140 chains, and its breadth, which swells out a little at each end, is on the average about twenty chains; the whole area is about 280 square acres. Both sides are bold and rocky, but the two ends are low and marshy; the land around is altogether a good deal broken, the highest parts attaining an altitude of 200 to 300 feet, but it is heavily wooded with pine, hemlock, beech, elm, birch and other kinds of trees.

The southern or Great La Cloche Lake is divided eastwardly into two long arms, by the intervention of a mountainous peninsula, and westwardly into two short corresponding arms or bays, the north and south parts being joined by a strait between the two opposite dividing promontories. The northern division is crooked, running N. 85 E. two miles fifty chains, S. 16 E. seventy chains and N. 74 E. two miles and fifty chains, with irregularly indented sides, the breadth being in some places not over seven or eight chains, at others half a mile. The southern division is straight, being four miles sixty chains, in the bearing S. 70 E, with an average breadth of about fifty chains. The two eastern arms of the lake have a rude resemblance to the capital letter R., in which the junction of the top and tail of the crooked part do not quite reach the straight part, and the whole superficies of the lake is 2661 square acres, or a little over four square miles.

A sluggish stream running nearly direct east through a wide marsh, connects the Little with the Great Lake; it leaves the former towards its south western end, not far east from the portage landing, and enters the latter lake at the round part of the

letter R, to which its eastern arms have been compared. Two streams coming from the eastward, each about half a chain wide at the mouth, fall into the two eastern arms, one on the south side of each respectively, in the southern one close by the east end, and in the northern about half a mile from it, and the lake finds an exit by the La Cloche River; this stream flows out on the south side nearly opposite the channel between the north and south limbs, and taking a general course through a mountain gorge, in which two falls occur of fourteen and fifteen feet each, in the course of a mile inclusive of windings, joins Lake Huron at the Hudson Bay Company's station.

A large proportion of the northern shore of Great La Cloche Lake is low and marshy, and this is likewise the case in the bays at the extremities of the various arms, but with these exceptions the whole of its contour is bold, precipitous and rocky. The La Cloche Mountains, as they are called, rise up to the height of 400 feet or more, between the southern division of Great La Cloche Lake and the coast of Lake Huron, which run nearly parallel to one another, and the mountains present their more abrupt side to the south; another range of hills similar in character, although not so elevated, separates the southern and northern divisions of Great La Cloche Lake, and presents its more abrupt side to the north; to the eastward these two ranges seem to run into one, around the head of the southern division, but westward they continue nearly parallel for about two miles beyond the lake, where they die down to the ordinary level of the country. About four miles farther west, however, immediately over the eastern part of the island channel topographically surveyed on Lake Huron, a group of high, steep and picturesque hills, again presents itself, which preserves a mountainous character for about two miles and thence extends in a ridge running westward to the bay near the entrance of the Spanish River. At the base of these ranges, particularly on the south side, the land is of good quality, yielding a stout growth of pine, hemlock, beech, maple, oak, elm and ash; the hills themselves, however, are either scantily covered with diminutive evergreens, principally pitch pine, or are perfectly bare. The dazzling whiteness of the quartz rock of these mountains, their sharp, broken and irregular outline, and their rugged and

precipitous sides, dotted here and there with groves, whether seen in combination with the waters of Lake Huron, or those of the interior lakes, serve to render the scenery around La Cloche singularly picturesque and beautiful.

The country bordering on that part of the Spanish River which is above the first or lowest waterfall is broken and rugged, though not mountainous. The hills seldom attain a height over 300 feet, but the banks of the river itself are frequently bold, precipitous and rocky, particularly in the vicinity of the various falls. At the great fall, which is the fourth in succession, a picturesque and imposing ruggedness prevails. A ridge of smoothly polished bare rock rises in rounded knobs, so steep in places as to be inaccessible, obstructing the south-eastern flow of the river and splitting it into two parts, of which one turns a little to the northward of east, while the other is deflected to a precisely opposite course. The latter, after running above a quarter of a mile, is thrown in a beautiful cascade over a precipice thirty feet high, and then turning abruptly to the eastward, rushes violently for thirty chains in that direction, falling in vertical sheets over three successive steps of five feet each, when it is again united to the other division of the stream in a wide pool of nearly still water. In the immediate vicinity of this and the other falls and on the tops of the hills, the rocks are either bare or clothed only in spots by dwarfish stunted evergreens, but the country generally above the lowest cascade, is covered by a dense forest consisting principally of red and white pine. That part of the river which is below this cascade frequently presents high and steep banks, but these are seldom rocky ; they are composed chiefly of sand, resting on a close retentive clay, sometimes rising to the height of fifty or sixty feet, and it was evident that, in some parts, undermined by the action of the stream during freshets, masses of these deposits of considerable extent have been precipitated into the river by land slips. Much of the country for some distance back from the north side of the river, in that part between the second and third tributary, is flat or rolling, and is almost every where covered with a luxuriant growth of fine red and white pine. Following the portage to the lake on the second tributary, we found this character obtain for a breadth of

about three miles, but farther on the country became broken and rugged, and the timber perceptibly diminished in size and diversity all the way to the lake, where it was small, scattered and comparatively valueless, being principally pitch pine. The change occurs in the vicinity of the falls on this tributary already mentioned; approaching them a nearly vertical precipice is seen to rise abruptly to the height of 200 or 300 feet; it faces S. E., and broken by the gorge through which the tributary issues, constitutes one side of a valley transverse to that of the stream. This transverse valley is a geological boundary, and the difference which exists in the character of the vegetable covering of the country on each side of it, is no less obvious than that in the mineral quality of the rocks. In the district between the second tributary and the Rivière au Sable, the surface back from the river is more broken than that higher up, and it appears very rugged on the latter tributary. It nevertheless continues to abound in fine pine timber, until the indigenous produce is affected by the same geological change as before, which here occurs at the western turn in the stream. In some of the hollows and valleys however, connected with this western part, several groves of good sized red pine were seen, although on the whole undoubtedly inferior to those nearer the main river. For three miles below the mouth of the Au Sable tributary a beautiful growth of pine envelopes both sides of the river, but further down, especially on the south side, the land is bare, rocky and barren, the timber stunted and scattered, and large tracts have been overrun by fire. At the Indian settlement on the south bank of the stream, about six miles above the mouth, and at other parts where there are alluvial flats, the land produces some good hard timber, and when cultivated yields excellent crops of Indian corn, but on the whole, the soil is light and sandy.

The extent and value of the pine forests in this region, the facility offered by the river for navigation, the water power to be found on the main stream and all its tributaries, and the capabilities of the soil for raising most of the necessaries of life, all tend to indicate a probability that it is destined at some future period to become of commercial importance to the Province.

Character and Distribution of the Rocks.

