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GEOLOGICAL SURVEY

OF

CANADA.

REPORT OF PROGRESS
FOR THE YEAR 1849-50.

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GEOLOGICAL SURVEY OF CANADA.

MONTREAL, *May* 1, 1850.

SIR,

I have the honor to request you will do me the favor to present to His Excellency the Governor General, the accompanying Report of the progress made in the Geological Survey of the Province, during the year 1849-50.

I have the honor to be,

Sir,

Your most obedient servant,

W. E. LOGAN,

Provincial Geologist.

To the Hon'ble. 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, 1st *May*, 1850.

MAY IT PLEASE YOUR EXCELLENCY:

I have the honor to submit to Your Excellency's consideration the following Report of the progress made in the Geological Survey of the Province, during the year which has just elapsed.

A description of the soils of the country being one of the objects contemplated by the Legislative Act making provision for the Survey, Mr. Hunt was instructed to collect samples in different parts of both sections of the Province. The analyses of these have constituted the chief portion of his labors during the winter, in addition to the examination of various ores, minerals and mineral waters; and his Report on the result of his investigations I have now the honor of transmitting to your Excellency.

Agreeably to the design expressed in the Report of Progress of the 1st *May* last, my own attention has been principally devoted to the examination of the formations of the Eastern Townships, in their continuation beyond the Chaudière River to the Temiscouata Portage Road, in which I was aided by Mr. Murray

during the whole, and by Mr. Hunt for part of the time it occupied; but having been given to understand that an unsuccessful application had been made to the Legislature, during the last Session of the Provincial Parliament, by the member for Saguenay County, for the means of prosecuting researches for coal by boring, in the vicinity of Bay St. Paul, where the discovery of supposed indications of the mineral had been proclaimed by some of the inhabitants, and that the Government were desirous the geological character of the locality should be examined; for this purpose, when we arrived at L'Islet, in the progress of our exploration on the south side, the opportunity was taken to cross the St. Lawrence to the locality in question, and two weeks were employed in investigating the rocks in the neighborhood of Bay St. Paul, and also those of Murray Bay, which present features of a similar kind. The time thus subtracted from the exploration of the south side, disabled us from effecting so complete an examination in some parts of the region as we could have wished; but indeed, in respect to the whole of that region, the very complicated contortions of its strata, their frequent metamorphosed condition, and the great extent of surface that still remains unreclaimed from the forest, and unrepresented on any map, are such as would require a much longer exploration than has been bestowed upon it, or than can perhaps be at present awarded to it with due regard to other parts of the Province, to follow out the details of its physical structure. Many of the facts that have been ascertained appear isolated, and would require a knowledge of many more to bring into view their harmonious relation as parts of a whole, and it can only be a very general sketch of some of the main geological features of the district, that can at this moment be presented in connexion with and continuation of those exhibited in last year's Report.

In proceeding to place before Your Excellency some of the prominent facts ascertained during the season, it will be convenient to give precedence to those derived from Bay St. Paul and Murray Bay, as the rocks there met with support those constituting the south side of the St. Lawrence, and by placing them first, an ascending order of sequence will be maintained in the formations that enter into the present description.

BAY ST. PAUL AND MURRAY BAY.

These two bays, about seven leagues apart, are the terminations of two valleys, scooped out of a mountainous country, and resemble one another in almost every respect, with the exception of their direction. The valley of Bay St. Paul, through which flows the River Gouffre, has a north and south bearing, while that of the Murray Bay River in the portion of its course at present included, runs about S. 55 E. ; the former is the one further west, and it follows that the valleys approach one another in the interior; so that about ten or twelve miles up the Murray Bay River the distance between them is not over four or five miles, and there appears to be a depression from the one to the other along the foot of a range of high hills in which the Gouffre springs, but across which the Murray Bay River runs in a deep gorge, its sources being in the vicinity of those of the Montmorency River. From this vicinity it flows first to the north-east and then turns at nearly a right angle to this course, about eleven miles on the road from Bay St. Paul to Chicoutimi on the Saguenay. This road runs through the valley of the Gouffre, and another one joins it coming from the valley of the Murray Bay River and passing the Ruisseau des Frènes, the Little Lake and Nainé Lake, which are all tributary to this river. Both the valleys display a considerable amount of settlement for nine or ten miles up; the soil in both, to heights of 300 to 400 feet, is generally strong clay, with occasional patches of sand and gravel, and in the middle of the valleys these materials are found singularly distributed, not in even extensive layers, but in a multitude of small hills or hummocks, often of a perfectly conical form, thickly aggregated in many parts, and affording a marked characteristic. The soil of the uplands appears also in general argillaceous, but rising towards the mountains it becomes remarkably stony. The block of country between the valleys is mountainous, and so is the coast both above and below them, and the general elevation must be considerable, perhaps over a thousand feet above the level of the St. Lawrence. These elevated parts however, often shew excellent farms, from the fields of which the stones have been removed with great labor, and the

farms produce good crops of oats, barley, rye, pease and potatoes, in addition to which in the valleys, before the Hessian fly became so destructive in Lower Canada, abundant crops of wheat used to be obtained, and there can be little doubt, if due attention were paid to the application of manure, the mountainous character of the district would not deprive it of considerable agricultural value. A narrow strip of country on the margin of the St. Lawrence, occupying about fifteen miles of the distance between Bay St. Paul and Murray Bay, is marked by some of the same features as the valleys; included in the distance is the spot called *Les Eboulis*, displaying the ruins of a great land-slip, by which a vast mass of clay, sand and gravel has been precipitated from the higher ground and pushed forward into the St. Lawrence, where it is now spread out into an area occupying about one third of a square mile; the surface presents the mammillated character marking the lower levels of the valleys, whose aggregated hummocks may be due to a similar cause.

The rock formations met with in the district, in ascending order, are as follows:

1. *Metamorphic Group.*
2. *White Quartz rock.* (*Potsdam Sandstone.*)
3. *Calciferous Sand rock.*
4. *Bituminous Limestone.* (*Trenton.*)

1. *Metamorphic Group.*—The prevailing rock which constitutes this mountainous tract of country is gneiss, sometimes of a granitic and sometimes of a syenitic character. On the west side of the valley of the Gouffre, where a path from Côte St. Antoine crosses a temporary foot bridge on the Bras du Nord-ouest, the rock is a true gneiss, with black mica; it holds garnets in abundance, and its stratification shews a dip S.E. mag. $<30^{\circ}$. Near the Rivière des Mares the rock was found to consist of opaque white quartz and feldspar with black mica, so aggregated as to give an excellent building stone. On the uplands west of St. Urbain Church, where the rock holds great masses of titaniferous iron ore, the mica was replaced by hornblende; and on the east side of Bay St. Paul, its constituents were greenish feldspar, translucent white quartz and black hornblende. On the

west side of Murray Bay, above White Cape, the gneissoid character of the rock is very distinctly displayed in a set of beds, which are marked by diversities of color allied to red, green, black and white; these beds are granitic, but very quartzose, and there are some bands among them that have the aspect of a slightly micaceous quartz rock; crystals of hornblende are sparingly disseminated in some of the beds, and epidote is present in others. The dip of the beds in the locality is N. W. mag, $<30^{\circ}$ to 35° , and there is present among them a large grained red granitic dyke, running in general with the strike, but here and there shewing its intrusive nature by cutting the basset edges of the gneissoid beds at a very small angle. On the east side of Murray Bay near Les Ecorchis, the gneiss presents the aspect of a dark gray compact, slightly micaceous hornblende slate, which would yield excellent flagging; in some of the layers epidote is met with. The gneiss is here also cut by a very coarse-grained dyke running generally with the stratification and consisting of quartz and opaque white feldspar, the latter in large cleavable forms, while hornblende prevails on each side of the dyke towards its contact with the gneiss. A little farther to the eastward, before reaching Le Heu, there is a very great and conspicuous large grained white dyke of a similar character; although it runs with the gneissoid layers in direction and often in dip, it is yet occasionally seen to cut down through them. It holds a large preponderance of feldspar, and in many places contains rather thickly disseminated small pink garnets; on each side of the dyke for some feet, the rock, consisting almost wholly of mica, is set with a great profusion of large coarse imperfectly crystallized garnets of the same pink color as the small ones; they are accompanied by small quantities of graphite, and the garnet-bearing part is so interlaced and cut up by white strings and branches emanating from the main dyke, that it is difficult, without a little study, to say whether it belongs to the country or the intruded mass. Near a rivulet between Les Ecorchis and Le Heu this garnet-bearing dyke is suddenly brought up against the more regular gneissoid beds to the west, by a transverse dislocation, which heaving its continuation out of sight, (but in which direction it is

uncertain,) serves, with an anticlinal fold in the beds to the west, to illustrate the disturbed condition of the strata.

The gneiss of this district belongs to that metamorphic group of rocks, which in previous Reports has been described as existing on the Ottawa, and as traceable thence, removed back usually to a distance of twelve to twenty miles from the north-west margin of the St. Lawrence, all the way to Cape Tourmente below Quebec, where it comes upon the river and from which it is washed by it to Bay St. Paul. None of the highly crystalline limestones, which on the Ottawa are so marked a feature of the group, were observed in the region under attention, but the examination has been of too limited and cursory a nature to determine their absence.

2. *White Quartz rock*.—This rock, which overlies the previous formation, was not seen at Bay St. Paul, but was met with on the west side of Murray Bay, above White Point, and at two spots on the east side, one of them within sight of the church just before reaching the Cape which it is necessary to double in proceeding along the beach to Les Ecorchis, and the other close by Les Ecorchis. In these three localities the formation consists of white translucent slaty quartz rock, rendered cleavable by the presence of silvery mica, into plates of half an inch to two or three inches thick, which appear to be conformable with the stratification; cracks in the rock occasionally present green stains due to carbonate of copper. If it were not for the fact, that in the different localities of its presence it succeeds different qualities of the gneissoid beds, while a uniformity is preserved in the character of the strata that succeed it, the rock might be mistaken for a more than usually quartzose member of the subjacent formation, from which however it might perhaps be occasionally distinguished by a want of conformity in its stratification. The thickness of the deposit at Les Ecorchis is about forty-five feet; but it is not improbable, that lying on an uneven surface, the inequalities of which it may fill up, it may be found to exceed this in other places. There appears to be little doubt that this rock is equivalent to the Potsdam sandstone of New York.

3. *Calcareous Sandrock*.—Resting conformably on the previous formation, there is met with a calcareous sandstone, or arena-

aceous limestone, of which, though observed both at Bay St. Paul and Murray Bay, the sequence is determined by the exposures at the latter place. At Murray Bay the rock was met with at White Cape; the point which there bounds the boat cove on the south is composed of it; in the cove some beds, partially concealed by sand, dip N. W. mag. $<51^{\circ}$, but at the small point mentioned, the dip gradually changes by a fold in the strata to E. mag. $<58^{\circ}$. With this dip, the beds shew a breadth of about twenty-three yards, which would give a thickness of fifty-eight feet. As a mass, the rock is here a calcareous sandstone, but the arenaceous layers are interstratified with occasional bands of limestone; the uppermost bed is of limestone, and there are some few of the same kind near the bottom. In one or two of the arenaceous beds there are quartz pebbles as large as hens' eggs, constituting them conglomerates, but in general the grains range from the size of snipe to that of partridge and pigeon shot, and they are usually so well rounded as to give an oolitic aspect to the rock; they consist both of limestone and quartz; sometimes the calcareous but in general the siliceous grains prevail, and the latter frequently to a considerable extent; the color of the beds is in general a dirty white. To the west of the boat cove there are two hummocks of the rock, forming the bluff from which White Cape takes its name. The character of the strata here displayed very much resembles what has already been described; the face of the cliff shews a section giving a thickness of between fifty and sixty feet, across a shallow trough in the strata, which on the west side, rise up at an angle, as displayed on the beach, of seventy degrees, maintained for sixteen yards, which would give a thickness of forty-five feet more. There then occurs an irregularity, beyond which a dip of N. 45° E. mag. $<85^{\circ}$ to 90° , is maintained for about thirty-five yards, and the 105 feet resulting from this may probably present a repetition of the two previous measurements. A gravel covered space of about fifty yards in a south-west direction occurs between the calcareous sandstone and a cliff of gneiss, the strata of which dip N. 45° W. mag. $<49^{\circ}$, moderating to $<30^{\circ}$ a short distance in the strike; the subjacent white quartz rock may be covered up in this interval, but it was not seen.

Some of the beds at White Cape are fossiliferous; a coral occurs in one of the coarse beds, and a convoluted shell, probably of the genus *Euomphalus*, in the more calcareous layers. On the east side of Murray Bay, where the white quartz occurs within sight of the church, it is immediately followed by a coarse conglomerate bed, which though on the whole conformable with it, fills up hollows and inequalities in its surface. The conglomerate appears to be composed of various moderately sized fragments of the quartz rock, and even considerable boulders or large angular blocks of it, held in various attitudes, in a partially calcareous cement, from which it would seem that the elements of the quartz rock had become indurated before the deposit of the conglomerate. This conglomerate is the base of the calciferous sand rock, and it is followed by finer calcareo-arenaceous layers; but though the succeeding formation makes its appearance not far from them, there are too many irregularities in the vicinity to give data to determine the total thickness of the deposit. Near Les Ecorchis the development is more complete; the lower part of the deposit there consists of calcareous sandstone, with a band or two of conglomerate, holding pebbles as large as pigeons' eggs, followed by gray and whitish layers, which weather of a yellowish white, assuming a light drab while the stone is wet. These are followed by a set of calcareo-arenaceous beds, which, though of a nearly uniform light gray color in fresh fractures, weather to a yellowish white and a reddish white, the two colors alternating with one another in the upper half of the deposit. The total thickness of the deposit is about sixty feet.

4. *Bituminous Limestone*.—The calcareous sandstones are followed by bituminous limestone beds, which are highly fossiliferous, and these in some parts display a considerable thickness. The following is a section at Les Ecorchis, in which are given, in descending order, all the deposits in succession to the gneiss:

Dark gray bituminous limestone, holding numerous fossils; this constitutes the face of the cliff, say.....	150 feet
Dark gray bituminous thin bedded limestone, holding fossils.....	12
Dark gray bituminous thin bedded limestone, somewhat nodular, holding fossils	16

Light gray calcareous sandstone ; slight differences of shade alternate, the darker weathering to a reddish white, the lighter to a yellowish white.....	13
Light gray calcareous sandstone, in a thick bed, weathering to a yellowish white.....	10
Light gray calcareous sandstone, in alternating differences of shade, weathering yellowish white and reddish white	7
Light gray calcareous sandstone, weathering yellowish white.....	1
Light gray calcareous sandstone, weathering reddish white.	3
Light gray calcareous sandstone, weathering to a yellowish white ; when wet the exterior of the stone is a light drab.....	13
Light gray and whitish sandstone, of a calcareous character	7
Light gray calcareous sandstone, some of the beds of a conglomerate character, holding quartz pebbles as large as pigeons' and hens' eggs	3
	— 57
Measures imperfectly exposed, in which a few alternating beds of gray and white quartz rock or sandstone are seen.....	14
White quartz rock, divided into plates by the presence of silvery mica	25
Measures concealed, supposed to be white quartz rock, succeeding which gneiss appears	6
	— 45
Total thickness displayed.....	<u>280</u>

The fossils met with in the bituminous part of the section, several of them having been found loose at the base of the cliff at Les Ecorchis, adopting the nomenclature of Mr. Hall of New York, in the first volume of his Palæontology, are as follows :— *Chætitis lycoperdon*, *Stictopora*? ———? *Streptoplasma corniculum*, *S. crassa*, *Receptaculites neptuni*, *Schizocrinus nudosus*, *Leptena alternata*, *L. sericia*, *Orthis pectinella*, *O.* ———? *Atrypa ambigua*, *Orthoceras* ———? *Platynotus trentonensis*, *Calymene senaria*.

At Bay St. Paul there is a great development of bituminous limestone at Cap au Rets, between which and the gneiss running out into Cap Rouge, the cliff exposes a section nearly at right angles to the strike of the strata. The general dip is westward, at an angle increasing irregularly from sixteen up to sixty degrees, as it approaches the gneiss ; between the limestone and the gneiss there is an interval of concealment of about fifty yards across

the measures, in which the calciferous sandstone may perhaps exist; but independent of this, and making an allowance for one or two twists visible in the cliff, there is breadth enough completely denuded to give a thickness of between 600 and 700 feet, the whole of which consists of dark gray and black bituminous limestone, with the exception of a band of white sandstone, within about thirty-five feet of the bottom: the calcareous beds are of various thicknesses, separated by partings of black bituminous shale. The rock is fossiliferous, and among the remains here met with are *Fucoides* ———? *Graptolithus amplexicaule*, *Asterias matutina*, *Leptena sericia*, *Orthis testudinaria*, *Atrypa extans*, *Avicula trentonensis*? *Calymene senaria*, *C.* ———? and *Trinucleus concentricus*,—nearly all, as well as those occurring at Les Ecorchis, belonging to the Trenton limestone of New York. There can therefore be little doubt of the true age of the deposit, and of the fact that it is far beneath the recognized carboniferous rocks of North America.

On the west side of Bay St. Paul, the same bituminous limestone is met with at the mill on the Rivière au Moulin. The deposit is here seen to dip eastward, and there is evidence to prove that it is brought into position by a dislocation. The bituminous beds abut against the gneiss without the intervention of the calciferous sandstone, or white quartz rock, and at the point of contact, the slope, which near the mill does not exhibit more than twenty to thirty degrees, is suddenly turned up on one side of the stream, at the cascade, to sixty and on the other to ninety degrees, while in one spot the strata, conforming to the face of the cliff, even overhang the perpendicular. The direction of the junction of the two rocks is N. 60° W. mag.; but following up the ravine, above the edge of the cascade, in a direction nearly transverse to this, after passing over a few yards of the gneiss, the limestone again occurs, and continues present on one side of the ravine, while gneiss occupies the other for the space of nearly fifty yards, to the second vertical leap in the fall. Here a face of gneiss presents itself, running N. 35° W. mag.; and on the east and west sides of the limestone thus limited, mineral veins occur holding small unworkable quantities of galena, which was tried for silver, but gave no trace. The gangue in which the ore is

set is composed of calcspar, partly colorless and transparent, and partly opaque white, mingled with apple green apatite, or phosphate of lime. The veins on the west side of the limestone are smaller than those on the east, but they are all probably ramifications connected with one great line of disturbance; on the east side there are two parallel veins in the space of six feet, one of them being three feet wide, including a fragment of gneissoid rock, occupying half the breadth. Veins of a similar character, running in a nearly parallel course, were met with near Les Ecorchis, where they cut all the formations.

The direction of these veins, though it runs with the strike of the limestone and its associated formations as they appear in the vicinity, is yet transverse to the great trend of the rocks through the country, which is from south-west to north-east, and such dislocations as those the veins are connected with, have probably been instrumental in giving the formations of the valleys of Bay St. Paul and Murray Bay, their peculiar geographical distribution. These formations lie in the valleys in the shape of long irregular troughs; in the valley of the Gouffre, the bituminous limestone, which at the mouth of the River has a breadth of two miles, was traced up to St. Urbain, a distance of about ten miles, reaching it without any disruption probably of its continuity; it is contracted however to a width of half a mile a little over half way up, at St. Croix and the Rivière Remy, but it widens again to a mile, before it terminates above the Church of St. Urbain. In Murray Bay, and on the coast below, it presents upwards of six miles to the St. Lawrence, and runs as many up the Murray Bay River, with a general breadth of two miles. At the bridge however near the mouth of the River, an undulation brings to the surface a narrow belt of the gneiss, which, running in an east and west course, approaches the coast beyond Le Heu, and there appears to be another parallel undulation immediately behind Les Ecorchis. Proceeding along the road from the Murray Bay River, by the Ruisseau des Frènes, there occurs a small patch of the limestone before reaching the Little Lake, and a larger one appears to extend from the Little Lake to Nairne's Lake. The latter patch is not over ten miles from the limestone of St. Urbain, and it is not impossible there may be

others between the valleys of the Gouffre and Murray Bay Rivers in the depression that runs from the one to the other. Between the mouths of these Rivers, on the St. Lawrence, the narrow fifteen miles strip of country mentioned as bearing some of the general characteristic features of these valleys, is underlaid by bituminous limestone; it extends from a point about half a mile above Les Eboulis to Little Malbaie, and displays some picturesque scenery, where intersected by the streams that descend from the gneissoid mountains behind. In this respect, nothing can surpass the romantic dell immediately near the residence of Dr. LaTerrière, where a succession of lofty waterfalls, towering precipices and wooded crags, combine to offer points of view of most striking beauty. This strip of calcareous country no doubt marks the general course of the outcrop of the Trenton limestone and the two inferior formations, in their progress down the St. Lawrence, the north bank of which appears to be the main boundary of those deposits, from Cape Tourmente to Labrador. In most parts of the distance they are concealed by the water, but they occasionally come upon the land in narrow strips and isolated spots, and from this main outcrop the limestones of the Gouffre and the Murray Bay Rivers are long tongue-like projections, with, in the latter case, outlying patches beyond.

Tertiary Deposit.

In the valleys of the Gouffre and the Murray Bay Rivers, as well as along the margin of the St. Lawrence between them, there are at various parts great accumulations of clay and sand with some gravel; and it is very perceptible that while they often present a confused aggregation of hummocks in the lower grounds, at higher levels, lying in horizontal beds, they are arranged into a succession of opposite terraces of equal height along the sides of the valleys, and corresponding terraces at intervals along the St. Lawrence, all probably marking ancient beaches or periods of retrocession of a tertiary sea by the elevation of the land. In the valley of the Gouffre a rude attempt was made with a pocket level to ascertain the height of some of these terraces. Two of them were well marked, and the approximation arrived at in regard to them, was one hundred and

thirty feet or the lower, and three hundred and sixty feet for the higher, over high water mark, in Bay St. Paul. The deposits in which these terraces were worn, consisted of clay, containing marine shells, among which were *Tellina groenlandica*, *T. calcarea*, *Saxicava rugosa*, with the genera *Nucula*, *Venus*, *Mytilus*, and *Balanus*; and their presence was traced up to a height of three hundred and ninety feet, though there was not at the spot any well indicated terrace. At Little Malbaie there were no less than six terraces, plainly visible one above another, but the heights were not ascertained. In the valley of the Murray Bay River, a great thickness of clay was met with on each side, and land slips had exposed in some parts nearly vertical sections of the horizontal beds making up the mass. On the Mailloux River, falling into the Bay a little above the church, a section of sixty to eighty feet is exposed, and near this the stream is precipitated in a cascade over a very steep face in the deposit, which is evidently fast yielding to the destructive agency of the water. The presence of moisture in some bed low down in the cliff, more arenaceous than others, and the want of support in front permit movements to occur, causing cracks at short distances from the edge; the water of the stream penetrates into these, and meeting with the more arenaceous layer escapes through it, quickly softening the base upon which the superincumbent clay reposes; the weight of this forces the bottom to slip out, and a slice of the cliff gently slides down to the foot of the cascade, gradually assuming a more and more recumbent position in its progress, the original surface of the slice gradually sloping more towards the cliff until at last it remains nearly facing it. The ruin is soon swept away by the stream, and as the cascade thus recedes, the sides display precipices from which, with the aid of rain, slides descend in the same manner, though at greater intervals of time. The summit of the deposit in this part exhibits a nearly horizontal surface, with the exception of a channel of no great depth for the river, for a mile up the valley to the foot of an upward step composed of sand, which appears to overlie the clay; this step not improbably indicates an ancient beach. By landslips a vast body of clay has been swept away, not only from the valley of the Mailloux, but no

doubt also from those of the Gouffre and the Murray Bay Rivers, both of which may at some ancient period have been nearly filled with the deposit up to the height of the terraces.

Economic Materials.

Among the economic materials of Bay St. Paul and Murray Bay, it is a matter of regret that I have it not in my power to include the coal reported to have been discovered there. Upwards of two years since, the Commissioner of Crown Lands transferred to me a few specimens of this mineral, which had accompanied a petition from Messrs. Julien Bouchard and Abraham Menard, of Bay St. Paul, to Your Excellency, representing that they had discovered such indications of its existence on their farms, as induced them to request an examination of the locality, by a competent person, at the expense of the Government. Knowing the general strike of the formations through the country, and being aware, from previous examination, as stated in previous reports, that a band of calcareous rock of the age of the Trenton limestone of New York, which is well ascertained to be far below the recognized carboniferous deposits of North America, carried its outcrop in a continuous line from Grenville on the Ottawa, to Beauport below Quebec, on the north side of the St. Lawrence; and that another formation (contemporaneous with the Hudson River group of New York,) superior to the Trenton limestone, but also far beneath the same carboniferous deposits, extended on the south side of the St. Lawrence, from Point Levi to Cape Rosier, it was but reasonable to infer that the calcareous rocks of Bay St. Paul, which have been mentioned in published geological papers by Capt. Baddeley and Capt. Bayfield, were of the Trenton era. The existence of workable coal beds in them, so far below their ordinary position, would have been a new fact, not only in relation to the carboniferous eras of other continents, but to that of North America itself, while it would also have appeared strange that the Trenton limestone, which in Canada and the United States has been examined over thousands of miles without any trace of true coal, should shew so novel and exceptional a feature at Bay St. Paul. The improbabilities of the case induced me to consider that it would not be expedient to anticipate

the visit that would be made to the locality in its turn in the due course of examination ; but the application made to the Legislature at its last Session by the Member for Saguenay County, for the purpose of moving the Government to incur the expense of prosecuting researches there for the mineral, by the costly method of boring, and the express desire of the Government to know whether the geological character of the locality would justify such an experiment, have prompted me, sooner than intended, to effect the examination from which the facts detailed in the geological description which has preceded have resulted. These facts, as they are related to the general trend of the formations through Lower Canada, to the sequence of those rocks which are associated in the locality, and to the character of the fossils with which the limestone of Bay St. Paul abounds, fully bear out that the age of this calcareous deposit is precisely such as was anticipated ; and it only remains to be considered whether the circumstances which have been adduced as affording indications of the existence of coal, are of such a conclusive nature as to raise up a probability that the Trenton limestone in Bay St. Paul presents conditions new to the formation, and new to geology.

The fact upon which the existence of coal was predicated, was that several persons worthy of credit, having visited certain springs of water on the farms of J. Bouchard and A. Menard, had extracted with their own hands, and seen others extract from the springs, pieces of coal of good quality, which were supposed to have been brought to the surface by the force of the water from some coal seam in the rock beneath. The discovery of such specimens in such a situation, in a country which had been settled for centuries, and in which pit coal had been long in use, would have attracted no attention whatever ; their presence would have been attributed to some one of the thousand accidents connected with the requirements and works of man, which might have brought them there ; but in a district reclaimed from its original forest within a comparatively recent period, where the history of the fields in which the specimens were found was known to the present cultivators, from the time those fields were first cleared, it was not by them supposed probable that the presence

of the fragments could be due to any forgotten accident. The specimens are pieces of excellent clean, hard, compact, brilliant, black, bituminous coal, bearing the undoubted evidence of stratification, and varying in size from one eighth of an inch to nearly one inch cube. They were chiefly taken, I was informed, from the vicinity of a spring, on the property of J. Bouchard; this property presenting a gradually rising surface from the river to the hills behind, is situated on the left side of the Gouffre, about two miles and a half or three miles north from Cap au Rets at its mouth. The spring is removed about three furlongs to the east of the road which runs up the valley, and giving a rather small but constant supply of water it rises immediately behind a block of limestone, through a sandy clay of a lead color. The clay holds, but in no great abundance, small and large fragments of limestone and gneiss, some of them worn into pebbles and boulders, and is covered with a thin layer of vegetable soil in which, where cut through within a foot or two of the spring, according to the report given me, the larger portion of the pieces of coal was found, while some were obtained from the mud of the spring itself. A trench of a few yards in length had been cut back from the spring into the rising ground, exposing the clay for a foot or two in depth; in this trench, I was informed, a few small pieces of coal had been met with. After the locality had been inspected by me, two men were set to work to clear out the trench, and to expose fresh ground on its bottom and sides, which they effected after a full day's labor. Some small fragments of coal were found in the ground that had been previously moved, but the most careful examination could detect none in the freshly exposed parts, either of the clay in the trench, or in the vegetable mould.

Immediately at the issue of the spring, and just above the block of limestone mentioned, the clay was softer than at a very short distance back from it, and the water in rising, moved the very fine grains of sand in contact with it; but the force did not appear to me sufficient to drive up fragments of coal of nearly an inch cube, and it seemed probable if such had been placed in the pipe giving escape to the water through the deposit, that its flow would rather have displaced the soft fine sand and clay

immediately around the fragments than the fragments themselves. The spring has existed as long as the memory of the oldest inhabitants of the valley can carry them back, and there are no means of placing any definite limit to its antiquity; but if it is of very ancient date, and has from time to time brought such fragments of coal to the surface, it would appear but reasonable to expect that a larger quantity should have been naturally accumulated than has been found, and particularly of fine grains, which on the contrary seem to be especially scarce. In districts where coal seams are known to exist, and where, through fissures arising from dislocations cutting the strata, springs of a much more powerful character well out, it is not usual to meet with such fragments of coal as have been presented to me, issuing from them; and the presence of fine grains even in such situations, if it could be proved that the ground had never been artificially disturbed, would be attributed rather to a derivation from the outcrop of some seam in the vicinity, than an escape from some part deeply seated beneath. But if the specimens from Bay St. Paul were from an outcrop, they could scarcely be so hard and fresh as they are. A coal seam at its outcrop is always more or less injured by atmospheric influences; it is always weak and friable and often reduced to a pulverulent condition, and it is very probable that one of the agencies by which it is thus brought to ruin is the decomposition of the iron pyrites which is disseminated more or less in almost all coal beds. It is to the decomposition of the iron pyrites that is due the great deposit of hydrated peroxyd of iron, usually occurring wherever springs issue from the seams, and so constantly does this red water, which among the miners of Wales is designated *the blood of the coal*, accompany the seams, that it affords one of the effective means of tracing them along their basset edges. The spring on Mr. Bouchard's land gives no red deposit, and while the pieces of coal are firm and hard, iron pyrites is exposed on some of them, quite free from the tarnish of decomposition, which it is not likely it would be if the fragments had been exposed at the surface for a long series of years.

About three or four furlongs east of the spring the gneissoid rocks rise up, there constituting one limit of the valley; and about

fifty yards west from the spring the bituminous limestone of the vicinity is exposed, dipping S. 70° W. mag. $<32^{\circ}$; the limestone is seen also between 200 and 300 yards from the road on a farm six acres below Bouchard's, and on another still lower it is met with at about the same distance from the road, and occurs at intervals for a space of 500 yards across the measures. From these facts there can be no doubt that the spring is underlaid by the limestone, and none also that the beds of the locality all come out in Cap au Rets, where it is probable nearly the whole thickness of the formation is exposed, and at any rate all that part of it beneath the spring, down to the calciferous sandstone. In the whole of this great natural section, which discloses more of the mineral character of the ground than could be ascertained by a most expensive boring, the closest scrutiny did not enable me to detect any trace of coal. It is true there was a concealment in the cliff of about fifty yards between the limestone and the gneiss, which may have comprehended the calciferous sandstone and the white quartz rock; the depth of covering, however, from the steepness of the cliff could not be very great, and considering that the lower beds of the limestone were tilted up to an angle of sixty degrees, and that the strata in the concealed part would run into the cliff at the same, it is very probable, if there had been any seam of coal in place beneath, some portion of its ruins would have been torn out and brought down into a short talus of detrital material, here present just above high water mark. The chance of the exposure of such ruins was enhanced by the fact, that from the edge of the cliff, at a point which the limestone sloping up from the beach would very nearly attain, to within twenty feet of the gneiss at the base, there ran a channel across the intermediate measures which had been worn out in the loose-surfaced deposit, by the operation of sliding fire-wood down the cliff; but neither in this channel nor in the talus were any traces of coal discovered; and it may farther be remarked, that there were no evidences of it in the formations in question where exposed in Murray Bay. The coal cannot be from the gneiss beneath, for, associated with such a rock, its character would have been anthracitic, and not bituminous.

Wherever workable seams of coal have yet been found on the face of the globe, the evidences connected with them prove beyond a doubt, that their origin is due to great accumulations of vegetable matter, which has been converted into a mineral condition. The vegetable structure is detected in the mineral by microscopic examination, and as might be expected, the strata associated with coal beds are profusely stored with fossil plants; even where the seams are too thin to be workable, or so thin as to be readily passed over without great attention, the vegetable remains disseminated in the masses of rock dividing the seams, are still in vast abundance. In the section of the Nova Scotia coal rocks, at the Joggins, for example, as detailed in the report transmitted to the Government in 1844, it will be found that in a thickness approaching 15,000 feet, seventy-six coal seams occur with a total thickness of no more than forty-four feet, and that for thousands of feet in some parts, no coal seam is met with over three inches; there are yet comparatively few layers of the rock that are wholly free from vegetable remains, and the substance of these remains, however thin the leaf or small the fragment, being generally converted into coal, the mineral, from the multitude of grains of it disseminated through great thicknesses of the strata, frequently gives a peculiar character to the stone as one of its constituents. The same thing is observable in other carboniferous localities, both in America and Europe, and it appears quite reasonable to suppose, that if coal seams were discovered of an older date than those which constitute the present known great magazines of fossil fuel, the vegetable growth that would be required to give them an approach to a workable thickness, would afford the means of an extensive distribution of remains in the strata with which they were associated. The formations of Bay St. Paul and Murray Bay however show no carbonized vegetable remains whatever, and the only plants they presented at all, were a very few obscure fucoids, the forms of which were replaced by peroxyd of iron. The bitumen of the limestone may possibly be derived from the soft tissues and gelatine of the marine animal remains which have been buried in the deposit, and supporting this opinion, indurated bitumen has been found in the interior of

some of the fossil testacea, of the same limestone at Beauport ; but the calcareous material of the harder part of such remains, so greatly predominates over the carbon of the softer, that coal seams could not be expected as the result of the mixture.

The specimens from Bay St. Paul have so thoroughly the aspect of such as might be derived from some of the coal fields of Great Britain that there remains upon my mind very little doubt of their vegetable origin. The mineral has a conchoidal fracture, a brilliant lustre and jet black color ; it has a cleavage in two directions at right angles to the stratification, and to one another, dividing it into rectangular forms, and in some of the joints there are thin layers of quartz and of iron pyrites ; there is present also in the specimens, small patches and thin layers of what in Phillip's System of Mineralogy is called *mineral charcoal*, a substance which has a glimmering silky lustre, and fibrous, wood-like texture ; it consists of charcoal with various proportions of earth and iron, and its peculiar texture is supposed to be derived from its vegetable structure. There being no lapidary in the city, I have not been able to submit thin translucent slices of the coal to microscopic observation, which in addition to shewing vegetable structure, might possibly determine vegetable species. If the species should be found to belong to the true carboniferous era, there would then be little wanting to trace out the probable history of the specimens. They are fragmentary and angular, none of their corners being worn off by attrition ; it is therefore probable, they have not travelled far by natural means. They are hard and firm, and shew marks of stratification, while the pyrites upon them is untarnished ; it therefore appears probable that they have not come from the outcrop, but from some deep part of a coal seam, and that they have not been exposed for any very great series of years. Where coal is known to exist, it is not usual to find it issuing forth in such fragments from springs, and here there are no carbonized fossil plants disseminated through the rocks to give a hope of coal seams, at the same time that the formation is well known to be of an age long anterior to any holding coal seams in any country in so far as the crust of the earth has yet been examined, and certainly as much, or more than as much, older than the recog-

nized carboniferous rocks of North America; it is probable therefore, that the specimens have not been derived from the rocks of Bay St. Paul. If microscopic examination should shew that the species of plants composing the fragments are of the true carboniferous age, then the conclusion forced upon us would be, that the specimens are derived from some imported cargo, and if the notion is rejected that they reached the spring by a forgotten accident, the probable supposition must be, that they were placed there by design. The frequency of these singular coal bearing springs in the vicinity, elsewhere so unusual, and the scarcity of fine grains of the mineral in them, rather tend to strengthen this suspicion. The number of the springs attested by the respectable persons of Bay St. Paul, whose certificate accompanied J. Bouchard and A. Menard's petition, is three, but I have been informed that another was brought prominently forward some years ago, as affording the same indications of coal, but that the late Mr. Andrew Stuart of Quebec, and Captain Bayfield, had ascertained beyond a doubt, that the spring had been packed by the proprietor of the land with a view to enhancing the value of his property. Possibly this person may have packed his neighbors' springs at the same time, with a hope that, should others make search in consequence of his pretended discovery, their researches might disclose facts to confirm his own.

There being not the remotest doubt whatever of the geological age of the limestone of Bay St. Paul, supposing the specimens were really derived from the strata, and that the species of plants should at the same time be ascertained to be identical with some of those of the carboniferous period, it would prove that all evidence up to the present time has been imperfect, and that the flora of this period is of hitherto unsuspected antiquity. But even in such a case, or supposing the plants were different in species from those of the true coal era, the paucity of vegetable remains being such that scarcely a trace of them is found in so great and so near a development of the strata as occurs at Cap au Rets, the probability, amounting almost to certainty, would be, that the specimens were derived from some local patch so

thin and circumscribed, as to be altogether worthless in an economic point of view.

Titaniferous Iron Ore.—In the valley of the Gouffre, there occur very extensive masses of iron ore. One of these is met with on the land of Mr. Charles Fortin, being the seventh or eighth lot from the south line of the concession of St. Urbain, and about twenty-two acres below the church. The ore occupies a position removed about forty acres to the west of the road, on the top of the hill flanking the valley; it is but feebly magnetic, has a black colour, gives a black streak, and shews a granular structure. The average breadth of the mass is about ninety feet from east to west, and in a north and south direction it is exposed for upwards of 340 feet. Mr. Fortin informed me that it had been traced five to six acres, but our researches did not enable us to detect evidences of its continuance beyond the distance stated. The rock on each side of the ore was syenitic gneiss, the run of which coincided with that of the ore, though it did not appear to coincide with the general strike of the formation through the country, probably from the influence of some great undulation or dislocation. According to the analysis of Mr. Hunt, the ore is mineralogically an *ilmenite*, containing so large a proportion of oxyd of titanium, as to reduce its produce in metallic iron to $36\frac{1}{2}$ per cent; its specific gravity is 4.6, so that a cubic fathom would yield about sixteen tons of the pure metal.

As already stated in respect to some of the iron ores of the Eastern Townships, before any attempt is made to apply such an ore to practical purposes, it would be prudent to institute experiments to ascertain whether the large amount of titanium it possesses may not render it unavailable, or require the use of peculiar fluxes to effect its proper reduction. But the results derived from the specimens brought from the locality were so unexpected on the spot, that the specimens were all taken from one part of the mass, and it will be but a proper precaution to try samples from other parts, before concluding that the whole may have a uniform character.

After I had quitted the valley, Dr. LaTerrière, to whom I am indebted for much kindness and attention, informed me that on

the same side of the Gouffre, but some miles lower down, another mass of iron ore, equalling if not surpassing the previous one in the area exposed, is to be met with. If the rock in which it is enclosed runs in the same direction as that on Mr. Fortin's lot, it would probably be found that the two exposures are parts of the same bed, and other exposures may be discovered between them.

On the left side of the Gouffre and in the bed of the stream, about a mile lower down than the church, several large lumps of ore, the largest of which measures six feet by nine, are enclosed in the gneissoid rock; they are all comprehended in a distance of twenty-five yards, in a direction N. E. and S. W., and the strike of the rock appears to coincide with the run of the nodules, which may perhaps have a farther continuance in the wood in the same direction. The ore in this instance, though having the color and streak of the magnetic oxyd, is not at all magnetic, and holds a large proportion of titanium.

Galena.—The traces of lead ore already mentioned as met with in the phosphato-calcareous veins near the mill in Bay St. Paul, are scarcely worthy of farther allusion, except for the purpose of remarking, that as the dislocations giving origin to them, intersect the Trenton limestone and its conformable formations beneath, as well as the metamorphic series supporting them, it will be proper to search for the mineral in all veins of calcareous spar that may intersect any of them.

Phosphate of Lime.—As already stated, the phosphate was met with in association with carbonate of lime, in veins ranging in width from three inches to three feet, both in Bay St. Paul and Murray Bay. No sample has yet been assayed, but judging by the eye, the phosphate, which is pretty equally distributed through the rock, may make up about seven per cent. of it.* In previous reports it has been mentioned, that the mineral

* The phosphate of lime of this locality was found on a qualitative examination by Mr. Hunt, to contain a large portion of fluorine, doubtless combined as a fluo-rid of calcium; traces of this element are very commonly present in the native phosphate, but the quantity in this case seems to be unusually large, and renders a quantitative analysis of the mineral desirable.

occurs in disseminated hexagonal crystals in the limestones of the metamorphic rocks of the Ottawa; it lies in amorphous masses in the veins of Bay St. Paul, and though the per centage of these veins may be too low to render them profitably workable even if they were wider, the existence of veins in which the mineral is present, gives the hope that other analogous localities may be found in which a higher per centage may render the rock more available. Bones, so serviceable as a manure, contain something over fifty per cent. of phosphate of lime, and it would be as a substitute for them, that the mineral phosphate would be used. There is an annual importation of bones into the United Kingdom for agricultural purposes, chiefly from South America, which in 1844, equalled in value £300,000, and may now amount to £400,000.

Building Stone.—Many bands of the gneiss would yield building stones of a handsome appearance and durable nature, but the expense of dressing them, at present influences the inhabitants in rejecting them as too costly in the erection of churches and such other edifices as they construct of stone. The best example observed was in a field, on a lot about six acres below the bridge over the Rivière des Mares, and about 500 yards to the west of the road. The rock is fine grained and consists of white feldspar and quartz, with a moderate quantity of black mica. The gneissoid structure is obscure, and the stone looks very like a true granite of a light gray or nearly white color; it splits into rectangular blocks.

The bituminous limestone though brittle is easily dressed, and proves a serviceable material for building; its color is either black or dark gray when freshly fractured, but it changes to a lead gray on the exterior by the action of the weather; surfaces dressed with the chisel have a gray color, from the effect of tooling.

A handsome building stone is obtained from the calciferous sandstone; examples of it occur in Murray Bay at Les Ecorchis and at White Cape, but the best beds met with were on the same side of the Bay as White Cape, on the face of the hill overlooking the boat cove. They lie on the properties of Mr. J. B. Du Berger, who kindly accompanied me to the quarries, and of Mr.

Thomas Chapreon, where an alternation of more and less arenaceous layers are interstratified with a few bands capable of yielding lime, and dip N. 35 E. mag. <14. The arenaceous layers give the building stones, in which equal sized grains of sand are uniformly distributed; the color of the stone is in general a very light gray, which changes but little by the action of the atmosphere, assuming however under its influence, a very slight yellowish tinge; the beds are evenly disposed, and vary in thickness from one to sixteen inches, a very usual thickness being eight inches; they are capable of division in the planes of two sets of parallel joints vertical to the stratification, but not quite at right angles to one another; but as the stone dresses very easily, the blocks can with facility be rendered rectangular. The church in Murray Bay is built of the stone, so also is the presbytery and Mr. Du Berger's house. Multitudes of chimneys and foundations of houses have been constructed of it, and it is used for chimney pieces, lintels and window sills.

Flag Stones.—Some of the thinnest beds of the calciferous sandstone of Mr. Du Berger's quarry would yield very good flag stones, but though of a better color they would not be so durable as those which might be raised from the slightly micaceous hornblende slate near Les Ecorchis. No experiment has been tried upon these beds, but they appear capable of splitting into slabs of all thicknesses down to an inch; there would be some difficulty in dressing the edges, but slabs of probably three feet square might be got out, and the stone being very tough and strong, with a thickness of one and a half or two inches it would make excellent pavements; the color is very dark gray or nearly black.

Mill Stones.—I was informed by Dr. LaTerrière, that one or two of the beds of the calciferous sandstone at White Cape yield serviceable mill stones; he himself has used the material for an upper stone in his mill, and according to his opinion it grinds wheat and other grains better than any of the gneissoid rocks of the vicinity that have been tried. He uses French burr stones also, and he finds that while these require dressing but once a fortnight, the sandstone requires it weekly.

Limestone.—The bituminous limestone formation in all its localities in the district under description, yields a vast amount of excellent material for burning into quick-lime. The bitumen it holds being of a combustible nature, cheapens and assists its perfect calcination, and the lime it yields is pure and white. Some of the comforts arising from an abundant supply of the material with good building stone, are visible in the neatly white-washed cottages of the peasantry, and the solid well-built chimneys that pierce the roofs and give strength to the dwellings; these chimneys contrast well with the rickety clay-built stacks or substituted stove-pipes, prevailing in such newly cleared parts as are far removed from good calcareous rock. Bay St. Paul and Murray Bay furnish annually, a good many small cargoes of limestone and of lime to the south side of the St. Lawrence for a considerable stretch along the coast, where limestone beds are scantily supplied to the strata, and those that exist are of inferior quality.

Mineral Springs.—In both the valleys as well as on the coast between them there are many mineral springs, the whole of which appear to be sulphurous, and some of them of considerable strength. Until an examination of their qualities is made, it will be sufficient to give a list of their localities: they all issue from the bituminous limestone through clay:

1. There is said to be a sulphurous spring near the mill, on the west side of Bay St. Paul, but not having become aware of its existence until the day after I had passed the spot in the course of examination, it was not visited.
2. On the land of Mr. Thomas Potvin on the east side of the Gouffre, about twenty-five acres above the church and three east of the road, there is a spring giving a considerable supply of water both winter and summer; it leaves a copious white deposit on the grass around the margin of the little pool at its issue, and on the sides and bottom of the rivulet that runs from it. A sulphurous odor can be perceived at all times on approaching the spring, and it is said to be sufficiently powerful when the weather threatens rain to reach the house, which is only a few yards from the road.
3. On the property of Mr. Tremblay near Cap au Rets, there is a sulphurous spring giving a copious supply of water; the grass along the channel in which it flows is whitened with a deposit from it.
4. About half a mile above the Pointe aux Eboulis there is a copious sulphurous spring, giving a white deposit like the previous one.

5. Another is met with close above the same point, being about half a mile below the previous one, and there are others between the two.
6. About half a mile above the bridge on Murray Bay River, there is said to be a sulphurous spring; at the time of my visit it was covered by the water of the river, and could not be seen.
7. About twenty acres still farther up, on the west side of the river, there is another sulphurous spring on the land of Ambrose Gagnon; it yields a large quantity of water, which is discharged from a box placed about it, from a hole of two inches in diameter, with a head of three inches; it smells strongly of sulphureted hydrogen, and whitens with an encrusting deposit, the spout and channel through which it flows.
8. Another of these springs is said to exist on the east side of the Bay, on the land of Vitard Goudreau, back from Les Ecorchis.

SOUTH SIDE OF THE ST. LAWRENCE.

Lower Silurian Rocks.

The country on the south side of the St. Lawrence, between the Chaudière and the Temiscouata road is inferior in general agricultural character, to that between the Chaudière and the Richelieu; it does not present the same breadth of champaign margin, and in that which may be called flat, there is a larger exposure of rock, giving it a more rugged aspect. The mountainous belt described in a previous report as occupying a breadth of thirty to thirty-five miles in the district above the Chaudière, gradually approaching the St. Lawrence, comes upon it below, and flanked by it from the vicinity of St. Thomas downwards, this belt, with about the breadth stated, may be considered to occupy the whole of the surface to the Provincial boundary line, in that part of the line which runs parallel with the river. The strata in by far the greater part of the exposures, exhibit a parallelism in their strike with the direction of the mountain belt, and therefore come upon the river at a small angle to the general trend of its south side; the true general strike however is with the river, and particularly with the north side, the apparent divergence on the south being due to the effect of a multitude of anticlinal axes, over which in succession the strata bend in very sharp plications, often leaning over to the north-west, giving the semblance of a nearly constant dip to the south-east, at high angles. These folds are so numerous, and frequently repeat the measures several times in so short a distance, as to

destroy confidence in every endeavor to estimate the thickness of the different divisions of deposit, and the want of a knowledge of the true thickness, on the other hand, renders it uncertain in any particular case under examination, whether all the folds affecting a set of strata, have been correctly ascertained. The main undulations can often be followed for considerable distances by means of the geographical distribution of contorted masses of the subdivisions, but unless a connection or relation with regard to each other, is followed out among these undulations, it is somewhat difficult to determine whether a form that may be subject to consideration is anticlinal or synclinal.

In ascending sequence from the Trenton limestone and Utica slate, the masses of rock which are met with are in their general characteristics as follows:—

1. A series of dark-gray clay slates, interstratified with gray, thin bedded sandstones, often calcareous, and weathering yellowish brown, and with gray yellow weathering limestones. This series is fossiliferous and holds shells and graptolites, and appears to be terminated by a set of bituminous shales and black limestones.

2. A series of gray, green and occasionally red shales succeed with thin calcareous layers, and it is not quite certain whether a considerable deposit of red shales, in addition to those associated with the gray, does not occasionally lie at the top of the series. These shales appear occasionally to hold bands of calcareous conglomerate, cracks in which are filled with indurated bituminous material.

3. A deposit of hard sandstones, varying in color from light gray to iron gray, and sometimes slightly greenish; they appear to hold but little mica; they seem to be sometimes fine-grained and thin, but close-bedded, and sometimes coarse and massive, being occasionally observed to pass into beds of a conglomerate character either wholly or in part; the pebbles of these conglomerates are frequently composed of gray limestone, containing organic remains of the Trenton formation, and in many places they appear to constitute beds so abundantly stored with calcareous material as to be burnt for lime. Thin bedded gray limestones are occasionally met with near the calcareous

conglomerates, and are supposed to belong to this division of deposits, and it is not improbable that the whitish limestone of Upton, Acton and Wickham mentioned in a previous Report, may exhibit a still more compact form of the same portion of the deposit.

4. Red and green shales follow the gray sandstones and their calcareous conglomerates; the red color is of a chocolate cast and the iron to which it is probably due, appears very frequently to be associated with titanium; the red is generally striped with green, and the green in some exposures predominates over the red; the red and green shales appear frequently to be interstratified with bands of hard, light-gray, fine-grained sandstone, which is very frequently calcareous.

5. Succeeding the red and green shales, and interstratified with some of the same character, there occurs a series of coarse-grained green sandstones, which hold more mica than the lower sandstones, and frequently present small spangles of plumbago; they appear to derive their prevailing color from chlorite, but red layers as coarse as the green and holding nearly as much chlorite, are in some parts interstratified; the beds of both colors which are almost always massive, are in general calcareous and often present bands of coarse conglomerate, with quartz pebbles, which sometimes appear to become mingled with pebbles and even boulders of gray limestone holding fossils, probably of the Trenton formation.

These five divisions of deposits occupy all the champaign country east of the Richelieu, between the mountain belt and the St. Lawrence, with the exception of the localities stated in a previous report, displaying the Trenton limestone and Utica slate, in a line between Phillipsburg and the Grondines; and in a more or less metamorphic condition they appear to constitute the mountain belt also, the inferior bituminous shales becoming plumbaginous slates, the gray sandstones being probably converted into quartz rock and talcose quartz slates, and in relation to this silicious zone, there appear to be in the metamorphic district, two magnesian belts shewing dolomite and serpentine, the equivalents of which in the unaltered rocks require farther investigation; the red slates and green sandstones seem to

become chloritic, epidotic and ferriferous slates, and less schistose forms of rock, and from the geographical position of what have been called the corneous rocks, it appears not improbable they may be referable to this part of the deposit; but a larger number of facts must be ascertained before the various divisions of the metamorphic rocks can be clearly traced to their unchanged equivalents. The whole belong to the Lower Silurian age, and they are followed by others which are shown by the fossils held in some parts to be Upper Silurian.

It is by the geographical distribution chiefly of the five enumerated divisions of deposit that the main anticlinal forms can be traced out, and the marked color of the red shales or slates is of great value in the investigation, when the dark gray and black shales come from beneath them. In the absence however of these dark colored lower rocks, the differences between the gray and green sandstones and their equivalents constitute a less certain means of distinction. Between the Temiscouata road and the Chaudière, with the exception of one locality where graptolitic shales occur opposite the upper end of the Island of Orleans, no clearly recognizeable mass of the first or lowest division was met with; the whole country north-west of the Upper Silurian boundary hereafter to be described, appearing, as far as the investigation has been carried, to consist of the remaining four divisions; but above the Chaudière as far as a line between Phillipsburgh and Montreal, as shewn in the Report already made on the rocks of the Eastern Townships, nearly one half of the district rests upon the first division.

In that Report, the positions of several anticlinals were indicated, and some of them have been farther traced both above and below the Chaudière. Three were surmised in the lower shales from the recurring presence of the fossiliferous part of them on the Rivers Richelieu, des Hurons and Yamaska, and the existence of the last is supported by the distribution of red shales on the Rivers St. Francis, Nicolet and Bécancour. On the first of these, they occur about three and a half miles above the Indian village near its mouth, and occupying a breadth of a mile, are followed by dark gray fossiliferous shales beyond; on the Nicolet, red shales are seen about seven miles above the village

of that name, occupying a breadth of upwards of three miles more ; on the Bécancour they occur about seven miles up from the mouth, and at intervals for about five miles more. The exposures on these two latter streams are supposed to belong to one trough, and the Yamaska anticlinal would run between it and the previous exposure, on a line from the elbow in the river at the junction of the Chibouet to the mouth of the Bécancour. The red portion of the trough, connected with these exposures on the Bécancour and Nicolet, probably terminates before reaching the St. Francis, as no corresponding exposure was observed on this stream, which is occupied by the strata of the first division for a distance of fifteen miles as far as the trap occasioning the fall at Drummondville ; but about a mile and a half above this village, a display of green sandstones and red shales is met with. There are corresponding exposures on the Nicolet and Bécancour, on the twelfth range of Ashton and the tenth range of Maddington ; but on the Nicolet just above Douglassville, there occur exposures of red strata on the ninth and tenth ranges of Ashton, which red strata do not reach the St. Francis on one side nor the Bécancour on the other, while lower shales come out on the eleventh range of Ashton. These lower shales indicate a not very important anticlinal ; but the axis of elevation existing between Douglassville and the red exposures lower down the stream would correspond with that which brings up the Trenton limestone in the vicinity of St. Dominique ; in consequence of a transverse depression however on the crown of the arch, the limestone which is met with again at the Grondines, appears to be covered up in the interval by the shales of the first division, the fossils of which are met with in a continuous line on all the three rivers. The Utica slates, and above them these shales with their fossils, come out on the St. Lawrence, south-east of the Trenton limestone of the Grondines at Pointe du Platon and St. Croix, and the shales are exposed at intervals on the bank of the river to within half a mile of St. Nicolas, the green sandstones with their red and green shales being greatly displayed at and below the village, where in successive ridges and valleys they occupy a transverse breadth of one third of a mile.

The green sandstones and red slates above Drummondville present a narrow exposure of about half a mile; they belong to the fifth division of deposits, and probably mark the position of a synclinal axis; proceeding from them, along the south east side of the general trough to which they belong, red shales, green and sometimes gray sandstones are met with in a nearly straight line, on the two Nicolets in Horton, on the Stanfold road in the ninth range of the Township, on the fourteenth lot of the eighth range of Somerset, and on the Bécancour in the north corner of Inverness, bounded by the strata of the first division all the way; and while between this line and the north rim of the trough to St. Nicolas, no rocks but such as might be referred to the second, third, fourth and fifth divisions, have been met with on three transverse lines of section, as far as the St. Croix road, no strata but such as are referable to the first division, have been found on the banks of the St. Francis, to the sixth lot of Kingsey, a distance of about fourteen miles, in a straight line. As stated in the previous Report on the Eastern Townships, this transverse span of the first division comprehends a very important anticlinal, traceable from the Province Line in St. Armand, to which it appears probable that two more, instead of one as there mentioned, are subordinate, the main one being still further traceable to the north corner of Inverness. It appears probable that this axis crosses the Chaudière between two exposures of red rocks two and a half miles apart, at a spot about fourteen miles in a straight line from its mouth, and the Etchemin, about two miles higher up than the bend above St. Henry, where it attains one of the tributary branches and part of the main continuous stem of the Rivière du Sud, following this to its mouth; on the south-east side of these latter streams, light gray quartz rock occasionally shewing a band of calcareous conglomerate runs all the way from St. Gervais to St. Pierre, while gray slightly calcareous sandstones are seen near St. Charles, on the north-west, with rocks of the fourth and fifth divisions on each side, further removed from the axis. From the Province Line in St. Armand to St. Thomas, the distance is about one hundred and eighty miles.

A section of the metamorphic rocks, which occur on the St. Francis, between the anticlinal axis just described and Melbourne Village, consisting of reddish, green and gray talcose clay slates, dolomites, quartz rock, chloritic and epidotic rock, and dark gray and black plumbaginous slates and limestones, has already been given in the Report for 1847-8, and it has there been stated that in these dark-colored slates and limestones, (which belong to the first division of deposits,) there runs an anticlinal from Sutton to Tingwick, to which two more are subordinate, and an additional one is found to be subsidiary to the Kingsey and Shipton trough. On the south-east side of the Melbourne and Shipton anticlinal there occur green talcose slates, gray sandstones, serpentines and corneous quartz rock, with partially epidotic and chloritic conglomerate and red jaspery slates; but it has been found very difficult to follow the anticlinal further eastward than Tingwick. Traces of it however are supposed to be met with across to the north corner of Ham, after intersecting the Nicolet at the south corner of Chester; its course across Wolfestown and Ireland is very doubtful, but it seems probable that it comes out upon the Chaudière, some distance below St. Joseph's Church. Dark colored clay slates and limestones cross the Township of Broughton, from the fourth range of Thetford, and come upon the Chaudière near the extremity of the Broughton Road, and to the south-east of these, removed about a mile to a mile and a half, serpentine, soapstone and dolomite are exposed at intervals in a nearly parallel course; but their relations are not yet satisfactorily made out, and it is not certain whether the serpentine belongs to the upper or lower magnesian belt.

In Ireland and Coleraine there is a great display of serpentine—the largest that has yet been met with; it lies on both sides of Black Lake, extending four miles to the south-west in the former, constituting Caribou Hill, and probably two miles to the north-east in the latter Township, with a breadth of about two miles and a half, thus spreading over an area of fifteen square miles. This mass must lie on the south-east side of the anticlinal axis, and there is not much doubt it is a continuation of that observed a previous season on the south-east side of

Wolfestown, which is traceable to the lower end of Nicolet Lake, and has since been met with on the south-west side line of Ham between the fourth and fifth ranges, in a direct line for the diallage of Richmond Lake in the south corner of Tingwick, and the Shipton serpentine beyond. There is another exposure of serpentine in Ireland, on the twenty-first lot of the first and second ranges, about a mile from a portion of the previous one, and as no rock was observed between them, it is not certain whether it may not be a direct extension of it. A very talcose slate, associated with soapstone, occurs on the tenth lot of the third range, and a band of dolomite in the general strike of the stratification on the twelfth lot of the fifth range, between which two exposures and the previous one, it is probable the axis of the anticlinal may occur.