The geological formations met with in the region thus described may be arranged into two groups, one of which appears to be nearly allied to, and the other identical with, the older rocks, of which mention was made in my Report of 1847–8. They are:

1. *Granitic or Metamorphic Group.*
2. *Quartz Rock Group.*

1. *Granitic Group.*—Within the limits of our survey the rocks of this group were found in general to present a limited range of mineral quality, and to exhibit similar characteristics in most respects in different places. The constituent minerals were usually those of granite or syenite or a mixture of both. The feldspar was the predominent constituent and varying from a pale flesh to a bright red, occasioned the rock at all times to assume a more or less intense red color. In some places the rocks were found to be almost entirely of feldspar and quartz, and in others, a greenish tinge was attributed to the presence of epidote. A gneissoid structure was observed on one or two occasions, but it was for the most part obscure and ill defined, being perceptible rather in a longitudinal arrangemeut of the constituent minerals, than in conspicuous beds of different quality. Dykes of greenstone trap intersected the formation in different parts, and veins of white vitreous quartz were of frequent occurrence, but in these no metallic ores were observed.

The formation appeared to rise from beneath the rocks of the second group in two different localities, namely about three and a half miles up the Rivière au Sable, and at the falls on the second tributary two and a half miles in a direct line back from the main river. The bearing from the first locality to the second is N. 77 E. and the distance eight miles in a straight line. As far as our examination went, the rocks of the country to the north of this line were all of the formation, with very little diversity of character, and it is not impossible, they may have a wide range in that direction; for the present however this can be only conjectural.

2 *Quartz Rock Group.*—The rocks of this group, where they came under our observation, like those examined the previous

season farther to the west, were found to be partly of aqueous, partly of igneous origin. The former consisted of sandstones, conglomerate slates and limestones, the latter of beds of trap and trap dykes. The prevailing color of the sandstones was white, sometimes with a tinge of pale green; often the color was gray. The rock was always very silicious and most frequently fine-grained, in some cases of so close a texture as to assume the aspect of a compact crystalline quartzite; but sometimes it was sufficiently coarse to constitute a fine conglomerate, of which the component grains and pebbles were by far the greater part of quartz; but in the beds of coarser quality pebbles of red or gray syenite occasionally occurred; small red jasper pebbles were observed in one or two places imbedded in white quartz rock, but they were by no means numerous, and they were confined to the upper portion of the formation. Some of the quartzose sandstone beds were of a deep orange red, but this seldom extended far. The slates were gray, green or blackish in color, and were usually more or less silicious and frequently very micaceous. Some parts of the formation, being the more schistose portions, were almost exclusively composed of mica, generally of a gray color, but sometimes tinged with iron-brown, and the parallel layers into which the rock was divisible, presented on their surfaces small sharp corrugations. Some parts were marked by small shining specks of chlorite, and in some places the slates contained imperfect crystals of epidote, occasionally arranged along the planes of the bedding, but more frequently along cracks or joints. In these epidotic slates the prevalent color of the rock was gray, and the epidote, of a dingy brownish green and sometimes disseminated, gave to smooth weathered surfaces the appearance of belonging to a slate conglomerate. The more purely argillaceous portions of the slate were generally black or of a very dark brownish tinge, and in these a very symmetrical jointed structure, dividing the rock into rhombohedral forms of considerable regularity, was frequently recognised. The slates were very often observed to pass into a conglomerate holding pebbles of granite or syenite chiefly, varying in diameter from the eighth of an inch to a foot, and imbedded in a black argillaceous matrix. The limestones observed, though of minor importance as regards thickness, were of a marked

character, and in most respects bore a strong resemblance to those found associated with the quartz rock formation at the western end of the north shore of Lake Huron. They consisted of calcareous beds of a dark blue color, interstratified with layers in which lime appears to be altogether absent, the composition of these being often almost purely silicious or argillacous. The outcropping edges presented alternations of thin sharp ridges and grooves. No organic remains of any kind were found associated with any of these sedimentary rocks, but distinct ripple mark was frequently observed on the surfaces of the slates and sandstones.

The trap rocks associated with the sedimentary strata described, were not found to differ greatly from those mentioned in the preceding season's report. The prevailing character of the interstratified portion was that of a coarse-grained greenstone, but parts of it displayed a very great abundance of chlorite and epidote, and other parts were micaceous. The trap dykes were also greenstone, sometimes gray or greenish in color, and coarse-grained, and at others fine-grained, compact and black. Copper pyrites and iron pyrites were found disseminated in small quantities both in the beds and in the dykes.

Veins of white quartz were observed to intersect the whole formation, in which dolomite spar, copper pyrites and iron pyrites were found associated, and occasionally in druses in these veins, rutile, actynolite, and calc-spar occurred.

The valley of the Spanish River below the third tributary, and the coast of Lake Huron to the south, run nearly with the strike of the rocks of the country, on the opposite sides of a geological trough in the Quartz rock group; the general dip on the lake side being to the north and that on the Spanish River to the south. The synclinal axis runs in the southern division of Great La Cloche Lake, on the opposite sides of which the same measures of the formation rise into two ranges of mountains. The breadth of country occupied by the north side of the trough from Great La Cloche Lake to the junction of the Quartz rock and Granitic groups on the Rivière au Sable is about nine miles, and a line from the one place to the other would cross the formation very nearly at right angles to the strike; but owing to

sundry irregularities which occur, and the concealment of many portions of the strata, it is very difficult to ascertain correctly the total amount of thickness. At the bends of the river occurring at the upper extremities of the first and second courses stated in the table, corresponding twists were observed in the stratification, and on the Rivière au Sable the rocks were found to be greatly disturbed and confused; it appears probable, however, that the thickness can scarcely be less than 10,000 feet. A good section of the upper measures is exposed, where the mountain range separating the northern and southern divisions of Great La Cloche Lake is cut by the strait between them. The strata are tolerably regular and they consist for the greater part of pure massive beds of white, associated with thin beds of gray quartz rock, and beds of greenstone, underlaid by less massive beds of greenish white, gray and red quartz rock, sometimes of a slaty structure, which in all amount to a thickness of about 4000 feet. Coming from below the quartz rock there are black argillaceous slates and conglomerates with syenitic pebbles, giving together an additional thickness of 800 feet, and these are followed by the limestone band, which with its silicious layers occupies fifty to sixty feet more. This silicio-calcareous belt was traced along the whole length of the north division of Great La Cloche Lake, in which it shews a general strike a little north of east and south of west. On the portage between Great and Little La Cloche Lakes and on Little La Cloche Lake itself, was found a considerable display of greenstone, and north from it in the hills which overlook the brook at the end of the portage, gray quartz rock and quartzose slates crop out shewing a southern dip. At the bends of the main river and on the Rivière au Sable the rocks are chiefly micaceous slates interstratified in parts with gray quartz rock, to within a mile of the granitic series, near which the whole lower visible portions of the formation consist of chloritic and epidotic greenstone. The contact of the formation with the granitic rocks is not exposed on the Rivière au Sable; the land in which it must occur being low, marshy and overgrown with trees and moss. There is likewise a concealment at their junction on the second tributary. In this instance the formations come together in a dingle a little south from the falls, where all the rocks on the north side of

the dingle are granitic, while on the south they are quartzose slates and quartz rock, the distance between the two groups not exceeding a hundred yards.