On the south-east side of the serpentine of Caribou Hill there is a broad zone of corneous quartz, which accompanies it through Garthby, Ham and Wotton, composing Ham Mountain in its course; associated occasionally with epidotic rocks, it is traceable in an opposite direction across Coleraine, Thetford and Broughton, rising into the White Mountain in the first and into Broughton Mountain in the last Township, and on the south-east side of the zone there is another band of serpentine. This serpentine is highly calcareous in Wotton, Ham and the south-west side of Garthby, but acquires a purer character on the north-east side of this Township, as well as across Coleraine, where it approaches to within half a mile of Lake St. Francis, proceeding in such a direction towards Adstock and Tring as would carry it to a junction with the serpentine of the Bras and the Guillaume in the Seignory of Vaudreuil Beauce, where it has corneous quartz rock on the south side of it, and a six feet bed of it about the middle. The corneous rock on the Chaudière in some places holds a large amount of diallage and in others hornblende, feldspar and mica, and for a short distance on both sides of the river it assumes the character of a perfect and very tough granite, passing sometimes into a syenite. Between the serpentine where it crosses the Chaudière and attains the Guillaume and the anticlinal of St. Joseph, exposures of red slate and red and green sandstone are frequent for a breadth of between four and five miles; they have

been traced to the north-eastward across Cranbourne into Sandon, a distance of twenty miles, and to the south-west about three miles and a half. In many parts of the area the exposures holding much epidote, still maintain a general red color, but accompanying the red there are also large masses of epidotic rock of a general decided green tinge. On the right bank of the Chaudière proceeding north-westward across the measures from the serpentine, after a concealed interval of a quarter of a mile, a very considerable breadth (nearly half a mile,) of north-westward dipping massive green sandstone, often of a conglomerate character, becoming interstratified with red slate, is terminated by a red sandstone bed of twenty-five feet, followed by a five feet band of highly crystalline red limestone with patches of red slate, to which succeeds a rock of a singular aspect, which might be readily taken for trap; seen from a distance it has a general gray color on the exterior, but internally it is red bordering on purple, and is composed of a vast collection of large kidney shaped or flattened subspheroidal forms, standing on edge in the direction of the strike; they are aggregated in such a manner as to interlock among one another irregularly, the intervals among them being filled by a mixture of blackish green serpentine, dark leek green chlorite, pistachio green epidote, opaque white calcespar, and occasional colorless translucent quartz; the latter four minerals are in a highly crystalline condition and the epidote frequently surrounds the nodules of calcespar. The *roggons* are of a jaspery texture and are sometimes minutely spotted with round and angular forms of a green mineral with the hardness of serpentine, which gives to them the semblance of pebbles and boulders of porphyry; in the centre of some of them there are lenticular shapes of white calcespar, and when fractured sub-spheres have been acted on by the weather they assume a circumvallation of colors conforming with the exterior, towards which the colors become of a lighter and grayer hue, the whole however being enclosed in a thin band of deeper red which fades into the surrounding matrix; there is also a distinct tendency in the nodules to divide into concentric shells in the direction of the colors. The ophitic matrix in which the reniform masses are imbedded is in some parts of a slaty structure and is studded with thin fragments of a slaty character,

presenting the aspect of a slate conglomerate, and this conglomerate, which in other instances holds small hard pebble forms of a brownish red jasper spotted with green, runs in bed-like bands in the strike, and on the exterior weathers into small pits and shews different colors, giving the rock a carious and variegated appearance. A multitude of cracks sometimes figure the face of the large *rognons* in section, and on each side of these cracks, where the surface is worn smooth at the mill and fall on the Rivière des Plantes, there rises a thin small ledge of a darker color than the rest; some of the *rognons* become epidotic towards the exterior, and epidote runs in various cracks and irregular bands through the rock. This singular mass has a breadth of nearly three hundred yards (including a part towards the middle which approaches the character of a red slate), and in its structure and minerals though not in color, it very much resembles a green rock heretofore described as met with near the eastern band of serpentine in Bolton, in the valley of the Missisquoi River. The general bearing of this red and green epidotic and ophitic rock is with that of the strata, to the north-east; it has been traced up the valley of the Rivière des Plantes for a short distance, and about three miles in continuation on the road to Cranbourne, where it appears to be wholly green, and though it retains its reniform structure it was not observed to be ophitic; but red and green epidotic rock without reniform masses and without serpentine occurs at different parts of the area that has been already mentioned. On the line between Cranbourne and Sandon it occurs with a transverse measure of about four miles from the River Etchemin to the line between Cranbourne and Frampton.

The Sutton, Shipton and St. Joseph anticlinal is probably the main axis of elevation of the Green Mountains in Canada; where it crosses the St. Francis its distance from that of Kingsey and St. Thomas may be considered to be about ten miles, but between them on the Chaudière it must be much more, and it is probable that some of those between the two may on reaching the Chaudière have increased in importance. In the vicinity of this river there are evidences of the existence of these intermediate anticlinals, but it has not yet been found practicable to connect

them with those on the St. Francis, though the general strike of the stratification in the interval has been pretty well determined by a band of dolomite occasionally passing into serpentine, which has been traced from the thirteenth lot on the line between Chester and Halifax, to the St. Margaret range in the south-east part of the Seignory of St. Giles, a distance of thirty-five miles. Chloritic and epidotic rocks much resembling those of Shipton, occur on the north-west side of the band nearly all the way. Where the band crosses the Chaudière is not quite certain, but on the east side of the river dolomite is met with in the Seignory of St. Joseph close upon the line of St. Mary, in two localities that would not be far removed from its course. Between this band and the Kingsey and St. Thomas anticlinal, there are many parallel exposures of conglomerate limestone beds associated with red and green slate. From St. Sylvester Church in St. Giles Seignory, which is four miles across the measures from the dolomite, there occur in a transverse breadth of five miles more to the forks of the Beauvillage River, four bands of this conglomerate which are probably repetitions of one bed. That at the Forks of the Beauvillage, which is burnt for lime, consists of

	Feet.
Sandstone.....	3
Limestone conglomerate, holding silicious and calcareous pebbles, the latter being very numerous; the matrix is a very arenaceous limestone.....	6
Sandstone.....	3
Limestone conglomerate, as before; the limestone pebbles and the matrix weather brown, particularly the matrix, which holds more sand than the pebbles; internally both the matrix and calcareous pebbles are gray, the pebbles the darker of the two.....	18
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Total thickness.....	30
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The next exposure occurs about two miles to the south-east, on the second lot of the Chute settlement, occupied by Samuel Orr; in one part it shews a conglomerate character, very similar to that of the previous exposure, for a breadth of twenty yards, with a dip 183° mag. $<53^{\circ}$, which would give a thickness of about forty feet; but pursuing it on the strike to the east side of the first lot, about an acre further on, its dip becomes 168° mag. $<58^{\circ}$,

and the rock changes its conglomerate character to that of a coarse arenaceous limestone, shewing transparent and translucent grains of quartz; a thickness of twenty feet of this is seen in a vertical escarpment. The third exposure occurs on the Craig Road, about a mile north of the west branch of the Beauvillage River; its strike would carry it about a mile south-east of the previous band, and the following is a horizontal section of the measures exposed near the band, proceeding from north-west to south-east:—

	Yards.
Quartzose conglomerate, holding small quartz pebbles chiefly, in a calcareo-arenaceous matrix	3
Calcareous conglomerate, holding gray limestone pebbles chiefly, with some of quartz in a calcareo-arenaceous matrix; the matrix weathers brown, but the limestone pebbles, under the influence of the atmosphere, remain gray on the exterior; they vary in size from half an inch to eight and ten inches in diameter, the majority being one and two inches; several of them hold fossils, encrinites being plainly discernible	1
Quartzose conglomerate, as before; the proportions of calcareous and quartzose parts in the whole band composed of this and the two previous beds vary very much in the course of 400 yards on the strike	4
Measures concealed; in this part there is probably an anticlinal axis; the dip of the preceding band is 335° , mag. $<35^{\circ}$; that of the succeeding portion of the section is 135° , mag. $<45^{\circ}$	50
Conglomerate, partially calcareous, as before	5
Measures concealed	6
Gray fine grained sandstone, weathering white	11
Measures concealed, probably sandstone.....	11
Gray fine grained sandstone, only partially displayed.....	18
Measures concealed	15
Green smooth surfaced slates	15
Red and green slates	6
Measures concealed	19
Red slates.....	23

The St. Sylvester exposure also is associated with fine grained sandstones and red slates, and can be followed from the Church along the road to St. Mary Seignory, to the turn which commences about a mile forward, where it appears to leave the road, keeping on in a straight line; a band, in the course it maintains, is met with on the road between the St. Martin

and St. John ranges of St. Giles Seignory, at the distance of about two miles from the St. Mary road, between which spot and this road two more bands are seen, all in the breadth of a mile, being probably repetitions through the effect of undulations; the most south-eastern of these appears to maintain a course about a mile on the north-west of the St. Mary road and nearly parallel with it, three exposures occurring about two miles apart from one another, and the last a little over a mile from the left bank of the Chaudière River, at about the same distance below St. Mary Church. This is the highest point on the Chaudière at which the calcareous conglomerates have been met with; four miles further down they occur in the bend at which the Quebec road leaves the river, and again in a probable continuation of the same band about a mile and a half lower, a little above the extremity of the road from St. Bernard Church; two miles beyond this there is a great exposure of coarse grained limestone, shewing no conglomerate, but probably referable to the same stratigraphical position; about a mile and a half below this there is an exposure of coarse arenaceous limestone, a little before reaching which a display of amygdaloidal trap occurs, and in less than the same distance farther, three bands of calcareous conglomerate are met with before reaching the position of the St. Thomas anticlinal. On the Etchemin an exposure occurs about half a mile below St. Clair Church, another about four miles farther down, where the band shews no conglomerate, and a third about four miles still farther, where the rock is a conglomerate, and probably corresponds with the lowest exhibition just mentioned on the Chaudière. Red rocks occur in the vicinity of most of the exposures of conglomerate on both the rivers, and extend in breadth on both about two miles beyond them, farther up. A corresponding width of the same has been seen on the road running south-east from St. Gervais Church, and extending eight miles to the boundary of Buckland Township. On this road the exposures of red and green rock, for two miles and a half, bear a similar epidotic and chloritic character to those in Cranbourne and St. Joseph, the first exposure occurring about a mile from the Church, where a band of a very trappean aspect is met with,

of an apparently amygdaloidal character from the presence of nodules of calcareous spar. No reniform masses were observed to mark its structure, but a portion of the band appeared to be a conglomerate with a calcareo-arenaceous matrix, enclosing hard jaspery fragments, and beds of red sandstone and red slate were in association with it; a red and green rock of an epidotic quality was observed also on the road between the St. Mary and St. Susanne ranges in the Seignory of Jolliet.

Towards the corresponding limits of these two areas thus characterised by red and green rocks, serpentine and dolomite appear on the one side and dolomite on the other, and not far from these magnesian bands in both, cracks in the contortions of the strata, are filled with quartz and calcspar, and marked by talc, chlorite and vitreous copper ore. Between these two red marked areas the country rises into a ridge on both sides of the Chaudière, displaying a great amount of gray sandstone and quartz rock, with talcose quartz slate, unassociated with any observed red strata. The breadth of this tract is about eight miles, and crosses Frampton Township into Buckland, monopolizing nearly the whole of both.

The road to the south of St. Pierre Church near St. Thomas, has been examined for a distance of about six and a half miles, and after passing the quartz rock, which has been already mentioned as occupying about a mile and a half, the remainder of the distance reaching about a mile into Armagh Township, is occupied by red and green slates and sandstones.

At l'Islet the immediate coast is occupied by the green sandstones of the fifth division of deposits, displaying interstratified bands of calcareous conglomerate, and to the south-east recurring exposures of sandstone of the same color, with red slates frequently filling the intervals, are displayed beyond the rear of the third range, a distance of between three and four miles. About two miles farther, light gray and white granular quartz rock rises into a considerable ridge, and occupies a breadth of about two and a half miles, in the Seignories of l'Islet and Lessard, beyond which the coarse green sandstones of the fifth division are again met with, and they appear to continue for between six and seven miles farther, which is as far as the bush road to

the Black River was examined. Sandstones alone were seen in place on the road and their color was always green, but large loose angular blocks of a red color were frequent and smaller fragments of red slate occasional. Similar rocks of both colors were met with in place on the Black River, which was ascended from the valley of the St. John, about two miles within the Province line, where the strike would bring them to a position about fourteen miles to the south-east of those seen on the road. None of them were in such a highly metamorphic condition as those in Buckland.

The quartz rock ridge of l'Islet and Lessard appears to constitute an anticlinal axis, and approaching nearer to the coast behind St. Anne and the mouth of the River Ouelle, to come out upon it between Kamouraska and St. Andrew. In this vicinity there are several considerable hills which run parallel with one another, and appear to be composed of the granular quartz rock. Just below Kamouraska the exposures are comprised within the breadth of about two miles and a half, but they are narrower at St. Andrew, near which, at a place designated from the display of abrupt rocky eminences, by the name of Les Caps, the width is less by a mile and a half; here the sides and summits of three hills appear to be cased over in succession by the same aggregation of granular quartz rock beds, the thickness of which, as displayed in one locality, appears to be about two hundred feet; the hills constitute three folds in the stratification, and a fourth one less prominently shewn is found a little farther from the coast. At the Grande Ance, six miles farther down the St. Lawrence, the exposures are straitened to half a mile, and the last observed traces of the quartz rock, as indicating the course of the anticlinal to which the folds are subordinate, were seen on the Rivière du Loup, below the fall of Caldwell's Mill, where they probably do not occupy half the breadth. In the Village of Rivière du Loup greenish sandstones are displayed, and they are traceable along the coast from the outside point of l'Ance Creuse beyond St. Patrick Church. These sandstones appear to be repeated in an abrupt rocky eminence called the Pilot, rising out of the flat land north east of the small bay at the mouth of the river; the thickness evident in this hill, where the dip is 135°

mag. $<30^\circ$ is 290 feet, but it is by no means certain that the whole of the strata belonging to the band are exposed. The transverse measure of the supposed equivalent band, as far as seen on the right bank of the river at the mill, is about a hundred yards, with a dip of seventy degrees, giving about the same thickness as before; but a short distance removed from the left bank, the breadth is nearly five hundred yards. It is uncertain whether the whole thickness is exposed on the right, and how many undulations may cause repetitions on the left. In the Pilot Hill, many of the beds are of a conglomerate character, holding quartz pebbles chiefly, among which are occasionally mingled several of limestone, some of which are fossiliferous. The strata of this hill and of the village are supposed to be referable to the fifth division of deposits, but no interstratification of red slates was observed among them. Red slates however constitute Rivière du Loup Point, whose strata would run to the north-west of Pilot Hill, and they are met with between the village mill rocks and the quartz rock at the foot of Caldwell's Fall.

On the road between Rivière du Loup and Temiscouata Lake, red and green slates, with an occasional interstratified thin bed of limestone, are the only rocks seen between Caldwell's Mill and the tenth road lot of the south-east-running double range, a distance of five miles; but on the four succeeding lots granular quartz again makes its appearance, very probably marking another anticlinal axis, which would cross the Green River, between the second and third ranges of Whitworth. Green slates were seen four and a half miles farther on, and red slates a mile beyond at the Green River, on the fourth and fifth road lots of the east-running double range; and the latter prevail for upwards of a mile and a half to a small stream on the thirteenth lot, about half a mile beyond which, on the eighteenth lot, a four feet band of close grained sandstone, resembling the granular quartz rock, is met with; though no great mass of such rock was seen associated with it, it may indicate the vicinity of an anticlinal. No exposure occurs for upwards of a mile to the River of Rocks, on the twenty-eighth lot; but at the summit of the hill which succeeds, massive coarse green chloritic sandstones

occur and constitute the whole mountain to the River St. Francis, a tributary of the St. John, flowing through the forty-third lot upwards of two miles on. Ascending the opposite hill, red slates are again met with, and at the summit massive green and occasionally red chloritic sandstones occur, which prevail to the valley of the Little St. Francis, two miles from the previous stream, on the fifty-fourth and fifty-fifth lots; and after a concealed interval of two miles more, red and green slates again occur on the sixty-fourth and sixty-fifth lots, rising from the valley of the Grande Fourche of the Trois Pistoles River, a tributary of the St. Lawrence. For the next eight miles no red strata were observed, and, with the exception of green chloritic sandstones on the sixty-ninth lot, the exposures disclosed were hard gray sandstones sometimes slightly talcose and thinly ribbed with black, green slates, green and gray slates, gray slates with smooth glossy surfaces, and gray slates interstratified occasionally with thin calcareo-arenaceous bands, the bands weathering to an ochre yellow. These rocks, notwithstanding the absence of red strata, may possibly be referable to the second and third divisions of deposit, but the constant absence also of the calcareous conglomerates which prevail on the coast, and are there so persistent on the strike, with the approach to undoubted superior rocks on Temiscouata Lake, render it necessary, without more extensive examination, that their geological place should remain for the present in some degree uncertain. On the one hundred and thirteenth lot and the next succeeding, which is the last in the road ranges, red slates mixed with green and gray occur, and just at the entrance upon the Temiscouata Seignory gray and greenish sandstones follow, and become striped and interstratified with red slates in such exposures as exist for half a mile to the thirtieth mile-post, sixty yards beyond which occurs the first stream falling into Temiscouata Lake. In the next four miles the rocks exposed are hard gray sandstones, sometimes exhibiting a ribband-like aspect from the presence of thin dark layers, striped green and gray clay slates with hard quartz rock-like bands, gray clay slates with wrinkled glossy surfaces, gray harsh arenaceous-argillaceous slates, with thin gray limestone bands weathering to an ochre yellow earth, and occasionally black carbonaceous

slates; while at the end of the distance strong greenish sandstones, followed by red and green slates, again occur, beyond which the two or three exposures in the remaining two and a half miles to the lake display gray, black and green clay slates. The strata occupying the four miles to the south-east of the thirtieth mile-post bear so strong a lithological resemblance to those of the nine miles to the north-west, that there is not much doubt they are geologically equivalent, but until a greater number of facts, shewing the geographical distribution of the rocks connected with the section, has been ascertained, their arrangement in the physical structure of the mountain range cannot be pointed out with precision. But from what has been stated, it would seem probable that the anticlinal of Rivière du Loup, St. Andrew and Lessard, keeping parallel with that of St. Thomas, will run into the southern part of Frampton, and that of the second and third ranges of Whitworth, with a parallel course, will attain the southern part of Buckland.

Notwithstanding that the anticlinals would thus appear in their south-western course to enter the metamorphic region, no rocks of the very highly altered condition which characterises those of the Eastern Townships, in the south-eastern development of the formation to which they belong, were met with on the Temiscouata road section, nor does it seem probable that any will be found on the line from l'Islet to the Black River; but where the metamorphic action begins to decrease between Buckland and the Black River, has not yet been determined, as the season did not permit us to ascend any of the tributaries of the St. John River higher up than that stream. The investigation of this question is not merely a matter of scientific interest, but one of economic importance, as it is very probable that with the decrease of metamorphic intensity will diminish that value of the mountain range as a mineral region, which it is known to possess in its whole extent from Canada to Mexico.

Upper Silurian Rocks.

A section across the Upper Silurian series of rocks, as displayed in the Eastern Townships, was given in the Report on that district already transmitted to the Government; in this it was

stated, that between the Shipton Pinnacle ridge and the Stoke Mountain range, both belonging to the lower series, there was a wide valley extending from Memphremagog Lake to Ham Mountain, which required farther examination. In the south-western end of this sub-elliptical area, two narrow, nearly parallel troughs of fossiliferous limestone, those of Potton Ferry and Georgeville, underlaid by clay slates, were shewn to occur with an anticlinal axis between them; on an excursion since made across the Stoke Mountains to the upper part of Windsor River, a third narrow, fossiliferous area has been met with on this river, in the twelfth and thirteenth lots of the eleventh range of Stoke Township, and from the proximity of this exposure to the north-west flank of the mountains, it seems probable that it marks the position of a third synclinal, being connected with one of the two undulations stated to be parallel and subordinate to the anticlinal of the Stoke Mountain range; this anticlinal thus making the sixteenth that can be distinguished between the Richelieu and Lennoxville, on a line passing through St. Hyacinthe, in a distance of about sixty-five miles. The clay slates which are beneath the Potton Ferry and Georgeville limestones, and appearing on the St. Francis, have been found also on the new road cut through to Danville from Rice's settlement, though absent on the south-eastern flank of the Stoke Mountain range, from what is considered an analogous position between that range and the equivalent limestones of Magoon's Point and Dudswell, and of all the intermediate localities, yet so often in other places precede the limestone in ascending series, that it appears probable they must be classed with the Upper Silurian division. On Lake Aylmer some beds of the calcareous part of the formation, but without fossils, are seen at the upper point separating Ward's Bay from the body of the lake; within the bay there is a small point which is composed of hard sandstone and very coarse conglomerate beds, some of the rounded masses constituting which are a foot in diameter, most of them being very feldspathic and appearing to be of igneous origin; these sandstones and conglomerates, interstratified with hard, fine green slates, dip S. S. E. mag. $<80^{\circ}$, and have a breadth of about 110 yards, and they are followed to the northward by 140 yards.

of the same green slates without sandstones: these strata may possibly belong to the lower rocks, but clay slates supposed to belong to the upper division succeed, and have a transverse breadth of four miles and a half to Lake Colombe on the road to Wolfestown, where they reach the band of calcareous serpentine that has been mentioned. On the south side of Lake Aylmer on the road through Strafford, calcareous strata of the Upper Silurian series without fossils, are met with about two and a quarter miles from the water's edge, on the forty-fifth lot, the interval being occupied by rocks of the lower series, consisting of green chloritic slates and sandstones, with an obscure indication of an ophitic character on the thirty-ninth lot, and slates of a talcose character nearer the lake, with a band of dolomite about twenty-five yards wide, on the twenty-eighth lot. The bed of the St. Francis River, between Lake Aylmer and Lake St. Francis, consists of clay slates, often shewing flat nodules of gray, yellow weathering limestone, and at the foot of the lake they occupy about half to three-quarters of a mile between the water's edge and the magnesian rocks and epidotic conglomerates of the lower series. They also compose both sides of the lake further up, first becoming interstratified with occasional layers of an argillaceous sandstone, and then assuming a slightly calcareous character; a few beds more arenaceous than others, are strongly marked by the presence of lime. About seven miles up the lake, a little way above the mouth of the Blueberry River, an intrusive mass of granite forms opposite points, bearing nearly E. and W. of one another; the breadth of the granite appears to be about 400 yards, and where the strata come in contact with it on the north side, the effect of the igneous rock on them is plainly discernible, in the presence of an abundance of small crystals of brilliant mica, and reddish andalusite in the argillaceous beds, while the sandstones have been converted to a dark gray quartz rock with disseminated grains of pyrites. On the worn surfaces of loose fragments of slate found in several parts round the lake, slender raised forms were attributed to the presence of imperfect crystallizations of the second named mineral. Three miles beyond the granite two opposite points jut out and form the Narrows; that on the right side consists

of talcose slates of a very quartzose character, showing a breadth of about 300 yards, and they are immediately succeeded to the south by two or three fossiliferous layers of limestone, the dip, which is N. N. W. mag. <84 , very probably shewing an inversion of the strata. The breadth of this fossiliferous part does not exceed ten feet, and it is followed by light-gray, thin-bedded limestones weathering to a yellowish red. Beyond these occur coarse and more arenaceous limestones, mixed with micaceo-calcareous sandstones, and these latter become interstratified with other sandstones that contain little or no lime, clay slates often separating the beds.

On an excursion of twenty miles across the forest, from Lake St. Francis to Lake Megantic, all the exposures of rock, which were not numerous, and with the exception of the granite in intrusions, in no case extensive, bore the character of the less calcareous strata of those last described; but on the western side and at the south end of Lake Megantic, chloritic and epidotic rocks, slightly talcose slates, and quartz rock again made their appearance, and it is not improbable that they belong to the lower series. A granitic dyke was observed to intersect these strata about a mile and a half from the upper end of the lake, and in the region between the lake and the St. Francis, there are great intrusive mountain masses of granite, which very probably produce considerable disturbance of the stratification. The largest mass constitutes the Great Megantic Mountain at the united corners of Hampden, Marston and Ditton, which with a length of six miles and a breadth of three miles, may cover an area of twelve square miles. This mountain was not visited by any of our party, but I have been assured by a competent person that the rock is of the same lithological character as the intrusions farther west. Another large nucleus was met with in the Little Megantic Mountain, which may cover an area of six square miles, not over from one to two miles removed to the south-west of the line between Aylmer and Gayhurst Townships. The rock was observed in a hill about a mile to the south-east of Lake Louisa; in another upwards of three miles long in Winslow, about five miles south-east of Lake Aylmer; and in two small hills on the Felton River, which discharges into Lake St.

Francis on the left side, one of them about half a mile, the other three miles up from the mouth; and it is very probable that most of the abrupt isolated hills of the district are composed of it. The bold and pointed form of Gosford Mountain at the head of the Arnold River, flowing in at the upper extremity of Lake Megantic, induces me to suppose it will be found to be composed of granite, and being aware from examination many years ago, that the rock crosses the Kennebec road a short distance within the boundary line of the State of Maine, and there constitutes bold mountains on each side of the road, it appears probable that it will be found to form the range of elevations, described as running to Bathurst on the Bay Chaleur, where its presence has already been mentioned in a previous Report, and where it has the same lithological aspect.

On the Chaudière, between Lake Megantic and the Great or Jersey Fall, a distance of about thirty-seven miles, the only rocks seen were fine and coarse gray micaceous clay slates, with gray micaceo-argillaceous sandstone, weathering greenish in the air, and becoming very smooth and reddish when exposed to the run of the stream, and an occasional band of hard drab sandstone, almost a quartz rock, with some few grains of feldspar. At the Great Fall there is a considerable exposure, measuring about 150 yards across the strata, which appear to dip S. 20° E. mag. 62°. The beds consist chiefly of gray sandstones, some of which are schistose and verge on a coarse mica slate, while others are massive; they weather of a greenish tinge where untouched by the water, but where acted on by occasional floods they have a reddish cast; they are interstratified with calcareous bands which are harsh and gritty to the touch, and no doubt containing a great preponderance of sand, none of them would burn to lime; other and thinner bands in the rock are blackish on the exterior, and these seem to become smoother than the rest, but they are soft and wear into grooves, while the sandstones stand out in relief; the black bands are finely laminated and split into brittle plates with glossy surfaces; the sandstones weather to a lighter gray than the calcareous beds, some of which approach a dull pale olive green on the exterior. A quarter of a mile below the fall, there is another exposure of

rocks of the same kind with more lime in some of the beds, and the same character pervades such strata as were seen to the junction of the Rivière du Loup, and three miles up this tributary ; it also belongs to those between this tributary and the Rivière à la Famine, with the exception of the fossiliferous limestone met with on the latter. The fossiliferous beds occupy a low ridge removed a short distance from the stream, and are confined to a breadth not exceeding ten to twenty yards, while about one acre to the south-east of them there is an exposure of slaty micaceous limestone without fossils. The bed of the stream a short distance up, is occupied by interstratified slates and sandstones, which with a dip S. 20 E. mag. $< 65^\circ$, plunge under the fossiliferous strata ; they are very similar in color and general character to those of the Great Fall on the Chaudière, there being however a larger proportion of the slates ; the sandstones often contain calcareous sub-lenticular patches, and are sometimes slightly calcareous throughout. In the valley of the Chaudière it is very difficult to determine with precision, where the line between the superior and inferior Silurian rocks should be drawn ; there seems to be a gradual passage from the one to the other for a considerable distance, and it is only on arriving within a mile of the serpentine of the Guillaume that the doubt diminishes. So far down as the Touffe des Pins, notwithstanding the presence of a few very thin bands or partings of a peculiar dingy, olive-green serpentine, mentioned in a previous Report, it appears probable, on a re-examination of the rocks, and a comparison of them with those north of the fossiliferous limestone on Lake St. Francis, that they belong to the upper series. The clay slates in the bed of the Touffe des Pins about a mile from the mouth, are of a bluish black, striped with a rather lighter color ; they are occasionally slightly calcareous, while the sandstones which are interstratified with them are strongly so, and shew also occasional disseminated crystals of feldspar. At the turn in the River Chaudière, about a mile and a half above St. Francis church, a thick and strongly feldspathic bed is followed three hundred yards farther down by clay slates and a few bands of dark gray quartz rock, associated with coarse dark gray or nearly black limestone, very much re-

sembling some of the limestones of the upper series. At the elbow in the river below this, another thick and strongly feldspathic rock occurs, a light gray bed subordinate to which is strongly calcareous; just above the church, dark gray and black clay slates prevail, interstratified with a few bands of sandstone, and little change is met with until reaching a corneous rock displaying diallage, standing boldly up by the side of the road on the right side of the river, about a mile above the Guillaume.

The section on Temiscouata Lake in succession to that on the Portage road, displays some new features in the upper rocks. That part of the lake which is above Fort Ingall extends to the north-eastward on the strike of the formation, at right angles to the part below, which with the Madawaska River to the Little Falls, and the St. John's River in continuation, to the vicinity of Woodstock, affords the means of a transverse inspection. The upper part of the lake on the northwest side, gives a fuller development of the strata which occupy the last two and a-half miles on the road, and probably belong to the upper series. Towards the upper part of the lake, that is to say above Sandy Point, which is four and a-half miles from the Fort, they consist of gray slaty limestones, splitting into thin firm laminæ, apparently in the direction of the beds which are nearly vertical, and would yield excellent tiles and flag stones; lower down gray clay slates are interstratified with calcareous sandstones, which weather to a yellow earth or rotten stone, and in some parts nodules of the same character occur; in addition to these strata clay slates sometimes of a dark and sometimes of a lead gray, are found interstratified with thin bands and lenticular patches of a fibrous limestone, the fibrous structure running at right angles to the beds and quite across them; these slates and fibrous bands of limestone prevail not only on the north-west side of the lake and for a mile up to the mill on the Ruisseau du Petit Lac, or Mill Brook, but they were observed extending along the south-east side of the lake from the head to the point immediately opposite the mill brook, where there is some irregularity, and where the gray slates are associated with beds of calcareous sandstone, and arenaceous limestone with dark banded green

slates. An interstratification of beds similar to these, has been mentioned in a previous Report, as met with north-west of the Mountains of Notre Dame on the Chat River in the District of Gaspe, and the peculiarity of the fibrous structure of the calcareous bands is so striking, as to induce me to suppose that the rocks must be equivalent.

After an interval of three quarters of a mile to the south-east, transverse to the stratification, in which no exposure occurs, we come upon the rocks which constitute Mount Wissick (*the Beaver Cabin*), as it was anciently named by the Indians, or Mount Lenox, as it is designated in recent maps; these in ascending succession appear to be as follows:—

	Feet.
Whitish massive sandstone of a moderately fine grain	45
Coarse calcareous conglomerate; the matrix is a greenish sand, and it holds a large amount of angular fragments and some rounded forms of gray limestone, with a much smaller number of quartz pebbles; no fossils were observed in the limestone pebbles and fragments...	20
Measures concealed	90
Green sandstone, with a few conglomerate bands similar to the previous one	20
Red and green shale in alternating bands, none of which were observed to be calcareous; there are three successive exposures of this shale, with fossiliferous limestones between them, but they are supposed, from changes in the direction of the strike and one observed anticlinal, to be repetitions, the shale being subjacent to the limestone.....	125
Gray nodular limestone well stored with fossils; the limestone presents a columnar structure at right angles to the beds, occasioned by two sets of joints dividing the beds into sub-right rhombic prisms	50
Gray hard sandstone; no fossils.....	10
Gray fossiliferous limestone, with a columnar structure.....	20
Gray arenaceous limestones and calcareous sandstones, with fossils at the base and at the summit, and probably all through; some of the beds have but very little lime, and many may have none at all. This constitutes the main body of Wissick Mountain, and the thickness is derived from the height of the Mountain, which is 550 feet, no rocks being seen across the measures from the band of gray sandstone above mentioned for a considerable distance...	500

To the centre of the valley between Mount Wissick and the next ridge running to Black Point, there would, if the dip remained constant all the way at that which the mountain shews (150° mag. $< 13^{\circ}$), be room for an addition of 1000 feet to the above; but no exposure of the strata appears on either side of the lake to tell of what the interval may be composed, and between the centre of the valley and the rock of Black Point there is another concealed interval, which directly across the measures would be four hundred yards.

Black Point, and Burnt Point which is opposite, consist of a very coarse conglomerate, composed chiefly of quartz rock and limestone pebbles, the former prevailing; the colors of the quartz rock pebbles, which occasionally hold a few spangles of mica, are green and gray, but principally green, and some of them are six to eight inches and even a foot in diameter; the calcareous pebbles weather in general to a yellowish cast, but some of them remain gray; some of the pebbles consist of red slate; the matrix of the rock is a sandstone of a dark gray color and it appears to be slightly calcareous. The first or lowest band of this conglomerate is about 400 feet thick, and it is followed by others varying from one to sixty feet, which are separated by beds of sandstone of from one to fifteen feet thick. The whole breadth of these coarse rocks is about 400 yards, and the dip remains very uniformly, 140° mag. $< 51^{\circ}$ to 56° , which would give a total thickness of very nearly 1000 feet.

This conglomerate rock constitutes a sharp and prominent ridge, which can be traced, as viewed from the summit of Mount Wissick, running far into the country north-east of the lake on the north-west side of the Toledo River, whose course is very probably guided by it for ten or twelve miles. From the same mountain, the course of the fossiliferous ridge to which it belongs, can be seen extending in a parallel line for upwards of ten miles, the last visible eminence in the line bearing 43° mag. On the west side of the lake the fossiliferous band is not so conspicuous, and not so clearly traceable, but it was supposed to direct its course to a hill on the north side of the Cabineau River, in the bearing 223° mag., while the conglomerate, it was presumed, would hold to a better marked ridge which occupies the south

side. With a hope of ascertaining the intermediate strata, so covered up on the lake, we ascended the Cabineau for four miles, in which only two exposures of rock were met with; the first, nearly three miles from the mouth, consisted of thin gray contorted limestone beds, without fossils; and the second half a mile beyond, of green slate banded with black, and interstratified with thin limestone bands, also without fossils; if the limestones of the exposure had been fibrous, which they were not, the measures would have resembled those below the Mount Wissick rocks.

Beyond the conglomerates of Burnt Point, the next rock exposed is a soft gray scaly argillaceous slate, becoming a little lighter in color under the action of the weather, which splits it into small flat fragments; on the west side of the lake it occupies about three quarters of a mile, in the distance of a mile and a half across the measures, and it probably forms the bed of the Toledo a few miles up from its mouth; it is not improbable that it is much contorted, and it is impossible to state the thickness it may attain.

The rocks which immediately succeed this slate on the west side of the lake, are given in the following horizontal section, reduced to dimensions at right angles to the general strike:—

	Yards.
Gray argillaceous scaly slates of the same kind as described above, interstratified with bands of sandstone, varying in thickness from an eighth of an inch to one inch; some of the bands are partially calcareous, and they are in general cut by veins of quartz not exceeding the thickness of paper.....	31
Measures concealed	14
Gray argillaceous slate with sandstone bands as before	69
Measures concealed, but supposed to be the same.....	13
Measures concealed, but so thickly covered with large angular blocks of a light gray sandstone with a greenish tint, of the same character as the bands, that there is little doubt much of it is present in thick beds.....	24
Sandstone of the same character as before, but in thick beds; it is of a light gray color, slightly tinged with green, hard and fine grained, very nearly approaching a granular quartz rock, and it is in the slightest degree possible calcareous. The dip is 143° mag. <83°...	7
Measures concealed, but probably the same sandstone.....	38

	Yards.
Light gray sandstone of the same character as before, with a few beds of slate separating the layers.....	9
Measures concealed	7
Light gray sandstone as before, weathering of a lighter gray than the internal color.....	10
Gray argillaceous slate, weathering green and crumbling under the influence of the weather.....	1
	—223
Dark gray altered argillaceous sandstone, very slightly calcareous; it has a greenish cast internally, and weathers more green externally; there are a few quartz pebbles at the bottom of the bed; fragments of the rock held in a proper position with respect to the light have a peculiar glimmering lustre from the symmetrical arrangement of a multitude of minute crystals of feldspar.....	10
Dark gray tough argillaceous sandstone of a similar character without any calcareous matter, alternating with beds of an impalpable grain, and as hard as jasper, in fact a perfect jasper, the color in some beds being a uniform black tinged with purple.....	10
Measures concealed, probably beds of a similar kind; this constitutes <i>Pointe aux Trembles</i>	30
Greenish tough argillaceous sandstone alternating with beds of a uniform purplish chocolate colored jasper; the sandstone beds have grains of red in them mixed with the green, but the general tinge is green	25
Measures concealed	86
	—161
Greenish tough argillaceous sandstone; in some parts it holds a few pebbles of a highly crystalline character, and of a red color, and others of gray and greenish hues; the rock may be termed a pebbly sandstone, but the pebbles are very obscure and tightly soldered into the matrix; fractures go through both without deflection	18
Measures concealed	18
Greenish tough sandstone as before; the occasional presence of pebbles is more observable than before; they sometimes stand up in relief on the surface, and the rock towards the top partakes more of a conglomerate character; some of the pebbles are five to six inches in diameter, and they are all highly crystalline, appearing in general to be of metamorphic origin. The matrix which is not very fine continues to be a mixture of red and green grains, giving a greenish tinge in the aggregate; some of the interstratified bands are of a darker hue than the general color, approaching an iron gray, but weathering to a yellowish white; by these bands and by bands of a deep purplish red slate the dip can be readily distin-	

Yards.

guished, being 144° mag. $<76^{\circ}$. There are thin vertical transverse veins of epidote cutting some parts, and the same mineral seems to prevail also as a constituent of patches of the rock; there is a very regular set of joints in the rock of which the underlie is 295° mag. $<22\frac{1}{2}^{\circ}$ 96

—132

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516

These rocks constitute two points on the west side of the lake; the upper one being called Pointe aux Trembles, is very conspicuous, just opposite to the Toledo River; the second point is of little or no importance in the configuration of ^{the} coast, but it runs back into a ridge, with a valley on each side of it, which well marks the run of the sandstone composing it.

About a hundred yards over a quarter of a mile from the last mentioned sandstones, at right angles to the strike, the rocks of the next point would come upon the section, and the interval, judging by the first rocks seen on the south side of the Toledo, at a corresponding point, would possibly be calcareous slate, of a blueish gray color and fine texture, with some thin bands and patches of a rather coarse grain. The stratigraphical divisions of these slates are obliterated by cementation, and it is only by slight differences of color that the beds can be distinguished. These slates are followed by gray slates, which are not calcareous; they weather to a dull olive green and cleave into very thin leaves, the surfaces of which have a dull glossy lustre, and the slates appear to be slightly micaceous; some faint differences of color shew the original beds, which are very thin. They pass into a gray sandstone, which weathers greenish; it is tough, slightly calcareous, and slightly micaceous; it is fine grained and has a dull granular earthy fracture; the slates and sandstones alternate and pass into one another by intermediate qualities of rock. They all weather greenish, but this is where washed by the water and spray of the lake; where surfaces were seen removed from the Lake and denuded of moss and trees, they were often found to be of a dull white with a small amount of reddish yellow in it, perhaps the result of the action of fire. The beds succeeding the calcareous slates have

a transverse measure of 290 yards, with a dip, when it could be determined, of 145° mag. $<50^{\circ}$.

The next five miles across the measures are occupied on the west side of the lake, by calcareo-argillaceous slates, occasionally interstratified with non-calcareous bands, and some of the beds are more arenaceous than others; the colors are dark blueish gray, light gray and black; the divisions of the original bedding are obliterated by cementation, and in fresh fractures it is only by the colors, the differences of which are often very obscure, that the stratification can be made out; but the action of the weather and water on the ice-rounded or *moutonné* forms which come upon the lake, distinctly shews the bedding by the unequal wear of the more and less calcareous layers, the one standing out in beads and the other re-entering in grooves. The beds are almost universally thin, and the surfaces give a pictorial display of a vast variety of the most complicated contortions, sometimes in folds leaning over one another to the north west, and sometimes in involved arrangements, which it is quite impossible to disentangle or understand, without a larger exposure than usually appears; combined with the contortions there are often disruptions or dislocations, which however shew no veins of interposed foreign material, the torn and twisted mass having been apparently compressed together and become cemented in such a way, that except for the colors or unequal wear it would never be suspected that it had been disturbed at all. In some parts however, these contorted rocks are cut up by a multitude of small veins of calcareous spar. In the vicinity of the Little Island, which stands opposite the Grand Bay, a span of three quarters of a mile across the measures, including the island, shews no calcareous matter in the slate, which weathers rather greener than the beds higher up, but there is a small amount of lime in the hard bands, which are very thin sandstones. Calcareo-argillaceous slate then appears again and continues for the succeeding mile and a half, and the remaining distance to the exit of the lake, another mile and a half transversely to the general strike, shews an occasional thicker bed of sandstone, gray calcareo-argillaceous slates holding gray thin calcareous sandstones, and black and dark gray non-calcareous beds, inter-

stratified with light gray slightly calcareous bands with more or less sand ; the last exposure, just at the exit, on the right bank of the Madawaska, consists of non-calcareous sandstones and slates, which are gray internally, but weather to a dull olive green, resembling those near the Toledo River ; the beds are all slightly micaceous, the slates more than the sandstones.

About half a mile down the Madawaska, where the rock comes close upon the river, the same greenish weathering, gray, slightly micaceous slate is seen, with thin light colored bands marking the bedding, and these thin bands are slightly calcareous, while the darker part is not. The exposures on the river, all the way to the Little Falls at its mouth, are by no means numerous, and they appear to consist pretty uniformly of the same slates and sandstones, the slates vastly prevailing and occasionally displaying a small amount of calcareous material, as where the hills approach the right bank between the tenth and eleventh mile posts. At the Little Falls the color of the rock is gray internally, weathering generally to a dull obscure olive green, but sometimes so decided as to give a chloritic aspect, and the slate which is micaceous is interstratified with occasional hard compact bands cleaving with difficulty, and possessed of sufficient grit to entitle them to the name of sandstones. Rocks of a similar general quality are seen on the St. John River, below the Little Falls, as for example near the Squesibish, where there is a transverse exposure of 200 to 300 yards, and where the slate, internally gray, weathers slightly greenish, and is interstratified with bands of slightly calcareous sandstone, some of which are four and five inches thick, and occasionally even a foot ; the bedding is well displayed at the place, and a few contortions in the stratification are visible.

Beyond this, about a mile and a quarter above the Shiguash, a band of coarse conglomerate crosses the road, which bears a strong resemblance to the Black Point conglomerate on Lake Temiscouata, and holds a great amount of large pebbles and small boulders of black limestone, weathering to an ash gray ; some of the calcareous pebbles are themselves of a conglomerate character, and their constituent pebbles shew a derivation from a stratified formation, while

their matrix holds organic remains ; with the calcareous pebbles of the final conglomerate are mingled others of silicious character, among them some of black jasper and chalcedonic quartz, and several are found of blackish green serpentine ; the matrix is a hard calcareous sandstone, with grains of transparent and colorless, opaque white and other colored quartz ; internally it is gray and weathers to a yellowish tinge. Vertical beds of the conglomerate running in the direction 54° mag. alternate with beds of sandstone much of the same character as the matrix, and a breadth of about seventy-five yards is visible, giving a thickness of 225 feet, and as the strata on each side are concealed, it may be greater, particularly on the south-east side, where the ground rises into a small hill for a quarter of a mile. At this distance these conglomerates are followed by calcareous slates, which at first are interstratified with a few bands of sandstone, resembling that associated with the conglomerate, but farther on display strongly calcareous beds weathering to an impure rotten stone, and sometimes the slates, without being calcareous themselves, are interstratified with slightly calcareous sandstones. These alterations are occasionally visible for about 500 yards, between which and the Shiguash there were no exposures on the road ; and the examination was not carried beyond this stream. It is not improbable that this band of conglomerate may be equivalent to that of Black Point, and if such be the case, it is not unreasonable to expect that limestones equivalent to those of Mount Wissick should appear at some distance beyond it, succeeded possibly by rocks of the lower Silurian epoch, before reaching the intrusive granitic axis, where it crosses the St. John River.

On the St. John River, rocks similar to those of the Little Falls and the lower part of the Madawaska, prevail as far up as we reached, and the same exist on the lower part of another tributary, the St. Francis ; the slates were in general micaceous and only occasionally calcareous, and the same may be said of the sandstones. We spent ten days in the examination of this tributary, and though it is not over twenty miles from the Madawaska, we were not successful in finding any of the conspicuously marked rocks of Temiscouata Lake ; we searched in vain

for the Point aux Trembles sandstones and jaspers, for the Black Point calcareous conglomerates, the Mount Wissick fossiliferous limestones, and the red and green shales beneath them, and all that we could establish after ascending to the head of the third lake, called by the Indians Wollenabégeg, or *the Water Basin*, was that the farthest down exposure of a coarse greenish chloritic sandstone associated with green slates, which we supposed to belong to the lower series of rocks, occurred just to the north of the Province Line, at the foot of this lake, below which the country consisted chiefly of clay slate ; that the most calcareous ridge, which however shewed no fossils, and did not possess so much lime as to give what could be called limestones, occurred about three miles above the Middle Lake, which goes also by the name of Bow Lake, or, as the Indians call it, Battéwichcàgameg, (*the lake encircled with burnt land*). A mountain on the north-east side of this lake, displayed some strong beds of sandstone, associated with blueish black or dark gray slates, both slightly micaceous, the sandstones more so than the slates, but the sandstones alone slightly calcareous ; and similar micaceous and occasionally slightly calcareous rocks prevailed to the mouth.

On the Black River, twenty miles above the St. Francis, there occur the same gray micaceous slates and sandstones, occasionally slightly calcareous ; the sandstones weather greenish, and when affected by the water, acquire a slightly reddish tinge. Large angular blocks of the calcareous conglomerate were met with, but the rock was not found in place. In the vicinity of the Province Line, both below and about half a mile above it, calcareous slates occur, with black or dark gray coarse limestone bands, similar to those some distance above the fossiliferous limestones on the Chaudière and the St. Francis ; and half a mile above this there is seen a conglomerate of which three exposures occur in 300 yards, consisting of boulders of fine silicious conglomerate and of gray quartz rock, with blackish vitreous quartz grains, and fragments of green slate, and of this green slate in a state of comminution, and of fine gray slate, the matrix appears to be composed. The double nature of the conglomerate, from the presence of conglomerate pebbles resembling

in lithological character some of the lower fine conglomerates, induces me to think the rock may belong to the upper series. The sandstones of the fifth division of the lower series were met with 300 to 400 yards farther up the stream, and as far as examined, a distance of about a mile and a quarter, they are distinguished by those marks which characterise them nearer the St. Lawrence; they are massive, coarse grained, slightly micaceous and slightly chloritic, they shew scattered spangles of plumbago, and they are interstratified with an occasional band of red slate.

Materials capable of Economic application.

The general nature of the materials capable of economic application, accompanying the rocks that have been described, as well as several of their localities, have already been stated in the Report on the Eastern Townships, and it only remains to mention such additional localities of their occurrence as have been recently ascertained.

Bog Iron Ore.—What appears to be a small deposit of Bog Iron Ore, was met with on the twelfth lot of the fourth range of Ireland, a little to the south-east of the middle of the lot; it occurs on the stream from Black Lake, and it is exposed on the north-east bank of it; the bed was about fifteen inches thick, but the whole area that could be traced had a breadth of no more than five feet and a length of only fifteen yards, extending just across the stream, and it could not be discovered beyond the bank on either side.

Another deposit occurs on the east side of the Chaudière in St. Lambert, on the Seignory of Lauzon, on the property of Antoine Hollie; it was first observed on the road, and with a breadth of thirty yards, it was ascertained to extend sixty yards to the south-east, but as the surface continues level in the same direction for a considerable distance, the area may be much greater than the measure specified. The land was partially covered with water and thick underbrush, and it was not found practicable to effect a thorough examination, without considerable delay and expense; the thickness of the bed appears to be about twenty inches.

A third locality was ascertained to exist on the property of Captain Morin, about one mile above the junction of the two branches of the Rivière du Sud in the Seignory of St. Vallier; two areas in this locality were examined; the first was about 300 yards north-west from the mill on the main branch about a mile and a quarter above the junction; it extended northward 380 yards, with a breadth of twenty-eight yards and a thickness of about twenty inches; the next area is removed about forty yards farther west, and was measured 1200 yards northward, with an average breadth of twenty-four yards, and a thickness of twelve to twenty inches. It was stated by Captain Morin that other areas are met with two miles to the south-east of the main branch, and also to the north-west of the smaller branch in St. Michael, and it appears not improbable, that the quantity in the whole neighborhood may be sufficient to become economically available.

Copper Ore.—Traces of copper ore were met with in two localities in the valley of the Chaudière, which appear to be in nearly equivalent geological positions in regard to the stratification of the country. One of them is on the land of Ignace Tardi, in the Seignory of St. Joseph, on the left side of the river, and about a mile removed from it, nearly opposite the road above the Church leading out to Frampton, where small spots of vitreous copper occur disseminated in quartz with talc, chlorite and earthy ferruginous oxyd of manganese, filling inconsiderable cracks in disturbed strata, consisting of red and green slate and green sandstone with occasional patches of red limestone. The second locality is on the Seignory of St. Mary, on the right bank of the river towards the front of the third concession, in a line with a point about a mile above the Church. The rock of the country is here also red and green slate of a talcose character with green chloritic sandstones on each side of it. A few bands of red dolomitic limestone are interstratified with the red slate; they are much cut up by thin reticulating veins of quartz, and present patches of red jasper and specular iron, as well as talcose slate. The strata display sharp plications, and in some of the cracks, resulting from the contortions, strings and short partial veins of quartz and calcspar with chlorite and talc in the limestone hold

spots of vitreous and pyritous copper, while small fissures and cleavage joints are coated with green carbonate. In many parts patches of the disturbed and broken limestone have decayed to a dark brown earth, holding iron, manganese and a trace of copper, and cavities in the rock are lined with this; no regular lode could be discovered, and the quantity of copper is too small to be available.

Quarries having been opened in the limestone of the fiftieth and fifty-first lots of the twenty-first range of Upton, for the purposes of the St. Lawrence and Atlantic Railroad, the vein of copper ore, which in a previous Report was mentioned as existing in the latter numbered lot, has become more exposed to view, and the facts furnished by a subsequent examination of the locality serve to give a better understanding of the probable mode in which the ore occurs. Several spots of ore running in a line N. W. and S. E., nearly across the general range of the limestone, induced the supposition that the lode was transverse to the stratification, but a bed of a conglomerate character, which accompanies the fine grained beds, having been found to make a sudden turn parallel to the course of the ore, it seems probable that in this case, as in all others in which metalliferous veins have been met with in the rocks of that part of the Province, the ore may in reality run with the strata, and the irregularity be due to a twist in the stratification. The ore is very irregularly distributed in bunches, some of which might produce five, and others two to three hundred weights of between twenty and thirty per cent. to a fathom of ground; but the irregularities appear too great to render the ore capable of being profitably mined, unless as an adjunct to the quarrying of the rock for the purposes of obtaining materials for building or for burning to lime.

Chromic Iron.—A bed of chromic iron was met with in the augmentation of Ham, in the vicinity of the fifty-third mile post on the Gosford road, being six miles from Rlee's settlement; it occurs in serpentine in the north-west corner of the twenty-first lot of the second range of the augmentation, and shews a thickness of twelve to fourteen fitches; a length of five yards of the bed was visible, running with the general direction of the

serpentine at the spot, E. N. E. and W. S. W. mag. The ore is of a brilliant black and highly crystalline ; and though it has not yet been analyzed, it is probable it will equal if not surpass in richness, the samples heretofore tried from other Canadian localities.

Farther to the N. E. in the same band of serpentine, on a small island in Breeches Lake in the Township of Garthby, opposite the fifth range of Ireland, there is a considerable amount of disseminated crystals of chromic iron running in parallel lines, but not in sufficient aggregation to be workable. The fact however is worthy of being noted, in consequence of the great development which the band of serpentine displays about six miles farther on, in Ireland and Coleraine, where as already stated, there exists an area of the rock of fifteen square miles, affording a favorable opportunity for researches for the mineral.

Gold.—The occurrence of gold in the gravel of the valley of the Touffe des Pins, a tributary of the Chaudière, has already been mentioned in a previous Report, and on revisiting the Seignory of Vaudreuil Beauce, a few days were spent in endeavoring to ascertain over what breadth across the stratification, the auriferous gravel might extend. Seven different places were tried, and the metal found in five of them ; no attempt was made to determine in what quantity it existed, as without a greater expenditure both of time and money than the funds devoted to the Survey would permit, no such result as might have been considered a just criterion could possibly have been arrived at. We were satisfied to establish the fact of its presence merely, and the smallest particle of the metal was deemed sufficient for the purpose ; two of the spots were indicated to us by Mr. Angers as localities in which he had himself met with traces ; one of them was on a small brook, tributary to the Rivière à la Famine, entering it on the south side about four or five miles from its mouth. About a mile and a-half above the fall on the Famine, there commences an extensive deposit of clay, sand and gravel ; we followed the section made through it by the river for about a mile and a-half, and constantly found the clay beneath and the gravel resting on it ; towards the top of the gravel, the bank often presented a horizontal deposit of the mingled oxyds of iron and

manganese, in some parts six to eight inches thick, filling the interstices among pebbles of various kinds, many of them being clay and talcose slate, quartz rock, chloritic sandstone, and some of them of white vitreous quartz with grains of black magnetic iron sand in the finer parts. The same deposit with the same arrangement exists on a small brook which gives a section through it at right angles to the main stream, on the S. E. side; ascending this about the third of a mile, and trying a few pounds of the gravel at the top which had not previously been moved, a small particle of the metal was immediately met with. Another locality was about a mile up the stream which discharges into the Chaudière, opposite the Famine, on the Seignory of Aubert Gallion, being on the twenty-second lot of the *do.naine*, where the metal was first observed by Mr. Fortier, one of the *censitaires*, in a narrow ravine with steep precipices of clay slate on each side; it occurs in the clefts of the slate constituting the bed of the stream, and in the clay and gravel immediately on the top of the rock, mingled with magnetic and chromic iron; the quantity of gravel at the spot is but small in consequence of the narrowness of the ravine, through which the water rushes with great violence during the freshets of spring; about a grain's weight of gold was here obtained; I have since been informed by Mr. Fortier, that he has traced it two miles farther up the stream. The metal was also met with close by the side of the river road, where it is crossed by the brook next below the previous stream. Mr. Hunt found traces of it in the gravel at the foot of the precipice of serpentine, just below the fall of the Guillaume River, where it was associated with grains of magnetic and chromic iron, as well as of rutile and ilmenite. He also discovered it about a mile below the Great Fall on the Bras, in similar gravel lying close on clay slate, where it could not be far removed from the band of serpentine constituting the rock of the fall.

These five localities, as well as that of the Touffe des Pins above mentioned, the Ruisseau Lessard, and the Ruisseau du Lac or du Moulin, in both of which particles have been met with, are all included in an area of about sixty to eighty square miles, with a breadth of about ten miles across the

stratification, and I have been informed that traces of the metal have been found on the River Metgermet, flowing into the Rivière du Loup, about fifteen miles still farther to the south-east than the Rivière à la Famine. Without a much more detailed and expensive examination than can be given to any one locality, on a Survey that is expected to embrace within a reasonable period an inspection of the whole Province, it would be premature either to assert or deny, that the precious metal may be held in sufficient quantities to yield a profitable return.

Bog Manganese.—Indications of bog manganese were observed in Tring, on the road from Lambton to St. François Beauce, near the eastern boundary of the Township; the deposit was visible for several yards on each side of the road for the depth of a few inches, and it was traceable into a field on the north side, where it became a foot thick; from the difficulties of the ground however, it could not be followed farther on one side than the edge of a swamp filled with boulders, while on the other it appeared to thin out, and the locality does not seem to promise any great economic result. The produce of the ore in pure peroxyd, according to the analysis of Mr. Hunt, is 25 per cent.

Indications of the same ore exist on several successive farms on the west side of the Chaudière, opposite to the mouth of the Famine River, running across the lots and parallel with the bank of the Chaudière. On one of the lots, in the occupation of John Harvey, it was followed for two acres with a breadth however, not exceeding twenty yards, and from this it was traced about three acres to the south-east and about six acres to the north-west. It appears to occur in disseminated nodules, similar to those mentioned in a previous Report as met with on the ninth lot of the tenth range of Stanstead, but in some spots in the area, the ore was found in continuous patches of a few feet diameter, with a uniform thickness of two to four inches. The yield in peroxyd is 20.5 per cent.

The ore was met with also in the Seignory of St. Mary, at the junction of the road between the second and third ranges, and that to Frampton, on the land of Etienne Grégoire; the area

over which it could be traced did not exceed sixteen yards by ten yards, but the thickness appeared to be about two feet in the centre, thinning out towards the edges; traces of it however, were met with three hundred yards to the S. E., in loose pieces on the surface. The yield of the specimens taken from the deposit is in peroxyd 30 per cent.

Mr. Murray met with indications of the ore in the Seignory of Ste. Anne, about three quarters of a mile from the Church, in the bearing S. 54 E. mag. The indications appeared to be confined to a patch of cultivated ground, covered at the time of examination with standing grain, rendering it inexpedient to follow them out; no traces were observed either on the one side or the other of the field. Fragments of the ore picked up on the surface, shew a thickness of a few inches, and on analysis have been found to contain 38 per cent. of peroxyd.

Flagging Stones.—On the fifth lot of the second range of Inverness, in the occupation of J. Forbes, about the middle of the north-east line, there occurs a band of talcose quartz slate, which has been to a small extent quarried, and which, splitting with facility into slabs down to the thickness to three inches, would yield very excellent flagging of any size up to seven feet by four; the divisional planes are very even and regular, and they display surfaces that would require little or no dressing. The band is about twelve feet thick and the color of the slabs is light gray with a tinge of green.