No evidence was observed, on these tributaries or on the main river, of any undulations so great as to cause a repetition, on the north side of the La Cloche synclinal, of the upper quartz rocks or of the limestone band beneath them, although minor undulations were met with in the inferior beds. At the lowest of the cascades on the Spanish River, the strata consist of green micaceous and quartzose slates, surmounted by beds of gray quartz rock, with two beds of greenstone interstratified, and their dip is S. 25 E. <42°. The step over which the water is precipitated was found to be occasioned by a coarsely crystalline greenstone trap dyke, measuring 360 feet across, running irregularly N. W. and S. E., and cutting the strata nearly at right angles to the strike. The dyke shewed an imperfect transverse columnar structure, divided by vertical parallel joints, giving to the precipices on each side of the river the aspect of great masses of rude masonry. A great mass of greenstone is exposed on the bank of the river at a rapid about two miles above the falls, which was supposed to be a continuance of the same dyke, and which if such be the case, shews its general bearing to be W. N. W., and E. S. E. The strata are much disturbed and fractured by the intrusion of the trap, and near to and running parallel with the dyke, there is a large vein of vitreous white quartz, from which a number of branches of the same mineral of small breadth extend, but all destitute of any metalliferous indications.

Above the elbow at the third tributary, the river flows obliquely across the measures in some places, and turns exactly on the strike in others, and numerous sharp folds and twists may be seen in the stratification, where the rocks are extensively exposed. At the second fall, which is about twenty five chains above the tributary, the dip is S. 10 E. <45°, where a section of gray and white quartz rock is exposed measuring 462 feet in vertical thickness, underlaid by greenstone. At the third cascade the dip is S. 30 E. <48°, and there is there displayed a thickness of nearly 1000 feet of quartzose, micaceous and chloritic slates, with greenstone interstratified, and massive beds of white, gray and

greenish colored quartz rock at the base; some surfaces both of the quartz rock and the slate beds shew ripple mark.

Where the river flows from the westward above the fourth tributary, it runs nearly in the general strike, but at the fourth and fifth cascades higher up, the rocks show several undulations. At the fourth cascade there is a great accumulation of green silicious, micaceous and epidotic slates, which at the lower end of the portage present a northerly dip at an angle of about 80°, while at the upper they incline S. <68°; and at the fifth cascade we found a section of dark gray quartz rock, interstratified with quartzose and micaceous slates, and some beds of silicious conglomerate, which are first seen to dip W. <60°, but which, tracing the outcrop round to the upper end of the portage, there incline S. 17 E. <70°.

On the south side of the La Cloche synclinal, the stream emptying Great La Cloche Lake cuts across a succession of thick beds of white quartz rock, and greenstone, and a mass of pale green and gray quartzose thin bedded sandstone and quartzose and micaceous slate; all of which dip at a high angle to the northward, and correspond with the rocks on the peninsula dividing the lake. A conglomerate, consisting of pebbles of syenite chiefly, imbedded in a black argillaceous matrix associated with black argillaceous, gray silicious, and occasionally gray micaceous, slates, is found on the islands opposite the Hudson Bay Company's Post, and this band of the formation may be traced along the coast up to and through the Island Channel, where it was always found inclining north, plunging below the quartz rock of the mountain range, at an angle seldom under 68°. On one of the small islands between Point Sagamook and the eastern end of the Island Channel, there is a dark blue or blackish colored rock passing below the conglomerate, which in external appearance very much resembles some parts of the calcareous band of Great La Cloche Lake. The exposure on the peninsula at the Petit Detroit exhibits greenstone; with which slates and quartz rock are associated in detached and broken masses, at the western extremity, where the cliffs on the coast display very great confusion. On the north side of the peninsula and the neighbouring islands in the bay, the rocks are quartzose slate

and quartz rock in a highly disturbed state; but on an island at the extremity of the point, which is the farthest western limit of the Spanish River, on the south side of its mouth, beds of quartz rock shewing ripple mark on the surface, dip S. <35°, and indicate that the continuance of the synclinal axis is probably in the cove between that point and the Petit Detroit peninsula.

The positions in which white quartz veins holding copper ore were met with, were in two spots on the Rivière au Sable, between two and a half and three miles back from the mouth of the Spanish River and the north part of the Petit Detroit peninsula, and in four spots in the area of a square mile at the eastern end of the island channel on the coast of Lake Huron. But with the exception of one among the last mentioned, already alluded to in last year's Report, where a mining location has been claimed from the Government, none of the instances appeared to be of sufficient importance to demand particular attention. About sixteen miles farther to the east, however, than the Hudson Bay Company's station at La Cloche, another mineral locality deserving attention, that of the Wallace Mine, was visited.

The Wallace Mine.

The Wallace Mine is situated on the coast of Lake Huron, about sixteen miles east from the Hudson Bay Company's Post, and one mile west from the entrance to White Fish River, (called La Cloche River in the first edition of the map of Bouchette, Jr.); the front of the location on which it is situated forms part of the north side of a great bay, bounded on the east and south by a long and bold peninsula of the main land, crowded with groups of various sized islands, affording ample shelter under any circumstances for vessels of every class, while excellent boat harbours abound in the creeks and coves which indent the main shore. The mouth of the White Fish River affords a good harbour, with a sufficient depth of water for the admission of most of such vessels as at present navigate the lake, and boats drawing three feet can ascend the stream nearly a mile, beyond which, contracted to a very inconsiderable breadth between rocky precipices, and thrown over a steep of thirty feet in a cascade, which would afford an admirable mill site, it permits no farther progress.

The general character of the country in the vicinity is rugged and broken; rocky ridges and knolls rise over alluvial flats and intervale lands on the coast; and advancing about a mile and a half in a northerly direction, a continuation of the La Cloche mountains rises abruptly to a high elevation, stated in Captain Bayfield's chart to be 700 feet above the level of the lake. The land on each side of the White Fish River below the falls, appears to be of good quality, bearing a growth of stout maple and other hardwood trees, intermingled with pines of good size. The flats and hollows between the ridges are frequently marshy, but among them spots are frequently found well fitted for cultivation, which may hereafter become of considerable importance.