Roofing Slates.—On the fourteenth lot of the first range of Halifax, there was observed a band of schistose rock, of which a breadth of about three yards was exposed, deserving well to be tried for roofing slate; it is of a blueish gray color and splits into laminæ of one eighth of an inch and upwards in thickness, The surface, instead of the earthy aspect which characterises the best slates of Great Britain, possesses a dull gloss arising from the presence of a small amount of talcose material. The plates are firm but not brittle, and may be easily pierced and dressed. It is probable that slates of any required size, from twenty-five by eighteen inches to thirteen by seven inches, might be obtained. The quality is almost precisely the same as that of the quarry in Frampton, opened by Mr. M. Quigley about

eight years ago, of which specimens were then sent to the Board of Works.

Mill Stones.—The granite met with in the vicinity of the serpentine of the Guillaume, in the Seignory of Vaudreuil Beauce, has been advantageously used for mill stones. Mr. Calway, who for twenty years has occupied the mill on the Rivière des Plantes, in the Seignory of St. Joseph, informed me that he had for more than half the time applied the stone to such a purpose in his mill, and that he considered it only a little inferior to French burr. The rock appears to have a rather larger amount of quartz than ordinary granite, and it is at the same time exceedingly tough; the color is a very light gray, nearly approaching white, its quartz and feldspar are very white and its mica dark brown. It is not impossible that some of the conglomerate beds of the green sandstones which lie a little both to the north-west and south-east of the Rivière des Plantes, would also furnish good material for mill stones. Judging from a specimen brought me from the tenth lot of the eleventh range of Ham, a conglomerate bed there lying immediately near a band of calcareous serpentine, which has already been mentioned, would probably afford good native mill stones; the pebbles of the conglomerate are composed of white corneous quartz, and vary in size from a quarter of an inch to two inches in diameter, and are very firmly and thickly set in the matrix, which is not quite so hard as the pebbles.

Peat.—For the valuable uses to which peat is applied, I beg to refer to the remarks of Mr. Hunt, accompanying his analyses of specimens from the deposit in the Seignory of St. Hyacinthe at St. Dominique. In addition to this locality he mentions others in the Seignories of Longueuil and Ste. Marie de Monnoir. It is also met with in the Seignory of Rivière Ouelle, where an extension of it called La Plaine spreads over four thousand square acres. Another deposit occurs in the Seignory of Rivière du Loup, the breadth of which, on the Temiscouata road, is a mile and a quarter; it occupies an area of about six thousand acres, and Mr. Andrew Russel, in constructing the road over it, ascertained its depth in some parts to be eighteen feet. I have been informed of another locality in the Townships of Matanne and M'Nider,

between the rivers Blanche and Matanne, but with its extent I am as yet unacquainted. A patch of a hundred acres occurs on the left bank of the Madawaska River, opposite to Mr. J. Walsh's farm, just above the twelfth mile post on the road to Little Falls.

Catalogue of Economic Minerals.—Desirous that as many as possible of the materials to be found associated with the rocks and deposits of the Province, and capable of useful application, should be represented at the Grand Industrial Exhibition to take place in London in the beginning of May 1851, a Catalogue of such as are known to me, with their localities, has been prepared with a view to promote by its circulation, a collection of such specimens as may be worthy of transmission to England, and considering that the document may tend to assist in diffusing a knowledge of the mineral resources of the country, a copy of it is appended to this Report. The chief part of the localities given are derived from the personal knowledge of myself and those associated with me in the Survey; there being however several districts which have not yet been examined, I have depended for some sources upon information obtained from others.

I have the honor to be,

Your Excellency's most obedient servant,

W. E. LOGAN.

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 GEOLOGICAL SURVEY,
MONTREAL, 1st *May*, 1850.

SIR,

After having accompanied you during a part of the season, in your explorations along the St. Francis and Chaudière Rivers, I proceeded in the month of September to the western portion of the Province, with a view to some chemico-agricultural investigations, in accordance with the design expressed in the Act for the Geological Survey, which provides for the examination of the soils of the country. My plan was to visit different districts, and collect from them specimens of such soils as I judged to be representatives of the neighborhood, selecting generally such as had never been cultivated, that I might ascertain their constitution when neither enriched by manures nor exhausted by long tillage. For the sake of comparison however, I not unfrequently took specimens from lands which had been impoverished by long culture. In connection with the samples of soils, it was also deemed important to collect, as far as could be obtained from the cultivators, information as to the character and capabilities of the soil for the different plants, the succession of crops and plan of farming pursued, and the manures, if any, which had been employed, with the effects observed.

In the course of my journey, I collected specimens from Woodhill near Hamilton, the residence of the Hon. Adam Ferguson, from the vicinity of Brantford, of Woodstock, Zorra, Oxford, London, Lobo, Chatham, Raleigh, Niagara, and Port Dalhousie, amounting in all to twenty samples.

After my return to Montreal I made an excursion along the River Richelieu, that I might have an opportunity of examining some of the soils of its valley. I also visited St. Hyacinthe and some places in its vicinity, and examined the valuable deposit of peat which is found in the adjoining parishes. The number of specimens of soils collected on this tour was also about twenty, making an aggregate of forty in all. To the analysis of these, I have given my attention during the past winter.

As I had foreseen while making the collections, the number of specimens obtained was far greater than could be properly examined by a single chemist laboring without an assistant, in the time allotted previous to making the Annual Report. I have however been able to complete the analysis of eighteen, the results of which I beg leave to submit to you, reserving the others for a future Report.

Collection of the Soils, and plan of Analysis.—The specimens intended to represent the surface soil, were generally taken from a depth of about six inches, and the sub-soils unless otherwise specified, at a depth of about sixteen or eighteen inches. Care was taken to have them a fair average of the fields, an end which was often attained by mixing samples from several different parts.

In arranging the plan of analysis, reference was had to the determination of those substances only, which are considered of importance to the vegetable economy. In order that my investigations should be of the greatest use, it was thought proper on the one hand, to neglect the examination of the different forms of organic matter in the soil, and some other questions, which although of scientific interest, would have greatly prolonged the labor, and have rendered the number of analyses completed much less, without adding materially to their value; and on the other hand to determine with accuracy, the proportions of those ingre-

dients upon which, although present in comparatively minute quantities, may often depend the barrenness or fertility of a soil. It is for this reason important that these ingredients should be determined with exactitude, as analyses of soils conducted in the manner of those which we find described, and for which processes are laid down in popular works on agricultural chemistry, are often of little value to the scientific agriculturist.

In the course of the analyses which follow, I have given first, a partially mechanical analysis, in which the amounts of clay and sand have been estimated by carefully washing a weighed quantity of the soil, and determining the weight of the portion which was not carried off by the water. The moisture present in the soil was ascertained by exposing it to a temperature of 300° F., until it no longer lost weight, and the organic matter, if present in any considerable amount, by the subsequent loss in ignition. In the case of clay soils, which retain a portion of water at the temperature used in drying, but lose it by a red heat, the loss representing the amount of organic matter, is of course augmented by a portion of water. Clays however seldom contain much organic matter, and when it is present in such a quantity as to make its determination a question of interest, I have carried the previous process of dessication as far as could be done without carbonization. In reference to the amount of moisture, it is to be remarked, that the soils had been previously dried by exposure to the air in a warm room.

In determining the mineral ingredients, I have deemed it sufficient to examine those which the soil yields to the action of hydrochloric acid by the aid of heat; those elements which are so combined as to resist the action of this agent, may be considered as not actually available to the purposes of vegetable life, although serving as a magazine of vegetable aliment to be slowly set free by the disintegrating forces constantly in operation.

The process adopted was briefly as follows: twenty grammes of the soil were taken in fine powder, and if the amount of organic matter was considerable, having been sometimes ignited, were digested for an hour at a boiling heat, with pure hydrochloric acid diluted with three or four parts of distilled water. The

solution being filtered, and the residue carefully washed, the liquid obtained was measured and divided into three equal parts. One of these was evaporated to complete dryness, and when the residue was dissolved in water with the addition of a little hydrochloric acid, left behind a portion of silica which had previously been in solution, and which was estimated. The liquid was then mixed with an excess of a solution of caustic baryta which precipitated any sulphates and phosphates, and all the earthy bases except lime, which together with the excess of baryta being separated by carbonate of ammonia, the solution was evaporated to dryness and the ammoniacal salts being expelled by heat, the alkaline chlorids remained behind; after weighing them, the respective amounts of potassium and sodium were determined by combining the chlorids with chlorid of platinum, and separating the potassium from the sodium salt by means of alcohol, in which the former is insoluble.

A second measure of the solution was mixed with a solution of chlorid of barium, and after heating and a repose of some hours, the precipitate of sulphate of baryta, often very small, was collected on a filter, and washed with a dilute solution of sal ammoniac, after which it was ignited and weighed. In the filtrate from this, the iron, alumina and manganese could be determined by the usual processes.

The third portion was employed for the determination of the phosphoric acid; notwithstanding the importance attached to a correct estimation of this element, our processes hitherto have been confessedly very imperfect. In the soil it is always associated with lime, magnesia, iron, and alumina, and the separation of it from these bases, especially the last, has always been a very difficult problem, which has engaged the attention of many skilful chemists, who have from time to time, proposed processes to this end, which have however, subsequently been found on thorough examination to be objectionable and unable to afford reliable results. It was therefore not without hesitation that I undertook this difficult matter, nor was it until after many unsuccessful trials, that I at last succeeded in obtaining results satisfactory to myself. I was then agreeably surprised, when a few weeks after, I received through the foreign journals,

a memoir by the distinguished analytical chemist, H. Rose, of Berlin, in which, after a thorough examination of the subject, he proposes a process for the determination of phosphoric acid in soils, identical in principle with my own. Having premised this much, I proceed to describe briefly my process, which depends upon principles already well known to chemists, and has nothing new except the application of facts previously made known by Rose and Bérzelius.

It is based in the first place, upon the fact that in the presence of a great excess of a persalt of iron, the addition of ammonia precipitates the whole of the phosphoric acid in combination with the peroxyd of iron. The acid hydrochloric solution is heated to ebullition, a few crystals of chlorate of potash added, and the whole boiled for some minutes; the object of this being to destroy any organic matter which may interfere with the complete precipitation of the alumina and iron, and to peroxydize the latter. Sal ammoniac is then added if the solution is not strongly acid, and caustic ammonia in slight excess. The mixture is digested for a few minutes, filtered while hot, carefully excluding the air, and the precipitate is washed with recently boiled water; the object of these precautions being to prevent the formation of carbonate of lime from the carbonic acid of the atmosphere. As the precipitated peroxyd of iron and alumina always carry down with them a trace of magnesia, which in a subsequent stage of the process, would be liable to vitiate the results, the precipitate should be redissolved in hydrochloric acid, and again precipitated with the addition of sal ammoniac, by a slight excess of ammonia. It is thoroughly washed and dried, and then consists of the alumina and peroxyd, with the whole of the phosphoric acid of the original solution. To separate this, it is pulverized, carefully levigated and intimately mixed with four parts of carbonate of soda and about two-thirds of its weight of pure silica. The mixture is then introduced into a platinum crucible, which is enclosed in one of clay, and the whole intensely heated for about an hour, in a furnace. It is essential that the heat be sufficient for a complete fusion; by this process the alumina and iron are converted into silicates, and the phosphoric acid is obtained combined with the soda; the mass which

is generally green from a trace of manganese, is dissolved in water, carbonate of ammonia is then added, and the mixture digested for a little time to separate a portion of dissolved silica. The filtered liquor is then concentrated by evaporation, the excess of carbonate of soda neutralized by hydrochloric acid, and the solution again made alkaline by caustic ammonia. From this liquid the phosphate is precipitated with the usual precautions, by a salt of magnesia with the addition of a little sal ammoniac, as the phosphate of magnesia and ammonia, from the weight of which when ignited, the amount of phosphoric acid is calculated. This process is quite easy of execution, and has afforded me very satisfactory results.

The solutions which have been filtered from the precipitate of oxyd of iron, alumina and phosphates, contain the whole of the lime and magnesia of the soil; these bases are determined in the usual manner, the lime by precipitation as an oxalate, and the magnesia as ammonio-phosphate.

The amount of chlorine was determined by boiling a portion of the soil with distilled water, carefully filtering the liquid and precipitating by a solution of nitrate of silver. In the following analyses it has as yet been determined only in a few instances; in the others it yet remains to be added, but the results as being otherwise complete are presented. The amount of manganese was found to be exceedingly minute in the clay soils, although never absent, and as it is not regarded as performing any part in the nutrition of plants, its quantity has not generally been determined. The iron in all soils exists in part as protoxyd and part as peroxyd; it has been determined as peroxyd in the analyses. The phosphoric and sulphuric acids are given without any attempt to combine them; the latter is to be regarded as combined with the alkalis, and with lime forming gypsum, while for the phosphoric acid we have often no satisfactory means of deciding whether it is to be regarded as combined with lime or magnesia, with iron or alumina; fortunately this is a question of little or no practical importance, for we are aware that plants have the power of decomposing and recomposing the compounds presented to their roots, to form those salts which are best adapted to their economy.

SOILS FROM CANADA EAST.

St. Charles.—In their virgin state, the lands of this Seignory consist principally of a light grayish or yellowish clay with reddish stains, often more or less mixed with sand and overlaid with a light black vegetable mould, averaging perhaps ten or twelve inches in thickness. The original growth was of hard wood, maple, elm and birch, except upon small ridges of gravel occasionally met with, which are clothed with resinous trees. By tillage the soil gradually loses its blackness, partly from the decomposition of the vegetable matter, and partly from the intermixture of the inferior clay. Many of the farms have been cropped with wheat for thirty or forty years almost without alternation or fallowing, and owing to this, and to the ravages of the fly, have for a few years past yielded but comparatively inadequate returns. They produce however good crops of peas and oats, and the cultivation of timothy and clover has of late years been found very successful.

From this Seignory I selected three samples of the soil. The black mould at eight inches from the surface, No. 1; the underlying clay at eighteen inches, No. 2; these two are from the domain of the Seignor, Mr. Kierzkowski, about four acres from the river and near the parish church; and a third from a long tilled field not far distant, the property of Dr. Leprohon; of these but the first two have as yet been analyzed.

No. 1 consists of,

Sand.....	49.2
Clay.....	23.4
Vegetable matter.....	20.8
Water.....	6.6
	————— 100.0

100 parts of this soil gave to hydrochloric acid:

Alumina.....	4.820
Oxyd of Iron.....	3.240
Lime, } in part as carbonates. {	1.033
Magnesia, }	.749
Potash.....	.435
Soda.....	.795
Chlorine.....	.080
Sulphuric Acid.....	.144
Phosphoric Acid.....	.557
Soluble Silica.....	.075

100 parts of this soil gave to distilled water .786 of soluble matter, principally organic ; by ignition it left .104 of an alkaline ash ; it contained .008 of chlorine, a small portion of nitrates and a trace of sulphates. The bases were alkalies, lime and magnesia.

No. 2. This contains but a trace of vegetable matter, and consists of

Sand.....	56.0
Pebbles.....	8 0
Clay.....	27.8
Water.....	8.2
	————— 100.0

The sand of this as well as the previous soil is silicious with occasional grains of feldspar ; the pebbles are apparently gnessoid and quartzose.

100 parts yielded :

Alumina.....	1.440
Oxyd of Iron.....	3.780
Lime.....	.650
Magnesia.....	1.036
Potash.....	.976
Soda.....	.340
Chlorine.....	.134
Sulphuric Acid.....	.034
Phosphoric Acid.....	.215
Soluble Silica.....	.150

100 parts of this soil yielded to water, .0506 of solid matter, which by ignition was reduced to .0347 ; it contained .0134 of chlorine .00046 of sulphuric acid, and .0085 of lime, besides magnesia and alkalies ; no trace of nitrates was detected.

St. Hilaire.—The clays which I saw in this Seignory seem much like those of St. Charles, but with a smaller admixture of sand. Around the base of the mountain the *débris* of the decomposing trap, has made a band of gravelly earth well fitted for fruit and for those crops which require a light warm soil. The compact texture of these very heavy clays, washed by the waters flowing from the hill side, is such as to require thorough subsoil draining, which has been effected in an admirable man-

ner by the proprietor, Major Campbell, to whose kind courtesy I am much indebted, and whose enlightened efforts are making his farm a model to the district. Thus drained, the clays are found to yield excellent crops of wheat and clover, with peas.

Upon the farm of Major Campbell, the original layer of vegetable mould has by long tillage entirely disappeared; the general character of the clay seems to be nearly the same for a depth of five or six feet, except that it is a little lighter on going down, a difference perhaps due to the fact that organic matters from the surface have not infiltrated thus far. When brought to the surface it breaks into hard angular fragments, but by the influence of the weather it crumbles down into a comparatively mellow soil, still however becoming hard and dry in the heat of summer. In laying out the railroad, a bank of the clay was cut down and uncovered in many parts to a depth of six feet. The surface thus exposed was entirely free from any organic matter, but was found after a dressing of plaster, to yield an excellent crop of peas; this manure has been used with great success by the proprietor for peas and clover, upon the clays generally.

Two specimens of the soil were selected from a field near the bank of the river, and not far from the residence of Major Campbell. This land had been for some time under tillage, and was in good condition; one portion was taken at a depth of about six inches, No. 3; and one from a ditch at thirty inches, No. 4.

No. 3 gave by washing, a small portion of white sand, composed of quartz and feldspar; it contained but very little organic matter.

Sand.....	3.0
Clay.....	89.7
Water and vegetable matter.....	7.3
	<hr/>
	100.0

100 parts of it yielded:

Alumina	12.429
Oxyd of Iron.....	7.320
Lime .....	.697
Magnesia	1.490
Potash .....	.591
Soda .....	.231
Phosphoric Acid .....	.396
Sulphuric Acid.....	.022
Soluble Silica .....	.165

No. 4. This clay contains but traces of sand and organic matter. It loses by ignition 15.5 per cent of water.

100 parts of it yield:

Alumina	4.380
Oxyd of Iron.....	6.243
Lime .....	.980
Magnesia	1.080
Potash .....	.753
Soda .....	.355
Phosphoric Acid.....	.474
Sulphuric Acid .....	.024
Soluble Silica .....	.216

Chambly.—The soils of this Seignory are principally of a reddish clay, which when exposed to the air, readily falls down into a mellow granular soil. In the places where I had an opportunity of observing, it is underlaid at the depth of three or four feet by an exceedingly tenacious blue clay which breaks into angular fragments, and resists the action of the weather. The upper clays constitute the wheat bearing soils, and were originally covered with a growth of maple, elm, and birch; distinguished from them by its covering of soft woods, principally pine and tamarack, is a gravelly ridge, which near the church is met with about fourteen acres from the river; it is thickly strewn with gneiss and syenite boulders much worn and rounded. The soil is very light and stony, but yields good crops of maize and potatoes, by manuring.

The extraordinary fertility of the clay is indicated by the fact that there are fields which have, as I was assured by the

proprietors, yielded successive crops of wheat for thirty and forty years, without manure and almost without any alternation. They are now considered as exhausted, and incapable of yielding a return, unless carefully manured; and such, for the last fifteen or twenty years, have been the ravages of the Hessian fly upon the wheat, which is the staple crop, that the inducements to the improvement of their lands have been very small; so that the Richelieu valley, once the granary of the Lower Province, has for many years scarcely furnished any wheat for exportation. But the insect, which for the last three or four years has been gradually disappearing, was last season almost unknown, and the crops of wheat surpassed any for the last ten or twelve years. With the encouragement inspired by the departure of this scourge, we may hope that more attention will be given to the subject, and that improved systems of cultivation may restore to fertility those exhausted soils, and enable this once productive valley to regain its former character.

Of a number of soils collected at Chambly, only three have as yet been submitted to analysis; they are—one of the reddish clay taken from a depth of sixteen inches, from a field in good condition, and considered as identical in character with the surface soil before tillage, No. 5; and one at a depth of six inches, from a field closely adjoining, but exhausted by having yielded crops of wheat for many successive years without receiving any manure, No. 6; the latter supported a scanty growth of a short thin wiry grass, which is regarded as indicative of an impoverished soil, and known as *herbe à cheval*; both were from the farm of Mr. Bunker; the third, No. 7, is a specimen of the gravelly loam above mentioned, from an untilled field upon the farm of Mr. Yule, who very kindly assisted me in my examinations.

No. 5 contained a small amount of silicious sand and traces of organic matter, and gave 5.5 per cent of water.

100 parts of it yielded:

Alumina	3.300
Oxyd of Iron.....	8.680
Manganese .....	.160
Lime.....	.711
Magnesia	2.310

Potash .....	.536
Soda.....	.340
Phosphoric Acid.....	.418
Sulphuric Acid.....	.020
Soluble Silica .....	.180

No. 6 consists of—

Silicious sand with a little feldspar.....	9.0
Clay	79.2
Vegetable matter.....	6.8
Water	5.0

100.0

100 parts gave—

Alumina.....	not determined.
Oxyd of Iron.....	4.560
Lime .....	.347
Magnesia .....	.888
Potash } .....	.380
Soda }	
Phosphoric Acid.....	.126
Sulphuric Acid .....	.031
Soluble Silica.....	.080

By the action of water, a solution containing minute traces of chlorids and sulphates of lime, magnesia, and alkalies is obtained. 100 parts of the soil give in this way, of chlorine, .0013; sulphuric acid, .0005.

No. 7. This soil contained about 20 per cent of pebbles, and 12 of coarse gravel; that portion which passed through the sieve consisted of—

Gravel.....	75.0
Clay.....	13.7
Vegetable matter	6.1
Water	5.2

100.0

The soil was very red, and the sand silicious and quite ferruginous, consisting of the disintegrated syenitic rocks which make up the coarser portions.

100 parts gave—

Alumina	2.935
Oxyd of Iron.....	5.505
Lime .....	.156
Magnesia.....	.409
Potash.....	.109
Soda.....	.144
Phosphoric Acid.....	.220
Sulphuric Acid .....	.018
Soluble Silica.....	.080

St. Dominique.—The savanne of St. Dominique and the reclaimed lands in its vicinity, present many things of interest, and being at St. Hyacinthe, I availed myself of the opportunity and the politeness of Dr. Bouthillier, who accompanied me to visit the locality. It consists of a large peat bog, which extends through the parish of St. Dominique, and parts of St. Rosalie and St. Pie, a tract perhaps five or six miles in one direction, by three or four in the other. This extent is covered by a layer of peat which from a depth of two or three feet at the edges, is six feet in many places, and in some parts is said to be even eighteen feet in depth. It supports in some parts, a growth of tamarack and is covered with sphagnous mosses, with many beautiful plants of the Orchideæ and Ericaceæ. It rests upon a tough blue clay containing a considerable portion of silicious sand, mixed with brilliant scales of mica, and presents occasionally the impression of marsh plants and small shells.

Since the settlement of the vicinity, large portions of this savanne have been reclaimed to the purposes of agriculture. A large drain of considerable length was some years since cut down to the clay, thus effecting a partial draining of a large portion of the marsh. The drained land being first cleared of the trees, is ploughed, and then in the dry weather of summer, set on fire. In this way eight or ten inches of the peat are burned, leaving a thin layer of a very fine light reddish ash upon the surface. This serves as a powerful manure, and the peat will then yield one or two fine crops of barley or oats; the straw attains an astonishing size and strength, and the grain is equally very superior. The burned soil produces also fine potatoes and turnips; but after two years it is found to be quite exhausted,

and requires to be again burned to render it productive. When by many repetitions of this process, the peat has been burned down to within a few inches of the clay, the two are mixed by deep plowing, and a rich mellow soil is obtained, which is unsurpassed for wheat, and yields at the same time fine Indian corn, peas and grass. Such are many of the reclaimed lands of the side of the savanne near to St. Hyacinthe, where from an original peat of four or five feet, the finest farms have been made, yielding rich timothy and clover, alternating with wheat and peas,—a system which is now very generally adopted in the vicinity. There are however, some fields that have been tilled for a long period of years, without manuring, and almost without any alternation, which are now quite worn out.

I collected for examination, a mass of the peat from a depth of five feet, No. 8; a specimen of the underlying clay, No. 9; and some of a long tilled and nearly exhausted field, not far from the present border of the savanne, No. 10.

The peat retains distinctly the forms of the mosses, and shows equally the remains of Equiseta and other larger marsh plants intermixed. When heated in a close vessel, it evolves a large quantity of gas burning with a brilliant flame, and gives a compact coke, which when ignited in the air, leaves a light reddish white ash.

A thoroughly dried specimen gave the following for its composition;—

Fixed Carbon.....	29.57
Ashes.....	6.75
Volatile matter	63.68
	— 100.00

Another specimen of more compact turf from the vicinity gave—

Fixed Carbon.....	29.30
Ashes	7.27
Volatile matter	63.43
	— 100.00

As the composition of the mineral portions was in an agricultural point of view, of much importance, I proceeded to make an analysis of the ash; the specimen of peat taken for this purpose, gave 6.58 per cent.

A watery solution of the ash contained chlorine and sulphuric acid combined with potash and soda, and a large amount of sulphate of lime. The whole of the alkaline salts were dissolved by the water. The ash was strongly alkaline in its reactions, and contained as might be expected, the magnesia and some of the lime in a free state. 100 parts of it gave me:

Lime.....	47.040
Magnesia	3.150
Peroxyd of Iron.....	4.680
Alumina	2.440
Oxyd of Manganese.....	.040
Potash.....	.330
Soda .....	.254
Chlorine .....	.247
Sulphuric Acid	9.175
Phosphoric Acid .....	.932
Carbonic Acid	23.060
Silica	4.920
Sand (mechanically present).....	4.040

These ingredients combined in the usual manner, will give the following compounds for 100 parts:

Carbonate of Lime.....	52.410
Lime } in part as silicates {	10.431
Magnesia }	3.150
Peroxyd of Iron.....	4.680
Alumina	2.440
Oxyd of Manganese .....	.040
Phosphate of Lime	2.019
Sulphate of Lime (gypsum).....	15.085
Sulphate of Potash.....	.605
Sulphate of Soda.....	.076
Chlorid of Sodium.....	.412
Silica.....	4.920
Sand.....	4.040
	<u>100,308</u>

The clay No. 9 left by washing, a portion of silicious sand with a little feldspar and mica. It consists of:

Sand	38.0
Clay	59.0
Water.....	3.0
	<u>100.0</u>

100 parts of it gave—

Alumina	4.520
Oxyd of Iron.....	6.440
Lime .....	.717
Magnesia	1.122
Potash.....	.158
Soda.....	.340
Phosphoric Acid.....	.152
Sulphuric Acid .....	.017

The exhausted soil No. 10, consists of—

Sand	46.0
Clay	42.2
Vegetable matter	9.5
Water	2.3
	<hr/> 100.0

100 parts of it gave—

Alumina	3.675
Oxyd of Iron.....	4.560
Lime (in part as carbonate).....	1.008
Magnesia .....	.687
Potash.....	.189
Soda .....	.255
Sulphuric Acid .....	.102
Phosphoric Acid .....	.342
Soluble Silica.....	.270

It will be at once seen from the composition of the peat ash, that it is a powerful fertilizer ; it contains more than two per cent. of phosphate of lime or bone earth, more than fifteen per cent. of gypsum, besides the alkaline sulphates and chlorids, carbonates and silicates of lime and magnesia, all substances eminently conducive to the growth of plants. More than sixteen per cent. of it is soluble in water, and the rest is in such a minutely divided state, that it is soon removed from the surface of the porous peat, being drained off by the atmospheric waters ; hence the rapid deterioration of the fertile soil which is obtained by burning the surface ; once however reduced so near to the clay as to be mixed with it by ploughing, the ashes are retained, and enrich very much the clay subsoil.

The analysis of No. 10 was executed upon a specimen which had been ignited to destroy the intermixed organic matter, which makes up about one tenth of the soil, and consists of yet undecomposed peat. Hence notwithstanding its impoverished condition, we find still a considerable proportion of phosphates and sulphates with some carbonate of lime; these are however enclosed by the vegetable matter, in such a way as not to be accessible to the plant. To show more correctly the actual composition of this soil as adapted to the purposes of vegetation, it will be necessary to make another analysis, upon a portion in which the mineral ingredients of the peat have not been set at liberty by burning.

In the plan commonly pursued for burning the peat, a great part of the ash is dissolved or washed away, and lost to the soil. If it were removed and employed as a manure upon other soils where it could be mixed by ploughing with the clay, lasting beneficial effects would no doubt be produced, which would make it well worthy the attention of farmers.

St. Hyacinthe.—Last fall, through the politeness of the Hon. A. N. Morin, I received two specimens of soils said to be from about two miles south of the village. They were described as follows :—“Blue Clay which has been tilled sixty or seventy years, and never manured,” No. 11; and “Blue Clay from the same field, at the depth of one and a half to two feet.” No. 12.

No. 11 contained a considerable portion of sand, and a little vegetable matter. Its composition is

Sand	34.0
Clay	62.2
Vegetable matter	1.5
Water	2.3
	100.0

100 parts of it gave

Alumina	2.200
Oxyd of Iron	5.860
Lime .....	.756
Magnesia	1.024
Potash.....	.450
Soda ...	.630
Phosphoric Acid .....	.189
Sulphuric Acid .....	.018
Soluble Silica.....	.135

No 12 is a pure clay, and contains no organic matter; by ignition it loses four per cent. of water. It effervesces slightly with acids from the presence of carbonates.

100 parts of it gave

Alumina	5.200
Oxyd of Iron	6.840
Lime..... } in part as carbonates }	2.625
Magnesia... }	2.647
Potash .....	.723
Soda .....	.380
Phosphoric Acid .....	.252
Sulphuric Acid .....	.006
Soluble Silica.....	.210

This soil evidently possesses the elements of fertility, but its mechanical composition shows that it is entirely different from No. 11, and consequently that the two are not valuable for the purposes of comparison; indeed I have not as yet been able to learn the position or depth from which the latter was taken.