The geological structure observed on the coast in the front of this location, and on the White Fish River, appears to correspond in all respects with that of the islands and coast of La Cloche. The points of the mainland and the nearest islands, were found to be composed of a conglomerate with syenitic pebbles, underlaid by quartzose and chloritic slates and thin bedded quartz rock, dipping at a high angle to the northward, while at White Fish River there is an exposure of thick beds of white quartz rock, dipping N. 15 W. <80°. The mineral deposit upon which work has been commenced, was first observed among the quartzose and chloritic slates close to the shore, on the east side of a small cove used as a harbour for the boats belonging to the Mining Company, where a shaft has been sunk for several feet, and a channel in the surface rock been excavated for a short distance on each side. From these openings a very pure yellow sulphuret of copper has been obtained, accompanied by an ore of nickel with traces of cobalt (probably an arsenical sulphuret), combined with arsenical iron pyrites. The metalliferous results are represented to have increased in quantity descending in the shaft; but unfortunately, at the time of our visit, the shaft was filled with water and all mining operations were temporarily suspended. We therefore had no favorable opportunity of making a satisfactory examination. There were perceptible, however, along the drifted channel at the surface, various strings and bunches of copper pyrites, which appeared to be interlaminated irregularly with the slates of the formation, and specimens of the ore of nickel and

arsenical iron pyrites were found in the same position. On the west side of the cove a body of trap, supposed to be a dyke, but running very regularly with the strike of the rocks, and from 150 to 250 feet wide, comes to the water's edge in a bluff precipice; but no rock on the east side in continuance of this trap is to be seen; it would seem probable therefore, that it must either pass along the coast under water or be displaced by a dislocation. Having traced the trap for about a quarter of a mile west we found slates similar in mineral quality to those on the east side of the cove to the south of the trap, and between it and the shore, apparently underlying it in the order of succession, and the slates were followed by a conglomerate with syenitic pebbles. Specks and patches of yellow sulphuret of copper were observed both in the slates and in the trap, and a shaft had been sunk near the junction of the two, where it was expected a continuance of the supposed lode of the boat cove would be found; should a lode running between the two points be struck as anticipated, it is evident that it must cut obliquely across the trap, which is not impossible, though we could not discover the existence of any definite vein or surface characteristics to indicate such to be the fact. There are abundant evidences of disturbance displayed in irregularities of dip and the intrusion of trap, and a vicinity presenting the features there displayed, is well deserving of thorough investigation; but notwithstanding the high value that ores holding even a moderate percentage of nickel and cobalt possess, before the locality of this mineral deposit has been more completely developed, it would be premature to hazard any full expression of opinion in respect to its importance. The temporary condition of the mine, at the period of our visit, rendered it impossible to obtain such specimens as might be considered an average sample of the material excavated from the shaft; but with a view of ascertaining the quality of the nickeliferous portion of the ore, a specimen of it, as free as possible from the copper pyrites, was submitted to analysis by Mr. Hunt, who found it to contain 8·26 per cent of nickel with a trace of cobalt, but as nearly two fifths of the specimen consisted of earthy materials, which might readily be separated by dressing, the quantity of nickel in the pure ore which this would represent, would equal nearly 14 per

cent. The percentage of nickel in the whole supposed lode would of course depend on the amount of pure nickeliferous ore distributed through it, which it is evident from the specimens obtained is very unequal; and as at the same time it is not in my power to give a fixed breadth to the supposed lode, it is impossible to form any estimate of the quantity of pure metallic nickel a cubic fathom of the metalliferous rock would produce—upon which, with the extension of the lode, would depend the value of the mine, in so far as nickel is concerned. The value of nickel is about four times that of copper.

While at the mine we were informed that on this location in the continuation of the La Cloche Mountains, about a mile and a half from the coast, there had been discovered a vein of specular iron cutting the strata in a north and south direction, with a width of fifteen feet. Specimens of the ore were presented to us by Mr. Bristol, but we had not an opportunity of visiting the locality. On analysis by Mr. Hunt, the ore is found to contain 68·6 per cent of metallic iron. Its specific gravity is 5·0, and the lode would yield twenty tons of metallic iron per cubic fathom, or, at a breadth of twelve feet, forty tons for every fathom forward by a fathom vertical.

Coast of Georgian Bay.

The description given in last year's Report of the characteristic features of the country on the French River is generally applicable to all such parts of the coast as we visited between the mouth of of that river and Matchedash Bay; but the lateness of the season at which we passed along this coast necessarily rendered our inspection hasty and superficial. Such parts of the land as came under our examination were in general low, rocky, and either perfectly barren or very lightly covered over by dwarfish evergreens and moss. Long narrow arms and inlets were found to strike far into the mainland, and crowds of islands and rocks to extend for many miles out into the lake, rendering the voyage through them very intricate. Harbours for all sizes of vessels presented themselves in abundance, as might be expected among such a numerous assemblage of islands and inlets; but the approach to the coast, amidst reefs and sunken rocks, is at almost all parts dangerous

and difficult. A pretty good description of soil was occasionally observed on flat lands between rocky knolls and ridges, where the timber was principally oak, but it would require a more minute and extended examination to ascertain where there is any great amount of surface valuable in regard to its capabilities for cultivation.

At such points as we touched, on this part of the eastern side of Lake Huron, one geological formation appeared to prevail, and little diversity of character was observed in its constituent parts, which seemed to consist almost exclusively of granitic or syenitic gneiss, intersected by numerous dykes of trap and veins of white quartz, some of which latter were met with exceeding eight feet in breadth, but without any mineral indications beyond iron pyrites. The rocks were in general very much contorted, presenting in some instances a repetition of folds and inversions, which when contrasts of color or quality were strongly marked, could occasionally be traced for long distances. There appears little doubt that these rocks belong to the formation described by yourself as existing on the Ottawa and Mattawa Rivers, but we did not observe among them any of those beds of crystalline limestone, which, in that part of the Ottawa country lying between the Mattawa and Grenville, appear to be of such frequent occurrence. It would be premature, however, to assert that none such exist; yielding more readily to atmospheric influences, the calcareous portions of the formation would most probably, as in the Ottawa region, in general occupy geographical depressions; they may therefore be concealed among the islands and beneath the soil in the valleys of the mainland, and require a more continued search than opportunity afforded us to detect them.

I have the honor to be,

Sir,

Your most obedient servant,

(Signed,) ALEXANDER MURRAY,

Assistant Provincial Geologist.

REPORT

OF

T. S. HUNT ESQ., CHEMIST AND MINERALOGIST

TO THE

PROVINCIAL GEOLOGICAL SURVEY,

ADDRESSED TO

W. E. LOGAN ESQ., PROVINCIAL GEOLOGIST.

LABORATORY OF THE PROVINCIAL GEOLOGICAL SURVEY,
MONTREAL, *April*, 1849.

SIR,

After having been engaged with you during the early part of the last year in the Townships of the East, and then having accompanied you to the north shore of Lake Huron, and after my return put into a state of forwardness the investigations which were required for your Report upon the mining region, I proceeded, in accordance with your instructions, to examine some more of the principal mineral waters of the Province. My object in these researches being at the same time to ascertain accurately the constitution of these waters with reference to their importance in a medicinal point of view, and to compare those of the different geological districts with each other, I at this time confined my examination to those which occur in the valleys of the St. Lawrence and Richelieu.

Having first visited the springs at St. Leon, Caxton, Champlain and Quebec, I proceeded to Varennes, and after collecting the waters with the precautions described in my Report for 1847–8, transported them to the laboratory in this City, where their analyses have engaged the greater part of the winter. As I have already given in the Report referred to, a sketch of the plan pursued, I will not repeat it, but mention that, with some little alterations and improvements, it was followed on the present occasion.

Varennes Springs.

These sources are upon the southern border of the St. Lawrence, about seventeen miles below Montreal, and rise through strata which though concealed by the tertiary clay of the valley, belong either to the upper portion of the Utica slates or the lower beds of the Loraine shales. They are pleasantly situated about a mile and a half below the church of Varennes, at the base of a little ridge which runs along at a small distance from the shore, and bounds a fine tract of meadow land. A century ago they were greatly resorted to, but of late years have fallen into unmerited neglect.

The springs, which are two in number, are very similar in their sensible properties; the outer spring, which is distant about a hundred rods from the house that encloses the other, is the one generally resorted to for drinking, and is called by the villagers by the way of distinction the "Saline," while the spring within the house, from the immense quantity of carburetted hydrogen which it evolves, is known as the "Gas Spring." Within about ten feet from this is another well, but the water has the same level and temperature as the last, and is said to belong to the same basin.

The water in the outer well is about eight feet deep; it rises quite to the surface and is limpid and slightly sparkling; from time to time a few bubbles of carburetted hydrogen are evolved. The flow of water from the spring is probably two or three gallons per minute; around the well there is a slight deposit, ochre yellow on the surface and bluish green within, and the course of the spring is tinged of a yellowish hue for some distance. The water is saline to the taste, and has a very agreable flavor. The water of the inner spring is about five feet below the top of the well, which appears to be nearly on a level with that of the one previously described. It is kept in constant ebullition by the escape of large volumes of carburetted hydrogen gas, which is collected by a gasometer and employed for lighting the rooms above. The discharge is apparently about the same as that of the other spring; the water is saline to the taste and closely resembles that of the one before mentioned.

The temperature of the two springs is somewhat different; on the 18th of October that of the outer well was 47°·5 F., and that of the inner one 45°·5; the air being at the same time 44°. I had before visited these springs on the 20th of November 1847, and found the temperature of the outer one nearly the same as above stated, 47° F., while the inner spring was 40°; the air being 19°. I was informed by the proprietor that the former spring, although not protected from the weather, never freezes to any extent, while the latter, although sheltered by the house, and so much below the surface, is filled with ice in severe weather. The escape of such a quantity of gas, which may be supposed to find its way into the spring below in a greatly condensed state, and be rarified in rising, may help to explain in part this difference: but it is conceived by the villagers that it is affected by the changes of the seasons, and is at the same time warmer in summer, a fact which I have, however, not yet been able to verify by experiment.

I. *The Outer Spring.*

This water has been already described as quite saline to the taste, and analysis shews the presence of a large quantity of common salt, with traces of a salt of potassium. The concentrated water is distinctly alkaline, from the presence of a small quantity of carbonate of soda; the lime and magnesia which are present are also held in solution as carbonates. In addition to these were obtained small quantities of bromine and iodine combined with the alkaline bases; traces of iron, alumina and silica, and two rare bases, baryta and strontia, which have never hitherto been observed in any of the mineral waters of this continent. The specific gravity of the water at 60° F., was determined to be 1008·15, pure water being 1000. One thousand grammes of the water yielded as follows:

Chlorine	5·777100	grammes
Bromine	·009790	"
Iodine	004512	"
Soda	5·098500	"
Potash	·077900	"
Baryta	·017500	"
Strontia	·007320	"
Lime	·198240	"
Magnesia	·259190	"

Protoxyd of Iron	·003000 grammes
Alumina	traces,
Silica	·046500 "
Carbonic Acid	·920000 "

These ingredients may be combined to give the following composition for 1000 parts of the water:

Chlorid of Sodium	9·42310
" of Potassium	·12340
Bromid of Sodium	·01265
Iodid of Sodium	·00541
Carbonate of Soda	·17050
" of Baryta	·02260
" of Strontia	·01400
" of Lime	·35400
" of Magnesia	·54432
" of Iron	·00480
Silica	·04650
Alumina and phosphates	traces,
Carbonic Acid	·46914
Water	988.80958
	1000·00000

The amount of saline materials present is by calculation 10·721. Direct experiment gave of residue dried at 300° F. 10·526 parts for 1000.

The quantity of carbonic acid in the earthy carbonates is by calculation ·4508 and the whole amount by experiment ·920, so that it is little more than the quantity required to form with them bicarbonates. It equals nearly 23·7 cubic inches in 100.

A pound avoirdupois of 7000 grains (which is very nearly equal to a wine pint of 7291 grains, and was selected as more convenient for the purposes of comparison than a measured quantity), contains the following ingredients:

Chlorid of Sodium	65·96170 grains
" of Potassium	·86380 "
Bromid of Sodium	·08855 "
Iodid of Sodium	·03787 "
Carbonate of Soda	1·19350 "
" of Baryta	·15820 "
" of Strontia	·09800 "
" of Lime	2·47800 "
" of Magnesia	3·81024 "
" of Iron	.03360 "
Silica	·32550 "
Alumina and phosphates	traces,
	75·04896 grains.

II. *Inner Spring.*

The same remarks that have been made with reference to the last will apply here; it contains all of the ingredients there mentioned, but with some little variations in their proportions. Its specific gravity at 60° F. is 1007·71.

1000 grammes of it yield the following ingredients:

Chlorine	5·133000
Bromine	·003600
Iodine	·007200
Soda	4·664800
Potash	·025000
Baryta	·009600
Strontia	·006800
Lime	·195440
Magnesia	·169500
Protoxyd of Iron, Alumina	traces,
Silica	·054000
Carbonic Acid	·792000

These may be so combined as to give in 1000 parts of the water the following composition:

Chlorid of Sodium	8·42860
" of Potassium	·03820
Bromid of Sodium	·00460
Iodid of Sodium	·00850
Carbonate of Soda	·32606
" of Baryta	·01237
" of Strontia	.00960
" of Lime	·34900
" of Magnesia	·35590
" of Iron, Alumina	traces,
Silica	·05400
Carbonic Acid	·31250
Water	990.10067
	1000·00000

The calculated amount of solid matters in 1000 parts of water in 9·58683; experiment gave of residue dried at 300° F., 9·420 in 1000. The small portion of carbonic acid, which is not sufficient to form bicarbonates with the earthy bases, connects itself with the presence of carbonate of soda, which, as I have shewn

in the alkaline waters of Caledonia, forms a double salt with the carbonate of magnesia.—(See Report for 1847–8, p. 147.) The quantities of the adventitious gases as carburetted hydrogen, nitrogen and oxygen, which are present in small portions in these waters, were not determined. The amount of the carbonic acid gas equals 15·78 cubic inches in 100.