SOILS FROM CANADA WEST.

When at Brantford, I had occasion to examine an interesting tract of land upon the Grand River. It consists in its original state of fine open plains, somewhat elevated, and may be defined as extending from Galt down the river for about eighteen miles. These plains support a fine growth of oak remarkably free from underwood, and are known by the name of "oak openings." The soil is a sandy loam very uniform in its character, which at a depth generally of from two to six feet, is underlaid by a coarse gravel, thus affording a natural drainage. The crops of wheat obtained upon these lands are excellent, but wheat is seldom sown for two successive years; the fall grain is generally followed by a spring crop, and the field then sown down with grass or clover, and pastured for one or two years.

Potatoes and root crops, as beets and turnips, succeed equally well upon these plains, which under a careful system of rotation are very productive; but it may be remarked that they would never endure the systems of tillage which are practised upon the heavy clay lands of the valleys of the Richelieu and the Thames. Besides the ordinary manure of the farm-yard,

gypsum, which is found in great abundance in this vicinity, is very advantageously employed as a manure, especially for clover.

Along the banks of the river, at a lower level than the oak openings, are fine alluvial *flats* of a rich heavy mould, covered in their natural state with a thick heavy growth, principally of elm, beech and maple. The soil of these flats is scarcely adapted to wheat, which grows too luxuriantly, and is apt to suffer from rust, but it produces abundantly all the other crops of the upland.

Of the specimens illustrating the composition of these soils, the analyses of two are subjoined, which were collected at Strathmore, the residence of Major Burroughs, near Brantford. No. 13 is from the oak plains, and is the loam from an untilled and recently cleared field, taken from under a sod at the depth of eight inches. No. 14 is the black loam from the flats, taken under similar circumstances. A large proportion of No. 13 is very finely divided and readily washes away, but still is not of such a nature as to give to the soil the character of a clay.

The gravel is partly quartzose and partly argillo-ferruginous, as if derived from some decomposing sedimentary rock.

It consists of

Sand	47.4	
Finer material	49.2	
Organic matter	2.4	
Water.....	1.0	
		100.0

100 parts of it gave

Alumina.....	2.090
Oxyd of Iron.....	2.520
Lime .....	.310
Magnesia .....	.456
Potash .....	.105
Soda .....	.060
Phosphoric Acid .....	.380
Sulphuric Acid.....	.008
Soluble Silica.....	.060
	100.0

The black loam, No. 14 is slightly calcareous ; it consists of

Sand	72.0	
Finer material	20.0	
Vegetable matter.....	6.5	
Water	1.5	
		100.0

100 parts of it gave

Alumina.....	.915
Oxyd of Iron.....	2.415
Lime (as carbonate and sulphate).....	5.200
Magnesia (as carbonate in part).....	3.460
Potash .....	.162
Soda .....	.190
Phosphoric Acid .....	.309
Sulphuric Acid (= .158 of Gypsum).....	.093
Soluble Silica .....	.225

The examination of an interesting series of specimens which I collected while in the vicinity of Chatham, Western District is as yet unfinished. The rich alluvial flats of the valley of the Thames extend from the north branch of Bear Creek, on the north, to near Lake Erie on the south, constituting a large portion of the western peninsula. The land is quite level, and requires draining to make it fit for successful culture. The soil may be described as a rich black mould, which along the Thames is from six to ten inches deep, but near Bear Creek is said to be very much thicker.

This at the places where I examined it upon the banks of the Thames, rests upon a yellowish or grayish clay, often containing abundance of small shells, which by exposure to the air darkens and crumbles down into a mellow granular soil. In some sections seen near to the village of Chatham, this clay was about four feet in thickness, and was underlaid by a more or less sandy loam, regularly stratified, while beneath at about ten feet from the surface, appeared a tenacious blue clay. The ordinary tillage rarely brings up the lighter colored subsoil, but a plan of deep ploughing has been lately adopted by some of the farmers with excellent results. The wheat sown upon the black mould grows too luxuriantly, and is disposed to rust, tendencies which are arrested by an admixture of the clay. There are fields near the river in the Township of Raleigh, which I was well assured had been cropped with wheat for thirty or forty years, without manuring, and with very little attention to crops or fallowing, and yet these still yield very fair returns. Upon the best conditioned lands thirty-eight to forty, and even forty-

two bushels of wheat to the acre, are obtained in good seasons. Hemp has recently been tried with much success.

The newly cleared lands are frequently first sown with Indian corn, which grows luxuriantly, and preferring as it does a light open soil, succeeds perfectly well in the richest moulds. The crops of oats and barley are also very fine, potatoes succeed well, and mangel wurtzel and carrots are beginning to be cultivated for the feeding of stock. The evil of rust is often severely felt upon the wheat crop; the fall sown grain however, suffers less from it than the spring wheat. Sifting lime over the field while the grain is yet in the milk is said to have been found useful in preventing this disease, and I was informed by a gentleman interested in agriculture, that a plan which has been tried in very rich soils is to sow a much larger portion than usual of grain to the acre. The result of this is, that the plant becomes checked in its otherwise luxuriant growth, and ripening more rapidly, escapes the rust. The yield is not what would be obtained in proper soils with much less grain, but it yields crops of wheat where other means have proved unsuccessful in the Townships of Zone, Dover and elsewhere, and is recorded rather as a fact of interest than an example for general adoption. Draining and subsoil ploughing, where the clay can be brought to the surface, will be found the remedies most efficacious.

Such is the fertility of the soils in this region that but little need has hitherto been felt of a system of rotation in crops; some however have begun to adopt it, and have commenced the cultivation of clover, which grows finely, especially with a dressing of plaster, which is used to some extent.

The natural growth of these lands is oak, elm, with black walnut and whitewood trees of enormous size; the black walnut timber is already becoming a considerable article of export. Fine groves of sugar maple are also met with, from which large quantities of sugar are annually made.

I give here an analysis of a specimen of the black mould from the seventh lot of the first range of Raleigh. The mould here is eight or ten inches in thickness, and had been cleared of its wood, and used six or eight years for pasture; the specimen from a

depth of six inches contained but a trace of white silicious sand.

No. 15. It consisted of—

Clay	83.4
Vegetable matter	12.0
Water	4.6
	<hr/> 100.0

100 parts of it gave—

Alumina.....	2.620
Oxyd of Iron and a little Ox. Manganese	5.660
Lime	1.500
Magnesia	1.060
Potash and Soda .....	.825
Phosphoric Acid .....	.400
Sulphuric Acid.....	.108
Soluble Silica.....	.290
	<hr/>

The examination of the clay subsoil is yet to be made, as well as the determination of some points of interest with regard to No. 15.

Near to the mouth of the Thames, and skirting the borders of Lake St. Clair, is an extensive prairie which is supposed to cover about 30,000 acres. Commencing nearly behind Chatham, it forms a belt three or four miles wide, which keeps the south side of the Thames for about six miles; here it comes upon the river, and occupying both banks, extends down to the lake; stretching as far as the eye can reach in one vast plain, broken only here and there by *oases* of forest, like small islands, dotting its surface. These consist of a growth of soft maple, walnut and elm, with occasional willows, which are seen springing up here and there in little copses, with thorns. The plains are covered in some places with a coarse sedge, and in others with a stout jointed grass, which sometimes attains the height of three feet, and makes good hay and pasturage for the half-wild poneys which feed in great numbers upon these prairies.

In spring time the greater portion of this region is overflowed with water from a few inches to two or three feet in depth. The whole of the country to the south from the ridge near Lake Erie, discharges its water upon this tract, and it is said that in the spring time a current is perceptible across the whole sur-

face. In 1836-37 nearly the whole prairie was covered throughout the year, a circumstance connected with the yet unexplained change in the levels of the upper lakes.

The soil is a black unctuous mould from six to eighteen inches or more in depth, with a subsoil composed of blueish or whitish clay, which by exposure to the air readily disintegrates. It often contains shells and fragments of wood, and an intelligent man employed in ditching assured me that he had met with the end of a canoe at the depth of eight feet in the heavy clay. About 2,000 acres of the prairie are under cultivation in the Township of Raleigh, and from 6,000 to 7,000 more rise to a height of about twelve feet above the lake, and might readily be drained. Some parts of the eastern extremity are at present rarely submerged, and present gentle undulations of gravelly loam, black with vegetable remains.

The cultivation of wheat does not succeed well upon the mould of the prairie; the heaving of the soil injures the fall sown, while the spring sown grain rarely escapes the rust. Where however, the mould is so thin that deep plowing can be made to bring up the clay, a good wheat soil may be obtained. Indian corn, oats and barley succeed and grow luxuriantly, as also many root crops. The last season, although the tillage of these lands is not generally the best, the first prizes for these products, offered by the County Agricultural Society, were gained by crops raised upon the reclaimed prairie.

The cultivation of grass has hitherto been much neglected, as the natural growth of the country serves for both hay and pasturage, but clover has been a few times tried and great crops obtained. One fault of the soil is its exceeding richness in vegetable matter; it is probable that a judicious application of quick lime would be found very useful. Specimens of the soil were taken from a recently drained portion in the seventeenth lot of the first range of Raleigh. The mould was here twelve inches deep; a specimen of it at the depth of six inches, No. 16, and one of the clay at twenty inches, were taken. The analysis of the mould is subjoined; it contains no sand, and consists of:—

Clay	80.9
Vegetable matter.....	13.6
Water	5.5
	— 100.0

100 parts previously ignited, gave :

Alumina	4.340
Oxyd of Iron	7.090
Lime (in part as carbonate).....	1.580
Magnesia	1.030
Potash .....	.855
Soda .....	.240
Phosphoric Acid .....	.320
Sulphuric Acid.....	.155
Soluble Silica.....	.380

An analysis of the soil before ignition, a determination of the condition of the organic portion, and an examination of the sub-soil, are yet to be made.

I have not spoken of my examinations of the soils in the vicinity of Woodstock and Zorra, in the neighborhood of London and Lobo, of Hamilton, and of St. Catherines and Port Dalhousie, as the results are not yet completed, and must form part of a future Report.

I may however here introduce the analyses of two interesting calcareous clays from London and Niagara. That of London is met with at a depth of five to ten feet, and is seen cropping out upon the banks of the Thames, near the town; wells have been sunk in it thirty and forty feet. Mr. Hamilton of London, who had submitted it to a partial analysis, has found it extremely beneficial as a manure when applied to his garden. It has the texture of a fine clay and is mixed with limestone pebbles; during solution in hydrochloric acid it evolves a bituminous odor; it contains no sulphates.

No. 17. It consists of :

Clay insoluble acids	57.00
Carbonate of Lime	29.40
Carbonate of Magnesia	6.91
Phosphate of lime * .....	.39
Oxyd of Iron and Alumina...	4.40
Water, alkalies and loss	1.90
	— 100.00

* The composition of the phosphate of lime here represented, is that of bone earth, of which thirteen parts correspond very exactly to six of anhydrous phosphoric acid.

A similar clay to that of London is found in like circumstances in Delaware and Mosa, and a specimen from Port Stanley was found to be similar in constitution. For those soils which are deficient in lime, it will be evidently extremely valuable, as it is in composition a rich marl.

The second is a clay taken at a depth of eight inches from an untilled field in the Township of Niagara, upon the ridge of land or escarpment here formed by the Niagara limestones. It contains three or four per cent. of silicious sand with mica, and some calcareous pebbles.

No. 18. Analysis gives for its composition :

Insoluble in acids.....	58.00
Carbonate of Lime.....	15.30
Carbonate of Magnesia.....	7.68
Oxyd of Iron	}..... 13.50
Alumina	
Manganese, a trace	
Alkalies.....	.51
Phosphoric Acid .....	.09
Moisture	4.70
———— 99.78	

It contained besides a small amount of sulphuric acid, which was not determined.

I have refrained from speaking of the conclusions to be drawn from the preceding analyses, or the various theoretical deductions which might present themselves to the agricultural chemist, because sufficiently complete investigations have not yet been executed, to warrant me in generalizing. Some of the consequences are however so obvious, as to suggest themselves to every scientific agriculturist, and to the attention of such I commend these results, as the first fruits of my labors on the soils of Canada.

Peat.—I have already alluded to the peat of the Savanne of St. Dominique, which from its abundance appears well worthy of attention in an economic point of view. In a country like Lower Canada where coal is wanting, and where wood is already becoming in some parts scarce, the public attention must ere long be turned to some other source of fuel. Among these we have at home a very important one in the shape of our immense

deposits of peat. Besides the large area above alluded to, there is an extensive deposit of a similar character which appears on the road between Longueuil and Chambly, and extends westward over a large tract; another described as of large size is found in the Seignory of Ste. Marie de Monnoir, and still another south of Laprairie; while the peat bogs on the south side of the Ottawa, and along the line of the Rideau Canal, which you have alluded to in your Report upon the Ottawa, are of great and but imperfectly known extent.

The value of peat as a fuel is almost unknown in this country, but the amount of it consumed in the British Isles and in Continental Europe, shows that it is a product of great and increasing importance. The amount of peat raised in France in 1845 was 420,000 tons, and its value 977,560 dollars; the number of workmen employed was nearly 40,000. Its price in the city of New York, where it is consumed in considerable quantity, is about \$4½ per ton. In addition to its use as a fuel in domestic operations, peat or the coke obtained in charring it, by a process similar to that employed for the manufacture of wood charcoal and mineral coke, is now successfully used to a large extent for the manufacture of iron, in France, Sweden, Bohemia, Bavaria and Wirtemberg; the iron thus obtained is said to be of superior quality, and the peat coke is even preferred for the refining of steel. Peat affords by distillation a brilliant gas for illumination, in a quantity as great as ordinary coal and entirely free from those sulphurous compounds, which contaminate the gas from the latter. In Ireland according to Sir Robert Kane, it is in general use upon the steamers on the River Shannon, in the midst of a coal bearing country, and is employed in mills and factories for generating steam, to which from its flaming character it is well fitted.

By a process recently patented in Great Britain, by which the peat is condensed with the aid of a strong hydraulic press to about one third its bulk, a fuel is obtained more dense than oak wood, which by charring yields a coke eminently combustible, and heavier than wood charcoal; it can be manufactured for twenty shillings sterling per ton. The patentee, who is the managing director of the Dublin Steam Navigation Company, prepares

also an artificial coal from peat, of which it is stated, as the result of experiments made on the vessels of the Company, that with ten hundred weight, the same steam power is obtained as with seventeen and a half hundred weight of pit coal; thereby saving thirty per cent. in the stowage of fuel.

For the above facts, which I have adduced in order to call attention to the value of our own peat bogs, I have been indebted to Mr. R. C. Taylor's late valuable work, "Statistics of Coal," and Sir Robert Kane on the Industrial Resources of Ireland.

The late surprising statements of the O'Gorman Mahon, as to the practicability of manufacturing oil, acids, wax, as well as gas and coke from the peat of Ireland, do not appear as yet sufficiently sustained by experiment to render them perfectly satisfactory; although such products are undoubtedly to be obtained by distillation of peat, it does not appear certain that they can be made economically available.

The peat of our vicinity is of a very excellent quality, and contains but a small portion of ashes; according to competent judges who have seen it, it is equal to the best peats of Ireland and Scotland. It shall be my endeavor to collect for another year some statistics as to the extent of our deposits, and to submit the different samples to examination in order to determine their real and relative value as fuels.

In this connection I may allude to the asphaltum or mineral pitch which is found on the nineteenth lot of the sixth or seventh range of the Township of Enniskillen, Canada West; attention was first called to it by His Excellency Earl Cathcart, who gave specimens of it to the Commission; since then Mr. Wood, the late member for Kent, has kindly sent a mass of more than one hundred pounds weight. It is said to be spread over an area of several acres, and from the specimens received it is at least two feet in thickness. Its consistence is about that of the variety known as *mineral caoutchouc*. The consumption of this material in England and on the Continent for the construction of pavements, for paying the bottoms of vessels, and for the manufacture of illuminating gas, to which it is eminently adapted, is such that the existence of deposits of it in this country is a matter of considerable importance. A careful examination of the

locality with regard to its extent, will be made during the ensuing season. The specimens in my possession contain from seventy-eight to eighty-one per cent. of combustible and volatile matter.

MINERAL SPRINGS.

In my Report for 1847-8, I had occasion to describe the well-known Sour Spring of the vicinity of Brantford, which is remarkable for containing a large amount of free sulphuric acid. Since that time I have learned of the existence of several springs of a similar nature in the same portion of the country. One of these has been described by Dr. Mack of St. Catherines, in the *British American Journal* for July, 1849.

It is situated about a mile and a half above Chippewa, near the Niagara River, and fills a small basin which has no visible outlet. The water is described by Dr. Mack as intensely sour to the taste, and strongly impregnated with sulphuretted hydrogen. A qualitative analysis shewed that the acid was the sulphuric, and that no chlorine was present. Protosalts of iron, and small quantities of lime and magnesia were also detected. A specimen of this water was kindly furnished me by Dr. Sutherland, by which I was enabled to confirm the results of Dr. Mack, and to detect a portion of alumina, thus completing its resemblance to the water of Tuscarora, to which it seemed closely allied in the proportion of free sulphuric acid. Dr. Chase of St. Catherines, shewed me a specimen of water from a spring near to St. Davids, which was similar in character to the above, but less strong.

Another interesting locality of acid water occurs in that vicinity, which I had an opportunity of examining personally. It is upon the S. W. corner lot of the Township of Niagara, upon the land of Mr. McKinley, and near the margin of a small rivulet, which at the time (Oct. 15th) was dry, and showed in its bed, at the depth of three or four feet from the surface, the red and green variegated Medina sandstones of the region in place; they are covered by a tenacious yellow clay, in which the basin of the spring is formed. It is nearly circular, between three and four feet in diameter, and about thirty inches in depth. The water rises to within six or eight inches of the surface, and has no visible outlet; its level is said to be nearly the same through-

out the year. It is kept in constant agitation by the escape of considerable quantities of carburetted hydrogen gas, which burns with a bright flame on contact with a light.

The soil is devoid of vegetation for a distance of six or eight feet around the basin, yet there is a layer of black vegetable matter a few inches in depth, which covers the surrounding soil and extends to the very edge of the spring; small maples are growing near.

About twenty rods further up the stream, and at a level some feet above the basin, near to the course of the rivulet, was a bed of soft mud which had resulted from the drying up of a small pool. In a depression a small accumulation of water was found an inch or two in depth; it was very sour to the taste, and near it was a small hollow filled with a very acid mud, and exhaling an odor of sulphuretted hydrogen. I was informed that in summer, when the pool is quite dry, an inflammable gas issues copiously through fissures in the clay.

I collected some bottles of the water from the basin, and have since submitted it to a partial analysis. When recent, the water has a decided flavor of sulphuretted hydrogen, the odor of which is readily perceived in the vicinity of the spring. The water is slightly turbid and yellowish, and does not become clear by repose; its taste is styptic, and strongly acid.

The specific gravity at 60° was found to be 1002.16; the usual tests shew the presence in small quantities of lime, magnesia, alumina, and protoxyd of iron; the acid is the sulphuric, without any trace of hydrochloric acid. When evaporated at a gentle heat, the water leaves a moist residue, which blackens from the presence of an organic substance which exists in considerable quantity, and which has also been remarked in the acid water of Tuscarora, and by Dr. Mack in that of Chippewa. By ignition a residue was obtained of sulphates with oxyd of iron and alumina, which in two determinations equalled .580 and .620 for 1000 of the water; the same quantity gave .074 of lime, equal to .180 of sulphate. The sulphuric acid was found by two determinations to be 2.1308 and 2.1440, mean = 2.1376. Of this .106 are required to form gypsum with the .074 of lime, leaving 2.0316 of dry sulphuric acid, equal to 2.4887 of

oil of vitriol. The residue of the solid matters equalling .420, and consisting in part of sulphates, would not correspond to the decimal part of that quantity; so that in round numbers the water will contain two parts of hydrated sulphuric acid in 1000. At a future time I purpose to make a complete analysis of the fixed ingredients of this spring.

It is interesting to remark, that this water collected in clean bottles, was found at the end of some months to contain abundance of small flocculi of an organic substance, which under the microscope appeared to consist of groups of filaments, each composed of a single chain of globular homogeneous and translucent vesicles of a yellow color. The existence and development of vegetable life in a solution of sulphuric acid and sulphates of iron and alumina, appears somewhat curious and worthy of record.

It is to be remarked in connection with the view suggested by me in my Report for 1847-48, as to the relation between these springs and the gypseous deposits, that the first of those above mentioned, like that of Tuscarora, rises from the gypsiferous rocks, and that of Niagara from the upper portion of the Medina sandstones, to some portion of which formation the one nearest St. Davids will also belong.

Providence Spring of St. Hyacinthe.

Two bottles of the water from this recently discovered spring were kindly furnished me by Dr. La Bruyère, and have been submitted to a qualitative analysis. It contains a considerable amount of mineral ingredients, 1000 parts yielding of salts dried at 300° F., 5.16 parts. Evaporated to one-tenth the water is strongly alkaline and saline to the taste; it contains a considerable amount of alkaline chlorids, effervesces with nitric acid, and gives with salts of baryta a copious precipitate, which is completely soluble in hydrochloric acid. Neutralized with acetic acid and evaporated to dryness, the saline mass gives by the ordinary tests, distinct reactions of bromine and iodine.

The precipitate which separates during the evaporation of the water consists of the usual earthy carbonates, and a trace of iron; in addition to these the hydrochloric solution of the precipitate

gave by the addition of solution of gypsum, after some time, a heavy precipitate indicating strontia. This spring then contains chlorid with traces of bromid and iodid of sodium, carbonates of soda, lime and magnesia, with small portions of carbonate of strontia and iron. It is interesting from the large portion of alkaline carbonate which it contains, and deserves a quantitative analysis.

Aurora Spring of Point du Jour.

This spring, the waters of which have recently been brought into public notice, occurs in the Parish of L'Assomption. The well is four or five feet in diameter and the water rises nearly to the surface; it is kept in constant ebullition by the escape of volumes of carburetted hydrogen gas, and is slightly turbid from a little suspended clay; the supply is abundant. Owing to an accident I was unable to determine its temperature, which however appeared not to differ from that of the springs of that class generally.

It is strongly saline to the taste; 1000 parts of the water yield 7.36 parts of solid matter, consisting of alkaline chlorids, with bromids and iodids in considerable quantity, and very small portions of chlorids of calcitum and magnesium, besides carbonates of lime and magnesia, with small portions of carbonate of strontia, and a trace of iron.

Georgian Spring of Plantagenet.

Under this title, the water of a mineral spring upon the property of Captain Kain, has lately been brought into this city. A qualitative analysis of a specimen of the water, sent me by the proprietor, shows it be a very strong saline, resembling the Plantagenet water already so well known to the public. It affords 11.84 parts of solid matter in 1000, and contains besides alkaline chlorids and small portions of bromids and iodids, chlorids of magnesium and calcitum; the former in great abundance. Besides these there is a large quantity of carbonates of lime and magnesia, with a trace of iron.

In the month of January last I went by request to visit a spring, situated about two leagues beyond St. Eustache, on

the land of Joseph Laurin. The water contains but a small amount of mineral ingredients; 1000 parts yield by evaporation 1.88 parts, consisting of common salt with a large proportion of sulphates of lime and magnesia, besides carbonates of these earthy bases; it contains no salts of iodine and but a trace of bromids.

Minerals and Metallic Ores.

But few examinations of this kind have been made during the past season; of different specimens of galena which at your request, I have submitted to examination for silver, I may mention those from Brome, E. T., Chateauguay, from the vicinity of Toronto, and from Bay St. Paul; none of them were found to be argentiferous.

I have examined specimens of bog manganese from Tring, St. George and Ste. Marie Nouvelle Beauce, and from Ste. Anne; they contain respectively 25, 20.5, 30, and 38 per cent of peroxyd of manganese. These impure ores contain a large proportion of oxyd of iron in admixture, and those of Tring and St. George are mixed with silicious sand.

The detection of the very rare mineral species *Humboldtine*, or oxalate of iron, in the shales of the Hamilton group from Cape Ipperwash, is a fact of interest to mineralogists. It encrusts the surface of the shales as a soft earthy coating, dull and of a sulphur yellow color, and resembles at first sight the pollen of pines which is often found in similar situations. By heat it instantly blackens and becomes magnetic; a continuance of the heat changes it to red. Its occurrence in a shale containing the remains of a species of *Calamites*, tends to confirm the idea of Rivero, that its formation is due to the decomposition of plants.

The result of my examination of the specimens of the iron ores of Bay St. Paul, shows the existence of deposits of titaniferous iron of hitherto unexampled magnitude. One mass, as described by yourself, is 90 feet in breadth by 300 in length, and besides great numbers of masses a few feet in diameter, forming nodules in the syenitic rock, there is said to be another surpassing even the first mentioned in size.

The ore is massive, and often coarsely granular; its color

and streak are black, and its lustre metallic. It affects very feebly the magnetic needle. Its specific gravity is 4.56—4.66, and hardness 6,

The qualitative analysis of two specimens from different localities shewed them to be quite similar in composition, and the analysis of a fragment from the large mass gave—

Oxyd of Titanium.....	48.60
Protoxyd of Iron.....	46.44
Magnesia	3.60
	— 98.64

No traces of silica, lime or manganese were present. The iron was principally in the state of protoxyd, but a portion existing as peroxyd makes the deficiency observed. If with Mosander we regard the proportions of metal and oxygen in the compound, such that their equivalents shall be as 2 : 3, we have by calculation the following composition—

Oxyd of Titanium (TiO ₂).....	48.60
Protoxyd of Iron.....	37.06
Peroxyd of Iron.....	10.42
Magnesia	3.60
	— 99.68

This result is sensibly the same as that obtained by H. Rose, for the titaniferous iron from Ilmensee in the Urals, to which he has given the name of *Ilmenite*. He obtained—

Oxyd of Titanium.....	46.92
Protoxyd of Iron.....	37.86
Peroxyd of Iron.....	10.74
Magnesia	1.14
Protoxyd of Manganese	2.73
	— 99.39

To this variety then our Canadian deposit is referrible. The consumption of the compounds of titanium in the arts, is at present limited, and a sufficient supply is afforded by the native oxyd, rutile. If at a future time a greater demand should arise, it would be necessary to seek some more abundant source of the mineral; and the localities at Bay St. Paul might then

be made to furnish inexhaustible supplies of it at a very moderate price.

I regret that some interesting investigations, of which I had hoped to present the results in this Report, are as yet unfinished, and must be reserved for a future occasion.

I have the honor to be,

Sir,

Your very obedient servant,

T. S. HUNT.

C A T A L O G U E
 OF SOME OF THE
ECONOMIC MINERALS AND DEPOSITS
 OF CANADA,
 WITH THEIR LOCALITIES.

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NOTE—The quantities in the localities indicated are not in every case of a sufficient amount to be profitably available, but they are always of sufficient importance to draw attention to the localities, as a possible guide to the discovery of others in the vicinity, where quantities may be greater.

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Metals and their Ores.

- Iron**.....*Magnetic*.....Marmora, range 1, lot 7 (a 100 feet bed); range 2, lot 13; range 9, lot 9; range 9, lot 6.
 Madoc, range 4, lot 2, (a 25 feet bed); range 5, lot 11; range 6, lot 10; range 7, lot 9.
 South Sherbrooke, C. W., Myers Lake, range 3, lots 17, 18, 19, (a 60 feet bed).
 Bedford, range -, lot -.
 Hull, range 7, lot 11, (a 40 feet bed); range 5, lot 11; range 6, lots 12 and 13.
 Litchfield, Portage du Fort, a small vein.
- Specular*.....Lake Huron, Wallace Mine location, near Whitefish River, (a 15 feet vein).
 McNab, ranges C and D, lot 6, Dochart River, (a 12 feet vein).
- Bog*.....Middleton; Charlotville; Walsingham.
 West Gwillimsbury, mouth of the Holland River.
 Fitzroy, Chats; Eardley, range 8, lot 20; March, Constance Lake; Hull, range 7, lot 14; Templeton, McArthur's mill; Vaudreuil Seignory, Côte St. Charles and Sac au Sable.
 St. Maurice Forges.
 Stanbridge, range -, lot -; Simpson, range 12, lot 8; Ireland, range 4, lot 12; Lauzon Seignory, St. Lambert; Vallier Seignory, junction of Rivière du Sud and Bras.

- Titaniferous*...St. Armand East, lot 45, (a 5 feet bed).
 Sutton, (in beds of 2 to 8 feet) range 9, lots 4, 5, 6, 7, 9; range 10, lots 7, 8; range 11, lots 7, 9.
 Brome, (in beds of 2 to 15 feet) range 3, lots 1, 2; range 4, lots 5, 6; range 5, lots 4, 5.
 Bolton, range 14, lot 2.
 Vaudreuil Beauce Seignory, north corner, (a 45 feet bed).
 Bay St. Paul, St. Urbain, (a 90 feet bed); St. Lazare, (a still larger mass).

ZINC.....*Sulphuret*Lake Superior, Prince's location; Mamainse.

LEAD.....*Sulphuret*Fitzroy, range 8, lot 12; Bedford, range —, lot, —. Bastard, range —, lot —; Petite Nation Seignory? Gaspé, Little Gaspé Cove and Indian Cove.

COPPER...*Sulphurets, &c.*...Lake Superior—

Spar Island, Prince's location, a 4 feet vein (*vitreous sulphuret*, with *silver*).

St. Ignace Island, Harrison's, Ferrier's and Merritt's locations; (*native copper*, with *silver*).