The pound of 7000 grains will contain:

Chlorid of Sodium	59·00020	grains
" of Potassium	·26740	"
Bromid of Sodium	·03220	"
Iodid of Sodium	·05950	"
Carbonate of Soda	2·28242	"
" of Baryta	·08659	"
" of Strontia	·06720	"
" of Lime	2·44300	"
" of Magnesia	2·49130	"
" of Iron, Alumina }	traces,	
Silica	·37800	"
	67·10781	grains

For the separation and determination of the baryta and strontia the following method was adopted.* Having evaporated several litres to dryness with an acid, to separate the silica, the residue was dissolved in a small quantity of water, mixed with a little dilute sulphuric acid, and allowed to stand for twenty-four hours. At the end of this time the precipitate then formed, was collected on a filter, slightly washed, dried and fused with carbonate of soda. The mass thus obtained was treated with water, and the carbonates after being well washed, were dissolved in hydrochloric acid, the solution evaporated to dryness, dissolved in a little water, and mixed with a solution of hydrofluosilicic acid, which on standing gave a granular precipitate of the fluosilicid of barium. The filtrate from this (the washings being rejected as holding in solution a little of the baryta salt,) gave with a solution of gypsum after some time, a precipitate of sulphate of strontia. The nature of this was still farther proved by reconverting it into a chlorid, which dissolved readily in strong alcohol, and gave a solution which burned with a carmine red flame.

* See Fresenius Anal. Quant., p. 293 *et seq.*

The presence of such an active therapeutic agent as baryta might be expected to give some marked medicinal character to these waters, and as it has been supposed to be especially efficient in scrofulous and glandular diseases, where the compounds of iodine and bromine are used with so much success, it is probable that they will possess some difference in their action from those saline springs which do not contain baryta and strontia. This is a question the discussion of which belongs to the medical faculty, and I would only wish by what I have said, to recommend the water of these sources to their attention.

St. Léon Spring.

This mineral spring is situated in the valley of the Rivière à la Glaise, about a mile from the church of the Parish of St. Léon. It rises through the clays of the region which there rest upon the Trenton Limestone. The water of the spring is clear and strongly saline, and is kept in constant ebullition by the escape of large quantities of carburetted hydrogen gas; the discharge from the spring is very considerable; the temperature of the well was found to be 46° F. on the 12th October, the air being 42°. The specific gravity of the water at 60° is 1011·23; its taste is at the same time markedly saline and ferruginous, and a qualitative analysis shewed the presence of chlorids, bromids and iodids of sodium, potassium, calcium and magnesium; minute quantities of barium and strontium were likewise detected, and carbonates of lime and magnesia as usual, with small portions of alumina, carbonate of iron, and silica.

1000 grammes of the water gave on analysis:

Chlorine	7·606820
Bromine	·007956
Iodine	·004230
Soda	6·094400
Potash	·115800
Baryta	·001360
Strontia	·001270
Lime	·226240
Magnesia	·729070
Protoxyd of Iron	·009000
Alumina	·014500
Silica	·086500
Carbonic Acid	1·224000

These ingredients may be combined to give the following composition for 1000 parts of water:

Chlorid of Sodium	11·496800
" of Potassium	·183200
" of Barium	·001957
" of Strontium	·001960
" of Calcium	.071870
" of Magnesium	·663642
Bromid of Magnesium	·009156
Iodid of Magnesium	·004630
Carbonate of Lime	·349320
" of Magnesia	·938800
" of Iron	·014500
Alumina	·014500
Silica	·086500
Carbonic Acid	·577400
Water	985·585765
	1000·000000

The amount of solid matters in 1000 parts is by calculation 13·836835; the quantity of carbonic acid above that required to form neutral carbonates, is equal to 29·16 cubic inches in 100.

One pound of the water will contain

Chlorid of Sodium	80·477600	grains
" of Potassium	1·282400	"
" of Barium	·013699	"
" of Strontium	.013720	"
" of Calcium	·503090	"
" of Magnesium	4·645494	"
Bromid of Magnesium	·064092	"
Iodid of Magnesium	·032410	"
Carbonate of Lime	2·445240	"
" of Magnesia	6·571600	"
" of Iron	·101500	"
Alumina	·101500	"
Silica	·605500	"
	96·857845	grains

This spring is at present owned by Mr. Samuel Hough of Quebec, who has erected a hotel at the site, which has already become a place of resort in summer for the people of the vicinity.

The Caxton Spring.

In the month of February, 1848, Samuel Hough, Esq., of Quebec, placed in my hands a quantity of water from this spring for examination. At that time I made such an analysis of it as I was enabled to execute upon the small quantity received, which did not enable me to determine the iodine or carbonic acid. For the purpose of completing my analysis, I visited the spring last fall, collected the water and submitted it to a farther examination, which resulted in a complete verification of the results previously obtained, and enables me to supply the deficient data.

The spring is situated in the Township of Caxton, on the Yamachiche River, about five leagues from the village of Yamachiche. The river here flows between banks of clay, which are often sixty to eighty feet high, and exceedingly abrupt. The underlying formations are not exposed in the vicinity, but the position is probably near the dividing line between the Trenton limestone and the Potsdam sandstone. The spring rises in the narrow valley that lies at the foot of the hill, and near the river, but a few feet above its ordinary level. The water which is remarkably transparent, rises with great force, accompanied with volumes of carburetted hydrogen gas, which keep it constantly in violent ebullition. The discharge of water is very considerable, probably six or eight gallons per minute; the temperature of the well was found on the 25th of October, to be 49° that of the air being 44°. The specific gravity of the water at 60° F. is 1010·36; it is strongly saline to the taste, but from the smaller portion of earthy carbonates, less bitter than that of St. Léon, which it much resembles. Like that it contains in addition to these and the usual alkaline chlorids, portions of bromids and iodids and a little carbonate of iron. No salts of barium or strontium were detected.

1000 grammes of the water afforded:

Chlorine	7·44689
Bromine	·02956
Iodine	·00355
Soda	6·23900
Potash	·05050
Lime	·14636
Magnesia	·65650

Iron (peroxyd)	·00360
Alumina	.00500
Silica	·04795
Carbonic Acid	1·12600

These may be combined to give the following compounds:

Chlorid of Sodium	11·77500
" of Potassium	·08000
" of Calcium	·05030
" of Magnesium	·37435
Bromid of Magnesium	·03420
Iodid of Magnesium	·00390
Carbonate of Lime	·21600
" of Magnesia	1·05930
" of Iron	·00540
Alumina	·00500
Silica	·04795
Carbonic Acid	·48200
Water	985·86660
	1000·00000

The amount of solid matters in 1000 parts is by calculation 13·6514.

One pound of 7000 grains gives the following contents:

Chlorid of Sodium	82·42500 grains
" of Potassium	·56000 "
" of Calcium	·35210 "
" of Magnesium	2·62045 "
Bromid of Magnesium	·23940 "
Iodid of Magnesium	·02730 "
Carbonate of Lime	1·51200 "
" of Magnesia	7.41510 "
" of Iron	·03780 "
Alumina	·03500 "
Silica	·33565 "
	95·55980 grains.

While in this vicinity, I visited a locality of mineral waters which had attracted some attention among the neighboring inhabitants. It is near the village of Champlain, and about three leagues from Three Rivers; there are two springs here, but one was so filled with surface water that nothing satisfactory could be determined.