Michipicoten Island, (*native copper*, with *silver*).

Mica Bay, Mamainse, (*yellow, variegated, and vitreous sulphurets*).

Lake Huron—

Root River, a 3 feet vein, (*yellow sulphuret*).

Echo Lake, (*yellow sulphuret*).

Bruce Mines, a 4 feet vein, (*yellow, variegated, and vitreous sulphurets*).

Wallace Mine, Whitefish River, (*yellow sulphuret*).

Eastern Townships—

Upton, range 21, lot 51, (*argentiferous yellow sulphuret*), a 1 foot vein.

Ascot, range 7, lot 17, (*argenti-auriferous yellow sulphuret*), a 2 feet vein.

Inverness, range 2, lot 4, (*variegated sulphuret*), a 2 feet vein.

NICKEL...*Sulphuret, &c.*...Lake Huron, Wallace Mine.

Augmentation to La Noraye and Dautraye Seignory, (with *iron pyrites*), traces.

Brompton, range 11, lot 19, (*nickel ochre*), traces.

SILVER.....*Native, &c.*Lake Superior—

Prince's location, a bunch of 4 cwt. of 3½ per cent. met with, equal to 72 lbs. of silver per ton of rock.

St. Ignace Island, Harrison's, Ferrier's and Merritt's locations.

Michipicoten Island, north side.

GOLD...Native, in Gravel... Vaudreuil Beauce Seignory, Rivière Guillaume; Rivière Bras; Ruisseau Lessard; Rivière Touffe des Pins for 3 miles up; Ruisseau du Lac.

Aubert de L'Isle Seignory, Rivière Famine.

Aubert Gallion Seignory, Russieu —, Pozer's River for 3 miles up.

Rivière Metgermet opposite Jersey.

GOLD...Native, in Vein..... Lake Superior, Prince's location, (traces).

Ascot, range 7, lot 17, (with *copper* and *silver*, value of *gold* \$1 per ton of rock.)

Chemical Materials, being such as require peculiar chemical treatment to fit them for use.

URANIUM—(For glass staining, and porcelain painting, &c.)—

Madoc, range 4, lot 12, traces in the iron ore bed, in the form of *uran ochre*.

CHROMIUM—(For glass staining, porcelain and oil painting &c.)—

Bolton, range 7, lot 26, a 12 inch bed of *chromic iron*.

Augmentation of Ham, range 2, lot 21, a 14 inch bed of *chromic iron*.

COBALT—(For glass staining, and porcelain painting, &c.)—

Lake Superior, Prince's location, (traces); Lake Huron, Wallace Mine, (traces.)

Augmentation to La Noraye and Dautraye Seignory, with *nickel*, (traces.)

MANGANESE BOG—(For bleaching and decolorizing agents).—

Bolton, range 12, lot 22; Stanstead, range 4, lot 24; range 10, lot 9; Tring, near eastern boundary on road from Lambton to St. François Beauce; Aubert Gallion Seignory, near Pozer's River; St. Mary Seignory, 3rd range, Frampton road; St. Anne Seignory.

IRON PYRITES—(For manufacture of coppers and sulphur)—

Clarendon, range 2, lot 7; Terrebonne Seignory, a 4 feet vein; Augmentation to La Noraye and Dautraye Seignory, a 40 feet vein; Garthby, range —, lot —.

DOLOMITE, with 45 per cent. of CARBONATE OF MAGNESIA—(For manufacture of Epsom Salts and the Magnesia of Commerce)—

Exit of Lake Mazinaw; N. Sherbrooke, C. W.; Drummond; St. Armand; Dunham; Sutton; Brome; Ely; Durham; Melbourne; Kingsey; Shipton; Chester; Halifax; Inverness; Leeds; St. Giles Seignory; St. Mary Seignory; St. Joseph Seignory.

MAGNESITE, with 83 per cent. of CARBONATE OF MAGNESIA—(*For the same purpose*)—

Sutton, range 7, lot 12 ; Boulton, range 9, lot 17.

Stone Paints.

BARYTES—*Permanent White*—

Lake Superior, in a multitude of veins on the north shore from Pigeon River to Thunder Cape ; Bathurst, range 6, lot 4 ; McNab, mouth of Dochart.

IRON OCHRE—*Yellow Ochre, Spanish Brown, &c.*—

Waltham, Paint Lake or Pond, near Harwood Pierce's Clearing, Black River ; Mansfield, Grand Marais, opposite the most northern point of Calumet Island ; Durham, range 4, lot 4.

TALCOSE SLATE—*Ochre Yellow*—Stanstead, range 9, lot 13.

French White—Stanstead, range 9, lot 13 ; Leeds, range 13, lot 17.

SOAPSTONE—*White*—

Sutton, range 7, lot 12 ; Potton, range 5, lot 20 ; very pure ; Bolton, range 1, lot 17 ; range 2, lot 6 ; range 4, lot 4 ; range 11, lot 1 ; Melbourne, range 2, lot 19 ; Ireland, range 3, lot 10 ; Vaudreuil Beauce Seignory, range 3 on the Bras, pure ; Broughton, range 4, lot 12 ; Elzevir, range 1, lot 27 ; range 2, lot 13, pure.

SERPENTINE—*Greenish White*—

Eastern Townships, in places too numerous to be particularized. (For the range see Marble.)

FERRUGINOUS CLAY—*Light Red*—

Nassagaweya, McKann's Mills ; Nottawasaga, Mad River.

Materials applicable to the Arts.

LITHOGRAPHIC STONE—

Marmora, range 4, lot 8 ; Rama, on St. John's Lake, south of the Junction, and on Lake Couchiching ; there are probably many exposures between Rama and Marmora, the distance being 70 miles.

Materials applicable to Jewellery, and Ornamental purposes.

AGATES.....Lake Superior—St. Ignace and neighbouring Islands ; Michipicoten Island.

JASPER.....Ascot, near Sherbrooke, in a bed ; Gaspé, in pebbles.

LABRADORITE.....Drummond, range 3, lot 1 ; Bathurst, range 9, lot 19.

SUNSTONE.....Bathurst, range 6, lot 3.

HYACINTHS.....Grenville, range 5, lot 10.

ORIENTAL RUBIES } ...Burgess Range 9, lot 2, (in minute grains.)

SAPPHIRES }

AMETHYSTS.....Lake Superior, Spar Island, and sundry places along the neighbouring coast.

RIBBONED CHERT—(*For Cameos*)—Lake Superior—Thunder Bay.

JET.....Montreal.

Materials for Glass making.

WHITE QUARTZ SAND STONE—

Lake Huron—on the north shore, and the Islands near, in great abundance.

Cayuga, lots 45 and 46, Town line, north of Talbot road; Dunn; Vaudreuil Seignory; Isle Perrot Seignory; Beauharnois Seignory.

PITCHSTONE, BASALT and ALLIED ROCKS—(*For Black Glass*)—

Lake Superior—North shore and Islands; Michipicoten Island, and East coast.

Lake Huron—in the trap dykes of the north shore, and neighbouring Islands.

Rigaud mountain; Montreal mountain; Montarville mountain.

Refractory Materials.

SOAPSTONE—Elzevir, range 1, lot 27; range 2, lot 13; Potton, range 5, lot 20; Vaudreuil, Beauce Seignory, range 3 on the Bras; Broughton, range 4, lot 12.

ASBESTUS—Potton, range 5, lot 20.

SANDSTONE—Lake Huron, Island of Campement d'Ours, west side; St. Maurice Forges.

PLUMBAGO—Grenville, range 5, lot 10, 2 veins.

Manures.

PHOSPHATE OF LIME—

Ottawa, near the division line between Westmeath and Ross, above the head of Moore's Slide; Calumet Slide; Burgess, range 8, lot 4; Hull range — lot — near Blasdell's mill; Bay St. Paul; Murray Bay.

GYPSUM—

Dumfries, range 1, lot 27; Village plot of Paris; Brantford, range 1, lot 15; range 2, lot 16; range 3, lot 17; Oneida, lot 57, and the block next below on the Grand River; Seneca, lots 17 and 18, on the Grand River, and the Town plot of Indiana; Cayuga, range 3, lots 19, 20, 21, 22, 23.

SHELL MARL—

North Gwillimsbury, east point of Cook's Bay; Calumet Island, in a small lake 2 miles south east from Campement des Plaines; Calumet Island, 1 mile north west of Desjardin's clearing, opposite Moore's slide, and in several small lakes lower down the

island ; Clarendon, range 1, lot 23 ; Mink Lake, west of Bromley ; McNab, White Lake ; Nepean, on Spark's land, near Bytown ; Gloucester, Hon. Mr. McKay's land, near Bytown ; Argenteuil, range 1, lot 3 ; East Hawkesbury, range 7, lot 11 ; Vaudreuil Seignory, rear of Cavagnol Point ; St. Benoit, Grand Brulé, on Chenier's farm ; Grande Côte, between St. Thérèse Ferry and St. Eustache, on McAllister's farm ; opposite St. Rose, on the road to St. Thérèse, on Henrich's farm ; St. Armand West, lots 156 and 157 ; Stanstead, range 11, lot 5 or 6 ; St. Hyacinthe Seignory, junction of Granby and St. Pie roads ; Montréal, St. Joseph ; New Carlisle, in 4 or 5 small lakes, 1 or 2 miles from the village.

Grinding and Polishing Materials.

MILL STONES—

The localities of granitic and syenitic boulders strewn about the country, and used for mill stones, are too numerous and too accidental to be stated ; these boulders are derived chiefly from the granitic or gneissoid rocks, which range on the north side of the Ottawa and St. Lawrence, from Lake Superior to Labrador. Independent of them various rocks *in situ* are and may be used for the purpose, such as—

Silicious Conglomerate—Vaudreuil Seignory, Cascades, and Pointe du Grand Detroit ; Ham, range 11, lot 10 ; Port Daniel, at L' Ance à la Veille.

Granular and Corneous Quartz Rock—This rock accompanies the serpentinite of the Eastern Townships, (for the range of which see Marble,) and occurs in too many places to be enumerated ; a good sample has been obtained by the Hon. Mr. Knowlton from Bolton, range 6.

Granite—Stanstead ; Barnston ; Barford ; Hereford ; Ditton ; Mars-ton ; Strafford ; Weedon ; Vaudreuil Beauce Seignory, near the band of serpentinite. (The Vaudreuil Beauce stone is highly esteemed.)

Pseudo-Granite (without Quartz grains)—St. Thérèse, Belœil, Rougement, Yamaska, Shefford, and Brome mountains.

GRINDSTONES—A sandstone designated as the grey band which lies at the summit of the red strata of the Medina sandstones, and which reaches from Queenston by St. Catherine, and round the extremity of Lake Ontario by Hamilton, to Esquesing, and thence to Nottawasaga, has been used in some of the northern Townships for grindstones.

Some parts of the Potsdam sandstone have been used for the purpose as in Allumettes, at the Allumettes Falls; and in Fitzroy, at Shirreff's mills.

Some parts of the Gaspé sandstone, in Gaspé Bay, would yield grindstones, but though these might prove the best of the Canadian stones, none of them would equal those of New Brunswick and Nova Scotia, or those of Newcastle, in England.

WHETSTONES AND HOMES—Madoc, range 5, lot 4; Marmora, range 6, lot 22; Lake Mazinew, rear of Palmerston; Fitzroy, Whetstone Point, Lake Chaudière; Potton, range 11, on Magog Lake; Stanstead, from Whetstone Island, in Magog Lake, by range 5, lots 19 and 20, and range 7, lot 26, to range 9, lot 28; thence through Hatley, to range 9, lot 3, on Massawippi Lake; Stanstead, range 9, lot 4; Bolton, range 14, lot 5; Shipton, range 14, lot 19, and range 5, lot 16; Marston, on Megantic Lake.

CANADIAN TRIFIDA, a silicious infusorial deposit—Augmentation to La Noraye and Dautraye Seignory.

Materials for Paving, Tiling, &c.

ROOFING SLATES—

Kingsey, range 1, lot 4; Halifax, range 1, lot 14; Frampton, on the land of Mr. Quigley.

FLAG STONES—

Toronto, Rivers Credit, Little Mimico, and Etobicoke; Etobicoke, River Humber; York, East Branch of River Don; Lake Temiscamang, 7 miles below the Galère; Bagot, at Calaboga rapids; Horton and Clarendon, at the Chenaux; Sutton, range 2, lot 19; Potton, range 10, lot 26, at Potton Ferry; Stanstead, east side of Memphremagog Lake, for some miles above the Oulet; Inverness, range 2, lot 5; Port Daniel L'Ance à la Vieille.

Building Materials.

GRANITE of superior quality, white, and cleavable—

Stanstead, ranges 4, 5, 6, 7, lots 1, 2, 3, 4, 5, 6; range 9, lot 4 to range 11, lot 13; Barston, range 9, lot 1; ranges 10 and 11, lots 7 to 15; Barford, ranges 1 and 2, lots 5 to 9; Hereford, ranges 4 and 5, lots 19 and 20; Marston, 1½ miles from upper end of Megantic Lake; Great Megantic Mountain, occupying an area of 12 square miles, about the United corners of Marsden, Hampden, and Dutton; Little Megantic Mountain, 6 square miles in Winslow, about 1½ miles south-west from line between Aylmer and Gayhurst; Weedon, 1 mile south-east of Lake Louise; Winslow, 3 miles long, about 5 miles south-east of Lake Aylmer; Stafford, 1 mile, and 3 miles up Felton River; also 6 miles from foot of Lake St. Francis; Lambton, 6 miles from foot of Lake St. Francis.

PSEUDO-GRANITE *without quartz grains, white, cleavable—*

St. Thérèse, Belœil, Rougemint, Yamaska, Shefford and Brome Mountains.

SANDSTONE *yellowish white—*

Niagara, at Queenston ; Barton at Hamilton ; Flamborough West ; Nelson ; Nassagaweya ; Esquesing, range 5, lot 17 ; range 6, lot — ; Mono ; Nottawasaga ; Cayuga, range —, lot 45 and 46 ; Rigaud Seignory, Rivière à la Graise ; Vaudreuil Seignory, Pointe Cavagnol ; Isle Perrot ; St. Eustache ; Terrebonne Seignory ; Beauharnois Seignory ; St. Maurice Forges ; Allumettes ; Fitzroy.

CALCAREOUS SANDSTONE—

Rideau Canal ; Bytown ; various parts of Ottawa, north side from Bytown, to Papineau Island ; various places from Grenville to Point Fortune ; Brockville ; Murray Bay, at Les Ecorchats, and White Cape, and the lots of J. B. du Berger and T. Chapreou ; Lauzon Seignory, at St. Nicholas ; Cap Rouge near Quebec.

LIMESTONE—

Malden ; Manitoulin Islands, along the south side ; St. Joseph Island ; Coast of Lake Huron, from Cape Hurd to Rivière au Sable (north) ; various parts from Cabot's Head to Sydenham, in Owen's Sound ; and from Sydenham, by Euphrasia to Nottawasaga ; thence by Mono to Esquesing, and by Nelson to Ancaster ; Thorold ; Matchedash Bay ; Orillia ; Rama ; Mara and various parts to Marmora ; Madoc ; Belleville ; Kingston ; McNab ; Bytown ; and various parts to Plantagenet and Hawkesbury ; Cornwall ; Isle Bizard ; Beauharnois Island ; Caughnawaga ; Montreal ; Isle Jesus ; Terrebonne ; Phillipsburgh ; St. Dominique ; Grondines ; Deschambault ; Beauport ; Bay St. Paul ; and Murray Bay ; Upton ; Acton ; Wickham ; Stanstead ; Hatley ; Dudswell ; Temiscouta Lake ; Gaspé ; Port Daniel ; Richmond ; Anticosti Island.

LIME—Common—In the various localities above enumerated for limestone.

*Magnesian—*In the localities indicated for dolomite.

*Hydraulic—*Point Douglas, Lake Huron ; Cayuga, half a mile and 3½ miles below the Village, on the Grand River ; Thorold ; Kingston ; Nepean, near Bytown ; Argenteuil ?

Materials for Bricks, Tiles and Pottery.

CLAY—For Red Bricks—This is so widely spread in the valleys of the St. Lawrence, Ottawa, Richelieu, &c., that the localities are too numerous to be mentioned.

*For White Bricks—*York, range 2 from the Bay, lots 19 and 20 ; Peterborough.

*For Tiles and common Pottery—*All the same localities.

MARBLE—*White*—Dudswell ; exit of Lake Mazinaw, rear of Palmerston (a dolomite.)

Black—Cornwall ; Phillipsburgh.

Brown—Packenham, at Dickson's mill.

Grey and Mottled—McNab ; Phillipsburg ; St. Dominique ; Montreal.

Variiegated, white and green—Grenville.

Verd Antique—Stukely.

Serpentine—In many parts suitable for ornamental purposes, in a range of 135 miles, running through Potton, Bolton, Stukely, Orford, Brompton, Melbourne, Shipton, Tingwick, Wotton, Ham and its Augmentation, Wolfestown, Garthby, Ireland, Coleraine, Adstoch, Tring, Vaudreuil Beauce to Craubourne ; and in another range of ten miles, running through Leeds.

Combustible Materials.

PEAT—Wainfleet ; Humberstone ; Westmeath ; Beckwith ; Goulburn ; Napean ; Gloucester ; Cumberland ; Clarence ; Plantagenet ; Alfred ; Caledonia ; L'Orignal ; Osnabruck ; Finch ; Winchester, Roxburgh ; Longueuil Seignory ; St. Hyacinthe Seignory, at St. Dominique ; Ste. Marie de Monnoir Seignory ; Rivière du Loup Seignory ; Rivière Ouelle Seignory ; Matanne and McNider, between Rivière Branché and Rivière Matanne.

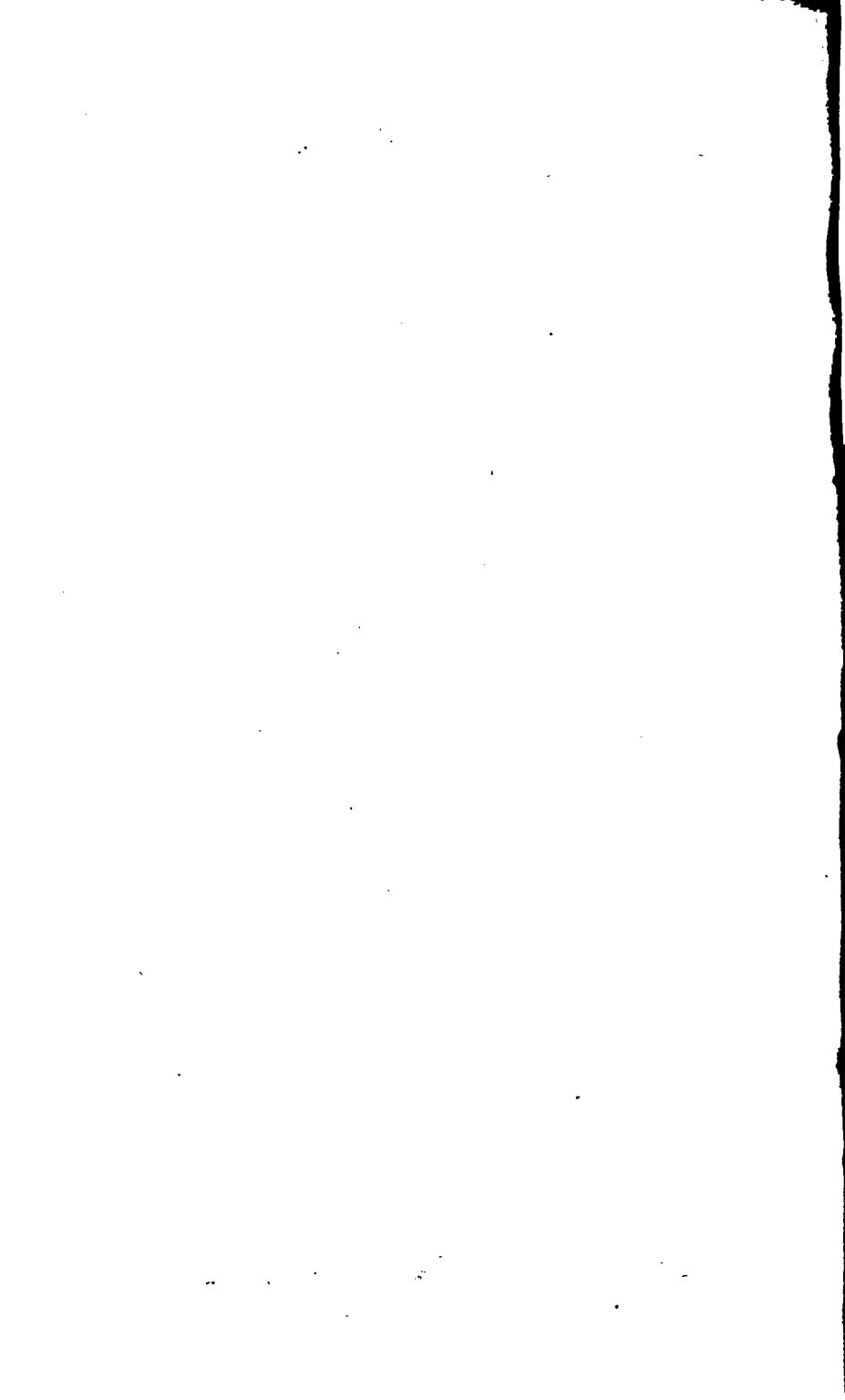
PETROLEUM, NAPHTHA, &c.—Mosa, range 1, lot 29, and several spots farther down on the River Thames ; River St. John, Gaspé, at the mouth, and 6 miles up on Silver Brook.

ASPHALT—Enniskillen, range 6 or 7, lots 19.

Sundry other Materials.

MOULDING SAND—Augusta, 3 miles above Prescott ; Montreal ; L'Acadie ; Stanstead.

FULLER'S EARTH—Nassagaweya, at McKann's mill, Sixteen-mile Creek.



GEOLOGICAL SURVEY

OF

CANADA.

REPORT OF PROGRESS

FOR THE YEAR 1850-51.

Printed by order of the Legislative Assembly.



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1852.

GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 20th August, 1851.

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 1850-51.

I have the honor to be,

Sir,

Your most obedient servant,

W. E. LOGAN,
Provincial Geologist.

To the Hon. J. 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, 20th August, 1851.

MAY IT PLEASE YOUR EXCELLENCY :

My absence from the Colony, under special leave from your Excellency, for the purpose of enabling me to superintend the arrangement of the collection of Economic Minerals, forwarded from Canada to the Exhibition of the Industry of all Nations in London, has prevented me from reporting at the usual time the progress made in the Geological Survey of the Province during the year 1850-51.

In now reporting to your Excellency on the subject, I have to state, that the Provincial Act of 1845, making provision for the Survey, having expired in March, 1850, the time which unavoidably elapsed before it could be renewed, considerably curtailed the season available for field exploration. On the renewal of the Act, the attention of my assistant, Mr. Murray, was devoted to an examination of the Peninsula lying between Lakes Huron and Erie ; and I have the honor to transmit to your Excellency his Report on the district. It is accompanied by the Report of Mr. Hunt, on the analyses of various rocks, mine

rals and mineral waters, which have been the subject of his examination in the Laboratory.

The favorable opportunity afforded by the Industrial Exhibition to spread a knowledge of the mineral resources of the Colony, in so far as they are yet known, induced me to consider it a duty to aid in procuring as efficient a collection of materials to illustrate them as circumstances would permit, and nearly the whole of my own time was devoted to this end. The localities which were visited in making the collection were mainly such as have been geologically described in previous Reports, and I have therefore little to state on the subject of exploration.

A part of the materials thus brought together, with contributions from other sources, was displayed at the preliminary Provincial Exhibition in Montreal in October last, and these with many additions, procured later in the season up to the commencement of winter, having been transmitted to London, now constitute one class of the native objects occupying the Canadian division of the Exhibition building, where they attract considerable attention. Until the publication of the Jury Reports of the Exhibition, in which will, no doubt, be found an impartial review of the comparative merits of the collection, it would be premature to place any statement of results before your Excellency. These, therefore, will be reserved for some future communication.

In the Report of Progress preceding this, mention is made of a partial examination of the gold-bearing drift of the Chaudière. This examination was last season continued, and the facts resulting from it constitute the only additional topic to which I have to invite your Excellency's attention. The auriferous district was found to spread over an area probably comprising between 3000 and 4000 square miles. It appears to occupy nearly the whole of that part of the Province which lies on the south-east side of the prolongation of the Green Mountains into Canada, and extends to the boundary between the Colony and the United States. Two general lines of exploration were followed, one of them up the Chaudière and Rivière du Loup from the seigniory of St. Mary to the Province Line, and the other from Lake Etchemin to Sherbrooke on the St.

Francis. The former, running transverse to the rock ranges, measured about forty-five miles, and the latter with them about ninety miles. The transverse line was more closely examined than the other, and traces of the precious metal were met with at moderate intervals throughout the whole distance. They were not confined to the channels of the main streams merely, but those of various tributaries furnished indications sometimes for a considerable distance up.

The lowest point in the valley of the Chaudière, at which the drift yielded traces of gold, was on a small stream, falling in on the left side of the river, not far within the south-eastern boundary of the seigniori of St. Mary. They were found to occur on four tributaries, in the seigniori of St. Joseph, for distances of one and two miles from their mouths. One of these joins the main stream, on the left bank, about a quarter of a mile below the parish church, and the other three are on the right. The lowest of them is about two miles below the church, the next about the same distance above it, and the fourth is the Rivière des Plantes, about half a mile farther up and near the south-eastern boundary of the seigniori. In Vaudreuil Beauce they were discovered on the Guillaume, much farther up than previously stated, and on the Bras opposite to it; on this and some of its tributaries the metal was traced to the centre of the township of Tring, a distance of about twelve miles. Three other streams which yield it in Vaudreuil Beauce, have heretofore been mentioned; they are the Ruisseau Lessard, Ruisseau du Moulin and the Touffe des Pins, on which it was first discovered. In Aubert d'Isle it was found on the Famine and traced to Harbottles Settlement, and beyond the seigniori into Waterford, a distance altogether of about ten miles. Some particles were obtained on the Ruisseau d'Ardoise, about a mile above the Famine, and it was followed about three miles up the brook commonly called Pozer's Stream, in Aubert Gallion. On the Rivière du Loup, in addition to its occurrence in a multitude of spots, in fact almost continuously from its mouth across Jersey and Marlow, it was found in nearly all its tributary brooks, such as the Ladyfair, the Grande Coude, the Metgermet for four miles up, the Travellers Rest, the Portage, Kempt's Stream, Oliver's Stream for four miles up, and

another stream between it and the boundary of the Province. Above the Loup, on the Chaudière, it occurred at successive intervals in twenty places in sixteen miles, as far as the south-western boundary of Dorset Township.

The localities of its observed presence on the other line of exploration were on Lake Etchemin and along the Famine in Aubert d'Isle, and Pozer's Stream in Aubert Gallion, towards Tring, and again on the St. Francis, in Dudswell, in Westbury, and near the joint corners of Westbury, Stoke, Eaton and Ascott, as well as in this last township near Sherbrooke.

It is not supposed that the limits of the auriferous district have been ascertained, but that it very probably extends much farther to the north-east, and attains the valley of the river St. John, while to the south-west it is known to reach Vermont, and to be traceable at intervals through the United States, even, it is said, as far as Mexico. In its breadth, however, it does not appear to cross the range of mountains with which it runs parallel, and no traces of it have been met with on their north-western flank. The deposit in which the gold occurs is part of an ancient drift, probably marine, and supposed to be of higher antiquity than that which, from the extent to which it occupies the valley of the St. Lawrence and some of its tributaries, Mr. Désor, who has recently bestowed much attention on the detrital deposits of North America, is disposed to give the name of Lawrencian. In this, alluded to in various Reports as tertiary and post-tertiary, the remains of whales, seals, and two species of fish, the capeling and the lump-sucker, and many marine shells of those species still inhabiting the Gulf of St. Lawrence, are found. These shells on the Mountain of Montreal attain a height of about 470 feet above tide level in Lake St. Peter, which is the greatest altitude known to me; none of the remains have yet been found in the Canadian gold drift, and as this appears in its lowest undisturbed parts to be at a height of about 500 feet above the sea, it is probable what is now exposed of it, had emerged from the ocean before the Lawrencian drift was placed, while in lower levels it would be covered up by it.