The other was a feebly saline water, containing alkaline and earthy chlorids, with traces of bromids and iodids, but no sul-

phates. The precipitate on boiling was abundant, and consisted of earthy carbonates with a small portion of iron.

THE PLANTAGENET SPRING.

This mineral spring has been quite recently introduced to the notice of the public as a strongly medicated saline. I have not as yet visited the locality, but in the month of February last, Mr. Charles La Rocque, the proprietor, placed in my hands several gallons of the water, which I have submitted to a careful analysis.

The water has at 60° F. a specific gravity of 1009·39; its taste is strongly saline, and more bitter than that of the Caxton Spring, just described. Analysis shews the presence of the alkaline and earthy chlorids, with portions of bromine and iodine, besides carbonates of lime and magnesia, with traces of carbonate of iron.

1000 grammes of it gave of

Chlorine	6·96020	grammes
Bromine	·00700	"
Iodine	·00480	"
Soda	6·18414	"
Potash	·05600	"
Lime	·08736	"
Magnesia	·52353	"
Iron, protoxyd	·00540	"
Silica	·07000	"
Carbonic Acid	undetermined	

These when combined give the following salts for 1000 parts of the water:

Chlorid of Sodium	11·66600
" of Potassium	·10400
" of Calcium	·13640
" of Magnesium	·24522
Bromid of Magnesium	·00805
Iodid of Magnesium	·00527
Carbonate of Lime	·03300
" of Magnesia	·89043
" of Iron	·00964
Silica	·07000
	13·16801

7000 grains, or one pound avoirdupois, contain

Chlorid of Sodium	81·66200	grains
" of Potassium	·72800	"
" of Calcium	·95480	"
" of Magnesium	1·71654	"
Bromid of Magnesium	·05635	"
Iodid of Magnesium	.03689	"
Carbonate of Lime	·23100	"
" of Magnesia	6·23301	"
" of Iron	·06748	"
Silica	·49000	"
	92·17607	grains

The similarity between the last three waters is very close both in the nature and the quantity of the ingredients which they contain. It will be observed that that of St. Léon contains, like the sources of Varennes, baryta and strontia, but in much smaller portions; while that of Caxton is distinguished by the large amount of earthy carbonates which it contains. These three springs, with the Intermittent of Caledonia, constitute a well defined class of saline waters, which are contrasted with the other sources of Caledonia, and those of Varennes. In the first class all of the soda and portions of the lime and magnesia exist as chlorids, while in the second the quantity of chlorine is not sufficient for the alkaline bases, and all the lime and magnesia, with a portion of the soda, exist as carbonates. From the presence of the carbonate of soda these waters are alkaline and will possess different medicinal powers from the others, which contain chlorids of calcium and magnesium; the medicinal action of these two salts, and especially of the chlorid of calcium, is so well marked that their presence ought not to be disregarded in estimating the therapeutic value of a mineral water; the distinction here drawn is therefore one to which I would call the attention of the medical profession.

SPRINGS OF SABREVOIS.

Having received a specimen of mineral water from a spring at Alburgh, Vermont, which was interesting as being a very

alkaline sulphurous water, I was led to suppose that the springs which occur at Pike River in the Seigniory of Sabrevois, but a few miles distant from Alburgh, and in the same geological position, might be similar in character. I accordingly visited them early in the month of February, and collected the waters for examination.

The springs are situated about a mile from the village of Pike River. There are several of them which rise within a few rods of each other; but with the exception of two principal ones they were frozen and covered up with the deep snow. The one nearer to the road, and on the right side of the path or bush road which leads through the wood in which they are found, is designated the "Sulphur Spring," and the other, a few rods beyond, although equally sulphurous, is more saline to the taste, and is known as the "Saline Spring." The temperature of the first was 38° F. and although the air had been for several days at or below 0°, and was that morning, February 8th, 10° F. there was only a film of ice over it. The other was rather more frozen and had a temperature of 37°.

I have as yet only been able to submit these waters to a qualitative analysis; they are both but feebly impregnated with mineral ingredients. The Sulphur Spring, as it is called, contains sufficient sulphuretted hydrogen to give it a flavor when recent, but the quantity is very small; it is slightly saline, and when evaporated deposits earthy carbonates, while the residue contains alkaline and earthy chlorids, with a small portion of sulphates, and slight traces of bromine and iodine. These elements may be so combined as to give chlorid of sodium with a little chlorid of potassium, sulphate of lime, chlorid of magnesium with traces of bromid and iodid of that base, besides carbonates of lime and magnesia.

The amount of sulphuretted hydrogen in the second spring is likewise very small, but the water is much more saline. It contains no sulphates, but gives on the addition of sulphate of lime, a precipitate indicating baryta and perhaps strontia. It contains both alkaline and earthy chlorids and small portions of bromids and iodids, besides carbonates of lime and magnesia, and a trace of

iron. From these we may deduce the following as the mineral ingredients of the water :—chlorid of sodium with a trace of potassium, chlorids of calcium, magnesium and barium or strontium, with small portions of iodid and bromid of magnesium, besides carbonates of lime and magnesia, and a trace of iron.

While in this vicinity, I visited a sulphurous spring on the land of David Miller, about two miles south of Henryville. The spring was frozen over and covered with deep snow, while a severe storm which was raging at the same time precluded the possibility of making an accurate examination. A portion of the water was however brought away, and the amount of sulphuretted hydrogen determined.

The water resembles that of Alburgh ; it is quite sulphurous, and has a somewhat sweetish saline taste. It is strongly alkaline in its reactions with tests, and when evaporated to one tenth is distinctly so to the taste. In addition to carbonate of soda, it contains a considerable amount of chlorids and a feeble trace of iodid of sodium. During evaporation it deposits abundance of carbonates of lime and magnesia. The amount of sulphuretted hydrogen corresponds to 1·6 cubic inches in 100 of the water. This spring is deserving of farther examination.

SALINE SPRING OF ST. BENOIT.

Having been informed by the Honorable A. N. Morin, of a saline spring at the village of St. Benoit, I proceeded, after my return from Sabrevois, to examine it.

The spring, which is situated directly opposite to the ruins of the burned church, issues from a tertiary clay which here overlies the Potsdam sandstone, and has been excavated to the depth of twelve feet. The supply of the water is copious ; it rises in a tube or box which surrounds it, fully three feet above the level of the earth, and would probably rise much higher if properly enclosed. The temperature of the spring on the 22nd of February, was 41° ; the air being 22°.

The specific gravity of the water at 60° F. is 1004·32 ; it is saline to the taste, though not strongly so ; when boiled it deposits an insignificant quantity of earthy carbonates. The liquid

contains chlorids of sodium, calcium and magnesium, with a considerable quantity of sulphate of lime, besides portions of bromid and iodid of magnesium, although in less quantities than in many of our saline waters. It has not yet been submitted to a quantitative analysis.

ST. JOHN'S SPRING, QUEBEC.

Last fall, at the request of some gentlemen of that city, I visited Quebec, to examine a sulphurous spring which occurs in St. John's suburb, on the property of Joseph Hamel, Esq.

The specimen obtained was much diluted with surface water, which at that season it was impossible to exclude; this however, did not prevent a qualitative analysis, which shews it to be an alkaline sulphurous water, like the "Sulphur Spring" at Caledonia, and that of Henryville, described above. It contains sulphate and chlorid of sodium, with a small quantity of carbonate of soda, besides a considerable amount of carbonates of lime and magnesia held in solution by carbonic acid; no bromine or iodine were detected in it. The spring is of an interesting class, and is worthy of notice; the mixture of rain water at the time deterred me from attempting a quantitative analysis of it.

MINERALS AND METALLIC ORES.

Lake Huron.

The examinations at the Bruce Mines developed no minerals of interest other than the ordinary ores of copper: the chemical analysis of the various samples of ore, embracing upwards of fifty assays, have been already published in your Report upon the Mines.

The nickel ore from the Wallace Mine on the White Fish River, referred to in Mr. Murray's Report, has been submitted to a partial examination. The specimen was a mixture of a steel gray arseniuret, the species of which I have not yet determined, with white iron pyrites, and probably some arsenical sulphuret of iron. As the immediate object of the analysis was to determine the proportion of nickel and other valuable materials in the crude ore, a mass weighing forty-five ounces was reduced to powder,

and submitted to analysis by the usual methods, with the following results :

Iron	24·78	
Nickel with a trace of Cobalt	8·26	
Arsenic (mean of two determinations)	3·57	
Sulphur	22·63	
Copper	0·06	
		59·30
Silica	28·40	
Carbonate of Lime	4·00	
Magnesia	4.40	
Alumina	3·21	
		40·01
		99·31

The cobalt equals about three parts in a thousand of the weight of the oxyd of nickel as given above, and is only detected by delicate tests. The five substances making 59·30 per cent of the ore are separated as corresponding to the metallic portion of the mass, although it is probable a portion of the iron is derived from the gangue.

In the process of dressing the ore, the earthy parts being removed by washing, the composition of the ore in 100 parts, as deduced by calculation from the above, would be

Iron	41·79
Nickel } Cobalt }	13·93
Arsenic	6·02
Sulphur	38·16
Copper	·10
	100.00

The small proportion of arsenic shews that a great portion of the metals must exist as simple sulphurets, and that, contrary to what might have been supposed at first sight, a large part of the grayish ore must be white iron pyrites.

A mass of the copper ore from the same mine weighing nine and a half pounds, was submitted to assay. The metal existed in the form of copper pyrites, and the yield of the specimen was 11·6 per cent of metallic copper.

The specimens of ores from this locality are very liable to decomposition by exposure to the atmosphere, and the result of this process upon the nickel ore, is a salt which has not to my knowledge ever before been described as a natural product. It coats the surfaces with a delicate white or greenish-white efflorescence, which in some cases is seen to be composed of extremely delicate acicular crystals several lines in length, and apparently rhombic in form; the taste is metallic-astringent. By a gentle heat the salt loses water, and the residue, which is perfectly soluble gives the reactions of sulphuric acid and nickel. No other metal is present, and hence the crystals are a hydrous sulphate of nickel, which is appropriately designated mineralogically as *nickel vitriol.*

The decomposition of cobaltiferous ores often gives rise to a product of very great value, the earthy cobalt, which is an oxyd of the metal, mixed with variable portions of iron, manganese, &c. Very valuable deposits of this have recently been found in Missouri which are already a source of great profit; they are derived from sulphuret and arseniuret of cobalt, which, associated with nickel, copper and lead, abound in the vicinity. The detection of a small portion of cobalt in association with these metals upon the shores of Lake Huron, should lead us to look for deposits of this rare and valuable material.

In the same band of rocks farther west, metalliferous veins occur, presenting copper with manganese, and it is not improbable that with these associations we may detect the presence of nickel and cobalt. In the veins on the coast, near the mouth of Spanish River, rutile occurs in delicate acicular crystals.

The Wallace Mine is the second place in which cobalt has been detected in Canada. I have already noticed it in the form of arseniate of cobalt, forming reddish crusts upon calcareous spar, at Prince's Location on Lake Superior. In this locality it is associated with vitreous copper, green and blue malachite, and native silver, while other parts of the same vein yield native silver, vitreous silver, blende and copper pyrites; in this connexion it may be mentioned that a mass of the silver ore, selected by myself from some hundreds of pounds, as an average sample, gave on assay 3·6014 per cent of silver, equal to 72 lbs. to the ton of ore.

A portion of the silver, extracted by a furnace assay from this ore, was found on examination to contain a small portion of gold, amounting to about one part in 7000 of the silver.

Eastern Townships.

The results of such of my mineralogical examinations in the Townships of the East as have not been embodied in your own Report, will be the subject of future description when I shall have been enabled to submit them to a careful consideration. Many substances, rare and of great scientific interest, have been detected; I shall at present give only the names and localities of some of them. In the trap of Montreal, yellow sphene, cancrinite, with heulandite and analcime; in the trap of the Mountains of Brome, Yamaska, and St. Therese, the same sphene has been detected, and in the first associated with fine blue cancrinite, reddish elaeolite and crystals of a white nepheline or sodalite. The magnetic iron ore beds of Sutton, and Brome, have furnished veins of a rare variety of sphene, which is white, often tinged green from the presence of copper. Rutile in small brilliant crystals, was found associated with crystallized specular iron in Sutton, and the latter species, which is found in many other localities, is finely crystallized in quartz in St. Armand, and in tabular crystals an inch and more in diameter, in Inverness. The clay and talcose slates of Brome contain in abundance the rare mineral ottrellite or phyllite, while the soapstone and serpentine rocks have in a great number of places afforded picrolite, talc, amianthus, a species which appears to be kammerite or rhodochrome, schiller spar, diallage in vast quantity, and chromic and magnetic iron. In Bolton and Sutton, a massive crystalline carbonate of magnesia is found in beds, in the latter locality associated with talc, colored of an emerald green by oxyd of chromium. The carbonate contains a small portion of carbonate of iron, and from its composition seems referable to the species Breunerite. Carbonate of lime, in the unusual form of arragonite, forms stalactites and delicate fibrous masses in a calcareous rock in Tring. The serpentine on the Rivière Bras, contains many veins of pure white heavy spar; the rutile and titaniferous iron ore of this region have already been mentioned. The dolomitic limestone and talcose rocks are very often stained

with chrome green. In the nineteenth lot of the eleventh range of Brompton, nickel ochre, a product due to a decomposition analogous with that giving origin to the nickel vitriol, was detected forming incrustations upon limestone, a fact which suggests the probability of finding cobalt (these two metals being almost invariably associated,) in connexion with the adjacent deposits of manganese, which are there quite common.

I have the honor to be,

Sir,

Your most obedient servant,

T. S. HUNT,

Chemist and Mineralogist to the Geological Survey.

DIGEST OF THE

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