In the localities in which the gold occurs, the coarser materials of the drift are made up in a large degree of the debris of

rocks similar to the clay slates and interstratified grey sandstones, on which it rests, but these are accompanied by fragments and pebbles of fine conglomerate, talcose slate, and serpentine, which with magnetic, specular, chromic, and titaniferous iron (none of them absent when the gold is present) are derived from the mountain range, bounding it on the north-west; pebbles and fragments of white quartz are abundant, which may be derived from veins of the mineral prevailing in the mountain range or from others on the south-east of it. With these materials there occasionally occur in the valley of the Chaudière and its tributaries, large boulders of limestone conglomerate, similar to the beds of St. Giles and St. Mary, and more rarely boulders of gneiss identical in character with known kinds of the rock on the north side of the St. Lawrence. Not only is the gold absent from the drift on the north-west flank of the mountain range, but so also are the chromic iron and the serpentine, notwithstanding that the two have been traced in association 135 miles, constituting a marked band accompanying the range from Potton to Cranbourne. On the north-west flank, however, boulders of northern gneiss are frequent, and a few of limestone have been met with even pretty high up on the hills, showing by their fossils their derivation from the Trenton limestone, the nearest exposures of which are on the north side of the St. Lawrence. In fact, in respect to the drift of the whole country, it may be said, that on southern formations are found resting the ruins of northern, but no northern rocks are met with overlaid to any extent by debris, derivable exclusively from southern. The auriferous drift shows no exception to this, and there is little doubt that causes connected with northern currents, when the rocks were beneath the surface of an ocean, have placed the whole. Ever since the surface, however, has risen from beneath this ocean, causes similar to those now in operation in the district have been working in a contrary course. The rivers of the district emptying into the St. Lawrence, flow north. In so far, therefore, as their forces modify the distribution of the drift, the materials of which it is composed are carried in that direction. This, no doubt, has some effect on the finer and lighter materials, and occasionally with the assistance of ice and great fresh-

ets, on some of the coarser and heavier, but the streams washing away the former in larger proportions than the latter, concentrate these in the valleys and channels. The gold being the heaviest substance is moved the least. It may occasionally be pushed along the bottom when this is smooth, but it seeks every hole and crevice in its course, and when it has once obtained shelter there, it remains protected. Where the edges of the slates come to the surface, the plates have all been moved by superficial forces, and they therefore lie more or less loosely on one another, and the fine particles of gold gradually work themselves down between them, reaching sometimes so deep as three feet.

Although it is probable the whole of the drift on the south-east of the mountain range, both that in high and that in low places, may be auriferous, it appears certain that the metal will be most concentrated in the valleys and the channels of streams, and the larger the stream, the more frequently it has broken down its banks, the oftener and more extensively it has changed its course, the more important the auriferous deposit is likely to be, and it is probably only in some such situations, if any where, that it will be worked to advantage. From the combination of the materials associated with the gold in the drift, there appears a strong probability that the metal is derived from quartz veins situated in the mountain range, through the agency of some southward-moving causes; and even if traces were found north of this range in the channels of the main streams, such as the Chaudière and the St. Francis, the circumstance would not militate against the supposition, as traces in such positions may be expected from the fluvial remodification of the drift; but with the exception of one vein in talcose slate near Sherbrooke, no auriferous quartz veins have yet been discovered, and in this one there was merely a trace of the metal, so that the facts of this gold district as yet offer no contradiction to Sir Roderick I. Murchison's theory, that the gold, when it was originally placed in the veins, occupied only that part of them which was towards the then existing exterior of the earth's crust, and that this part having been subsequently worn down by various destructive causes, the productive portion of the veins has been wholly or in a great degree removed, leaving

only their more quartzose continuation behind in situ, while the gold, the vein stone and the rock enclosing it have been carried away to form the drift. In this way it is his opinion that the drift will always be more productive than the veins; but whether this is to be borne out by the facts of California and Australia remains yet to be proved.

The object of this examination has not been so much to ascertain quantity as distribution, but an effective experiment being now in operation on the Rivière du Loup, under a letter of license from the Government, one condition of the lease being that a correct return shall be made of the quantity obtained, I am in hopes by the end of the present season to have a few such facts as will afford some criterion to determine whether there is reasonable ground for supposing the deposit in that vicinity can be worked advantageously.

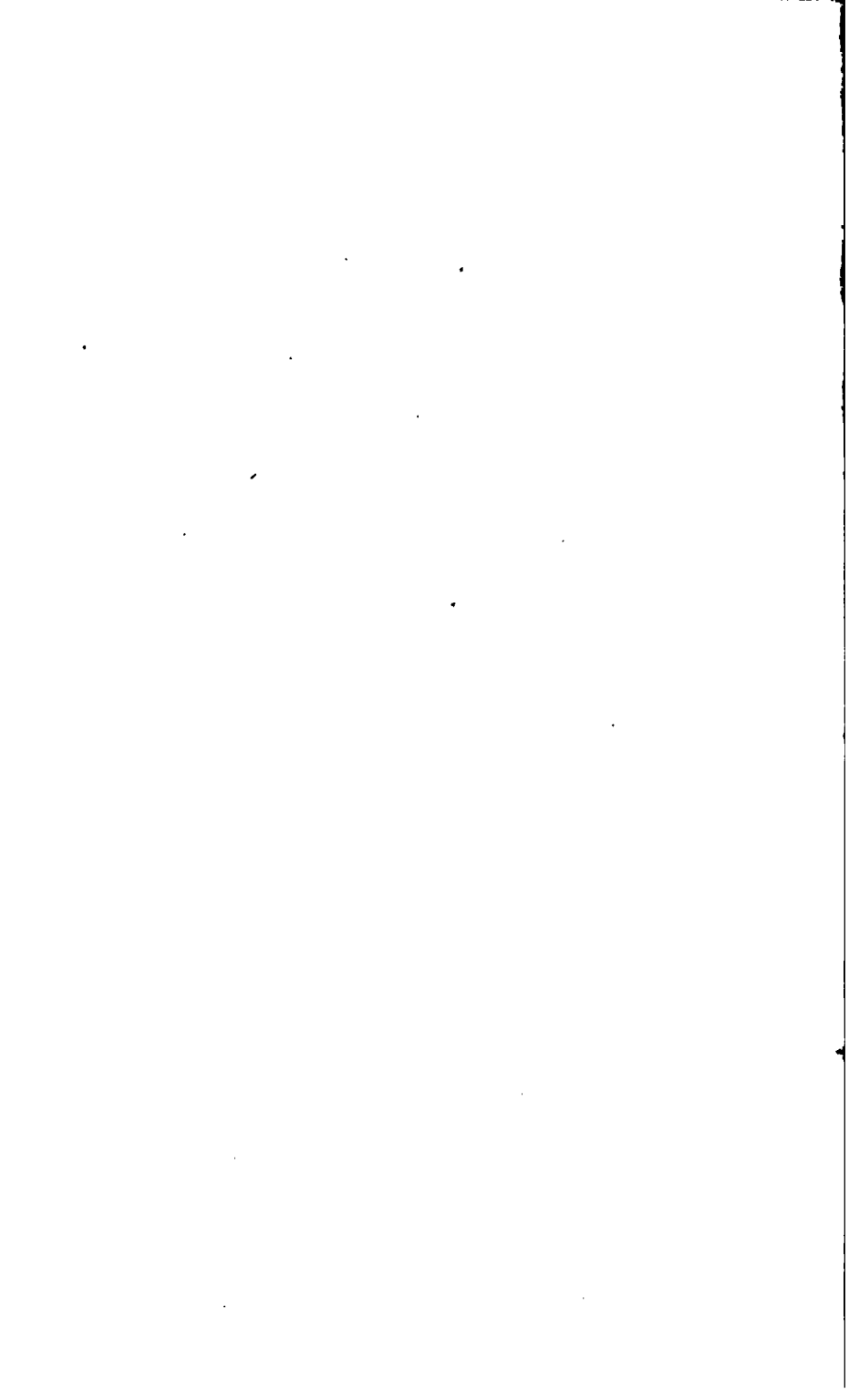
I have the honor to be,

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.

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MONTREAL, *16th December, 1850.*

SIR,—Agreeably to the instructions received from you in the beginning of August, after the renewal of the Act making provision for the Geological Survey of the Province, I proceeded without delay to continue the examination of the western portion of the Province, comprising the great Peninsula, bounded by Lakes Huron, St. Clair and Erie, for the purpose of more accurately determining the boundaries of the several formations, by which the country is underlaid, in their geographical distribution in the interior, and ascertaining the economic materials the various deposits might yield.

Repairing to Hamilton, and proceeding thence to Dundas, several days were occupied in making preparations for an exploration of the outcrop of the Niagara limestone group in the direction of Owen Sound, up to which place the same rocks had been followed from the opposite direction in the year 1848. In determining this as a base line for farther operations, little difficulty was experienced, a bold and sharp escarpment of the lower part of the formation running throughout the whole distance, which may be about 120 miles; but the higher rocks, which occupy the country west from the ridge formed by the previous group, are by no means so easily traced, being for the most part concealed by a thick deposit of drift, and only occasionally appearing in the channels of rivers and brooks, or on the shores of lakes, and at great distances apart.

For information regarding the route to be travelled through the northern townships, offering the greatest facility for the observation of the Niagara group, I am greatly indebted to the Rev. Andrew Bell, who has devoted much attention to the geological structure of this part of Canada, and to the collecting of fossils to illustrate it ; and for a series of levels taken on the Survey of the Owen Sound Road, and other levels ascertained in the neighbourhood of Dundas, I take this opportunity of acknowledging my obligation to Robert Wells, Esq., C. E. In an expedition down the Saügeen, I was indebted to Mr. Jackson of Durham, on the Owen Sound Road, Crown Land Agent, for conducting me to the encampment of Mr. Brough's survey, at that time going on ; and I have to acknowledge myself particularly obliged to Mr. Brough for kindly supplying me with a guide and assistant, while examining the district in which he was engaged.

As an agricultural country the whole of the Western Peninsula may be said to equal, if not surpass, in its capabilities of soil and climate, any other part of the British North American Provinces, as the rapidity with which it has been settled, the annual increase of its products and the growth of its numerous towns and villages, abundantly testify ; and it may not perhaps be deemed out of place to remark here, that the exceeding fertility of portions still wild and unsettled, as shown by the size and kinds of their spontaneous growth of timber in the townships of Collingwood, Euphrasia, Artemisia, St. Vincent, Sydenham and others, destines them to become within a short time of great agricultural importance, a result which will be greatly facilitated by means of the road newly opened, connecting Toronto and Owen Sound.

#### *Distribution of the rock formations.*

The rock formations of the Western Peninsula, in ascending order, are as follows :—

- Niagara group, including the Clinton rocks and the Grey band.
- Gypsiferous strata and limestones.
- Corniferous limestones.
- Hamilton shales.

*Niagara group.*—A beautiful exhibition of this formation is displayed on the Sydenham Road, on the seventeenth and eighteenth lots of the first concession of Flamboro' West, near Dundas, where the following ascending section of the strata was carefully measured, previous to setting out to trace the boundary northward.

## Section I.

|                                                                                                                                                                                                                                                                                      | ft. in.    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 1. Whitish and grey sandstone with ferruginous spots, being part of the grey band.....                                                                                                                                                                                               | 3 0        |
| 2. Thin arenaceous beds, which weather yellowish, divided by blue or grey shales in thin partings.....                                                                                                                                                                               | 0 11       |
| 3. Compact calcareous sandstone in two beds, with a thin pyritiferous parting; small nodules of iron pyrites, fucoids and other fossils, weather out on exposed surfaces.                                                                                                            | 1 9        |
| 4. Bands of arenaceous dark grey or bluish limestone, sometimes slightly pink, and weathering to a pale red, with partings of dark grey or blue, and sometimes black or buff colored argillaceous and arenaceous shales, containing corals, shells, tentaculites and trilobites..... | 7 0        |
| 5. Bluish-grey argillaceous shales, with thin bands of impure calcareous rock with fossils (corals, shells, tentaculites, encrinites and trilobites,) and patches of greenish shale, the lower bands granular and marked with small green spots.....                                 | 8 0        |
| 6. Buff colored shales with thin calcareous bands, with corals, bivalve shells and tentaculites.....                                                                                                                                                                                 | 12 0       |
|                                                                                                                                                                                                                                                                                      | ----- 32 8 |
| This is up to the top of the quarry on the seventeenth lot, and the following is in continuation from the last mentioned bed, where exposed on the travelled road on the eighteenth lot:—                                                                                            |            |
| 7. Concealed by debris.....                                                                                                                                                                                                                                                          | 7 4        |
| 8. Bluish-grey argillaceous and calcareous shale, with indurated argillaceous bands.....                                                                                                                                                                                             | 11 0       |
| 9. Green and grey argillaceous, calcareous, and arenaceous shale, with hard arenaceous and calcareous bands towards the top.....                                                                                                                                                     | 10 8       |
| 10. Thin hard red calcareous and arenaceous bands.....                                                                                                                                                                                                                               | 1 0        |
| 11. Green argillaceous and arenaceous shale.....                                                                                                                                                                                                                                     | 2 0        |
| 12. Red marly shale.....                                                                                                                                                                                                                                                             | 4 0        |
| 13. Red calcaeo-arenaceous rock, holding various fossils, mostly small corals and fucoids. This probably represents the iron ore bed of Rochester.....                                                                                                                               | 7 0        |

|                                                                                                                                                                                                                          | ft. in. |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 14. Red calcareo-arenaceous rock, of the same character as before, becoming brownish-red at the top, with partings of red marly shale holding numerous fossils, corals, bivalve shells and tentaculites.....             | 1 8     |
| 15. Red argillaceous shale with green stripes and patches, and three bands of red and green limestone.....                                                                                                               | 5 0     |
| 16. Pale green argillaceous shale, with three bands of limestone.....                                                                                                                                                    | 5 0     |
| 17. Greenish calcareous, argillaceous and slightly arenaceous shale, with thin divisions of a greener shale.....                                                                                                         | 1 3     |
| 18. Pale green or bluish calcareous sandstone, with nodules of iron pyrites, ferruginous stains and stripes, and obscure fucoids, corals and shells. ....                                                                | 1 9     |
| 19. Bands of calcareous sandstone with partings of green or bluish argillaceous shale stained with iron, and holding nodules of pyrites; encrinites, corals and broken shells prevail in great abundance at the top..... | 3 10    |
| 20. Green or bluish argillaceous shale.....                                                                                                                                                                              | 1 3     |
| 21. Grey limestone with <i>Pentamerus</i> in abundance and a few other fossils; joints and crevices are incrustated with orange-red calc-spar.....                                                                       | 1 0     |
| 22. Thin bedded blue limestone, with thin partings of bluish-grey shale, beautifully arranged in very regular beds from 16 to 18 inches thick; the stone is used for building purposes.....                              | 7 0     |
| 23. A massive bed of blue limestone used for building purposes, and known by masons and quarry-men as the <i>five feet band</i> .....                                                                                    | 5 6     |
| 24. Bluish-grey, sometimes nearly black, argillaceous, arenaceous, and calcareous slaty rock, hard and solid in the bed, but decomposing and crumbling when exposed to the atmosphere.....                               | 5 0     |
| 25. Massive solid beds of bluish-grey limestone, with great numbers of encrinites, the beds parted by very thin layers of buff colored argillaceous shale.....                                                           | 19 3    |
| 26. Dark bluish-grey argillaceous shale; this is a well marked band, traceable for a long distance.....                                                                                                                  | 1 0     |
| 27. Blue and grey limestone, with bands of chert and disseminated chert nodules.....                                                                                                                                     | 20 0    |

Resting on this cherty band in the channel of a small brook, on the property of Mr. Logie, seventeenth lot of the second concession of Flamboro' West, the ascending section continues as follows :—

|                                                                                                                                                                         |     |       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------|
| 26. Dark brownish colored beds of bituminous and slightly silicious limestone, with obscure fossils, and small crystals and specks of galena.....                       | 10  | 0     |
| 29. Dark grey bituminous limestone, in rough irregular beds.                                                                                                            | 5   | 0     |
| 30. Concealed by debris.....                                                                                                                                            | 5   | 0     |
| 31. Thin regular beds of black bituminous limestone.....                                                                                                                | 2   | 0     |
| 32. Black bituminous shale.....                                                                                                                                         | 1   | 0     |
| 33. Dark brown and blackish, very bituminous rock of a calcareous character, in thin beds with rough irregular surfaces.....                                            | 2   | 0     |
| 34. Dark brown and blackish bituminous, calcareous rock as before, with divisions of black shale, holding crystals of galena with <i>Leptena</i> and other fossils..... | 5   | 0     |
| 35. Black slaty shale, with <i>Conularia</i> .....                                                                                                                      | 2   | 0     |
| 36. Dark grey and blackish, very bituminous limestone, with black shale at the top; fossils abound, chiefly <i>Strophomena</i> .....                                    | 3   | 0     |
| 37. Compact dark brown and blackish bituminous limestone...                                                                                                             | 2   | 0     |
| 38. Black bituminous shaly limestone.....                                                                                                                               | 1   | 0     |
| 39. Concealed by debris.....                                                                                                                                            | 2   | 0     |
| 40. Black bituminous and partially silicious limestone beds with obscure fossils.....                                                                                   | 5   | 0     |
| 41. Black bituminous silicious limestone as before.....                                                                                                                 | 3   | 0     |
| 42. Slaty limestone, splitting into thin regular and even plates.....                                                                                                   | 2   | 0     |
| 43. Slaty limestone as before, with hard bands of 6 inches thick interstratified.....                                                                                   | 2   | 6     |
| 44. Dark brown and blackish bituminous and arenaceous shale, with trilobite tails.....                                                                                  | 0   | 6     |
| 45. Brownish, bituminous limestone beds, with partings and thin bands of dark brown bituminous shale.....                                                               | 15  | 0     |
|                                                                                                                                                                         |     | 68 0  |
|                                                                                                                                                                         |     | <hr/> |
| Total thickness.....                                                                                                                                                    | 222 | 2     |
|                                                                                                                                                                         |     | <hr/> |

The top of the grey band at the commencement of this section was found to be 204 feet above the level of the Desjardin Canal; and at Spenser's Mills, on the fourteenth lot of the first concession of the township, the bed measures about ten feet in thickness, and is there seen to rest upon the red marl of the Medina group.

A vertical section is likewise exhibited at the falls on Spencer Creek, in the twelfth lot of the second concession of the township, where an eye-sketch of its members in descending order was made as follows :—

*Section II.*

|                                                                                                     |      |
|-----------------------------------------------------------------------------------------------------|------|
| Bituminous limestones and shales (45 to 28 of Section 1).....                                       | 55 0 |
| Cherty limestones, (27).....                                                                        | 15 0 |
| Thick bedded blue and grey limestones, (26 and 25).....                                             | 25 0 |
| Argillaceous and arenaceous shales, (24).....                                                       | 6 0  |
| Massive limestones from the top of the five-foot band to the<br>foot of the falls (23 and 22.)..... | 12 0 |

113 0

---

The rocks of these sections frequently form two separate and distinct terraces, the lower and more decidedly marked escarpment exposing more or less of the strata below the cherty limestone bands, which cap the precipices at Flamboro' West, and on the opposite side of the valley of the Desjardin, near Hamilton; while the upper escarpment, composed of the bituminous limestones and shales, rises more gradually in a succession of steps, terminating at the summit in a vast extent of table land.

The lower terrace was followed from Flamboro' West, in an easterly direction, through Flamboro' East into Nelson, in which township it takes a sweeping turn to the north, and thence maintaining a very straight course nearly due north, it passes through the south-east corner of Nassagaweya, the centre of Esquesing, the north-west corner of Chinguacousey, and reaches Caledon; here it shews a deep sinus to the westward, on the Credit, and sweeps round to the north-west corner of Albion, which it intersects, curving thence through the south-west corner of Ajala; from this it runs westward to the Nottawa, in Mono, and making a deep bay, occupied by the valley of the river, it again turns north, and passing up the middle of the township, on the third concession, it reaches Mulmer, makes another bay, which touches the town line of Melancthon, and runs up to Nottawasaga, crossing the town line on the Hurontario Road; running a little to the west of north in this township, it veers to the westward, and intersects the north-east corner of Osprey,

proceeding thence across the south-west corner of Collingwood, and reaching the Beaver River in Euphrasia. On this river it makes a deep, narrow, southerly sinus into Artemisia, and returns northward to St. Vincent, in which it holds a north-westerly course, and forming a conspicuous promontory on the town line between this and Sydenham, it turns westerly, and strikes the Owen Sound Road, about a mile and a quarter from the lake shore, near the village of Sydenham.

The sandstone or grey band was seen at intervals all the way from Flamboro' West to the township of Mono, varying in thickness from ten to twenty feet, but preserving a pretty uniform lithological character; and indications of its presence were observed in the township of Nottawasaga, while examining that part in 1843. It has not, however, come under my observation in any of the townships west of Nottawasaga, nor is its presence indicated by angular fragments as in that township. This sandstone, wherever it has been observed, is a whitish or pale grey, fine, granular rock, sometimes striped and spotted with ferruginous stains; it is always well adapted for building purposes, and, in many instances, is a very beautiful and easily worked material. It has long been extensively quarried near Hamilton and at Waterdown, in the township of Flamboro' East, and is equally capable of being worked nearly all the way along its outcrop, to the township of Mono. In many places it is likewise of excellent quality for grindstones, for the manufacture of which it is used throughout the country in which it is known, and its applications thus render it a rock of considerable economic importance in its district.

The massive beds of encrinal limestone, which have been shown in Section, I. (25) to pass below the cherty band (27) hold the crest of the lower escarpment, north from Flamboro' East, and appear to attain a gradual increase in thickness, advancing to the northward. At Mr. McNaughton's farm, on the seventh lot of the seventh concession of Nassagaweya, there is a vertical precipice of limestone, varying from eighty to a hundred feet in height; and near Mr. Strange's mill, on the fourth lot of the fourth concession of Eramosa, a branch of the River Speed runs between vertical and solid calcareous cliffs of sixty to eighty feet, where divisional planes of stratification appear to be absent;

the Credit in Caledon is flanked by similar cliffs in many places, fully a hundred feet in height, which, ascending the valley, meet and form a crescent shaped precipice, over which the river is precipitated in a cascade; and in the valley of the Nottawa, in Mono, the same character prevails; similar cliffs were observed in the townships of Mulmer and Nottawasaga, and are mentioned in the Report of 1843; and in the valley of the Beaver River, in Euphrasia and Artemisia, the same limestone is at least 120 feet thick. These solid cliffs of limestone, however, probably contain all the strata between the pentamerus band and the top of the encrinal limestone (21 to 25 of Sec. 1) of Flam- boro' West, and this band, holding abundance of its characteristic fossil, was observed at the foot of the cliff, on the thirteenth lot of the first concession north of what is called the Centre Road in the township of Sydenham, and traced for a considerable distance, while angular fragments, holding the fossil, were seen in several other places in nearly the same position as regards the escarpment.

Huge caverns are of frequent occurrence at the base of this limestone, among the most extensive of which that were visited, was one on the twelfth lot of the second concession, east of the Hurontario Road, in Mono, on a branch of the Nottawasaga River, and another near Mr. Strange's mill, already mentioned as in the fourth lot of the fourth concession of Eramosa, on a branch of the Speed. The latter cavern extends under the cliff for between thirty and forty yards, and is about the same in width at the mouth; the roof, which is about five or six feet high at the entrance, slopes towards the floor inwards, and at the termination of the distance specified, the space between is insufficient to permit a man's body to pass, so that the extent of the cavern beyond is unknown; the roof and floor are studded with small stalactitic incrustations.

The shales and thin bedded limestones (18 to 2 of Sec. 1,) which intervene between these limestones and the grey band, are generally concealed from view by a talus of debris, while the sandstone crops out from below, and forms a low terrace of its own.

The encrinal limestones are every where qualified to make a durable and handsome building stone, and in some parts, when

sufficiently removed from atmospheric influences, might be used as a marble for common ornamental purposes. Most of its beds are likewise of good quality for burning into lime.

The cherty strata which rest on the encrinal limestone in the Section (27) were not seen in contact with them to the north of Flamboro', any where along the outcrop of the latter, but they occur in this relation, where the strata are exposed on the banks of the north-east branch of the Speed, near Strange's mills in Eramosa. The chert in this place is much less abundant in quantity, however, than in the cliff of Flamboro' West, and the escarpment near Hamilton.

The bituminous limestones and shales which constitute the upper terrace, occupy a breadth of country, varying from eighteen to twenty or twenty-two miles. The upper beds were seen in the channel of the River Speed, at the bridge on the Brock Road, and other places in the immediate neighbourhood of the town of Guelph, and sections of the group were observed at several places between Guelph and Strange's mills, in Eramosa. The valley of the Eramosa branch of the Speed, below the town line of Puslinch, is bounded on either side by vertical cliffs of this part of the formation; they are from twenty to thirty feet high, and expose the following ascending section:—

|                                                                          | ft.   | in. |
|--------------------------------------------------------------------------|-------|-----|
| Strongly bituminous black limestone without observed fossils,            | 12    | 0   |
| Brown, very bituminous limestone,.....                                   | 7     | 0   |
| Pale brown, very bituminous limestone to the top of the escarpment,..... | 7     | 0   |
|                                                                          | <hr/> |     |
|                                                                          | 26    | 0   |

Near McFarlane's tavern, in the second lot of the third concession of Guelph, on the Eramosa Road, there is another section, which is as follows in ascending order:—

|                                                                                      | ft.   | in. |
|--------------------------------------------------------------------------------------|-------|-----|
| Very dark brown, strongly bituminous limestone, in beds of about one foot each,..... | 4     | 0   |
| Dark brown bituminous limestone, brittle, hard and compact, in several beds,.....    | 2     | 0   |
| Dark brown bituminous and slightly granular limestone,.....                          | 2     | 6   |
| Brown, very bituminous granular limestone,.....                                      | 4     | 0   |
| Pale buff or whitish colored, slightly bituminous limestone with corals,.....        | 3     | 0   |
|                                                                                      | <hr/> |     |
|                                                                                      | 15    | 6   |

A short distance from the place where this last section was measured, there occurred about six feet of black shale and thin bedded limestone, which probably pass below.

The upper beds of the bituminous part of the formation were struck on the Grand River, near the town line, between Garrafraxa and Nichol, and portions of the same rocks are exposed in the bed of that river, from that point to the highest part of it that was reached, which, according to the measurement made, was to the eighth concession of Luther, near the town line between it and Amaranth. These rocks are no where so bituminous on the Grand River as they are farther to the south, nor are the black shales observed on that river at all. The following ascending section was measured in a cliff on the fifteenth lot, between the eleventh and twelfth concessions of Garrafraxa, on the river bank :—

|                                                                                                               | ft.   | in. |
|---------------------------------------------------------------------------------------------------------------|-------|-----|
| Compact buff colored limestone composing the bed of the river,                                                | 0     | 0   |
| Drab-grey limestone, with fretted cellular surfaces, and cavities showing obscure impressions of shells,..... | 0     | 2   |
| Drab-grey limestone, stained and striped with oxide of iron,.....                                             | 0     | 3   |
| Drab-grey limestone, slightly arenaceous,.....                                                                | 0     | 3   |
| Concealed,.....                                                                                               | 3     | 0   |
| Pale grey, hard, compact, slightly bituminous limestone, with cavities supposed to have held fossils,.....    | 3     | 0   |
| Very hard, whitish-grey limestone, slightly silicious, with obscure organic remains,.....                     | 4     | 0   |
| Drab and grey limestone, a few thin beds at the bottom,.....                                                  | 2     | 6   |
| Grey limestone, with obscure organic remains,.....                                                            | 1     | 0   |
| Bluish-grey, hard, compact limestone, with cavities and crystals of calc-spar,.....                           | 2     | 0   |
| Bluish-grey, hard, compact limestone, in irregular, rough surfaced beds to the top of the cliff,.....         | 4     | 0   |
|                                                                                                               | <hr/> |     |
|                                                                                                               | 20    | 2   |

The upper part of the bituminous limestone crosses the Owen Sound Road, about six or seven miles from the village of Sydenham.

With the exception of building stone and limestone for the kiln, there is little of economic importance associated with this part of the formation, but good material for either of those purposes can be found in abundance, and stone from its beds is

used for such, wherever exposures of the rock approach a settled part.

Rumours are current through the country of the existence of lead ores, which, from the position usually indicated, would appear to belong to these rocks; but as there is in no instance, that has come under my observation, any evidence of the existence of mineral veins, or of disturbances in the strata to lead to the expectation of them, the probability is greatly against the discovery of the mineral in such quantity as to justify mining operations. That isolated crystals of galena are not unfrequently found in the rock, sometimes in considerable abundance, and that fossil shells are occasionally replaced by that mineral, is beyond doubt; mention was made of such instances in the Report of 1843, but it does not on that account by any means follow, that the quantity in any one place is sufficient to render its extraction profitable. While at Guelph, I was informed that lead had been found in large quantity at Mr. Strange's mill in Eramosa; upon enquiry of Mr. Strange himself, however, the report proved to be a gross exaggeration, founded upon the fact, that while quarrying out some rock for the construction of his mill buildings, he had struck a bed of limestone, about six or seven inches in thickness, in which there was an aggregation of crystals of galena, forming a sinuous string of fifteen or twenty feet in length, branching into a few similar smaller strings. This portion of the bed in question had been totally removed previous to the time of my visit, but the face of the bed below was distinctly exposed, without any appearance of a mineral *vein* of any kind, but still containing isolated crystals of galena; from all of which it may be inferred, that the aggregation of crystals was confined to one small bed, and the whole amount of lead, on removal, appears to have been insignificantly small. At this place, however, the rocks were observed to undulate slightly, showing a dip at one spot of rather over ten degrees to the south-west, and of about the same amount to the north-west and north at others, but the movements which have occasioned this variation from the usual nearly horizontal position, have probably been too slight to occasion any great amount of dislocation.

*Gypsiferous group.*—Succeeding the previously mentioned

deposits, are a set of limestones, which, in a former Report, were classed with the Niagara rocks, but have since been found by Mr. Hall, of New York, to contain certain fossils peculiar to the Onondaga salt group, and probably ought, in consequence, to be associated with the gypsiferous formation, of which they form the base. An undoubted difference exists in mineral as well as fossil character, between them and the beds upon which they repose ; they are usually of a pale yellowish or buff color, free from any bituminous substances, and some of the beds are granular. These limestones are extensively developed on the banks of the Grand River from about a mile above Middleton Bridge, which crosses on the twenty-first or twenty-second lot of the sixth concession of Dumfries, where they dip at a gentle angle about south-west, up to the junction of the Speed, above Preston, and they continue exposed up the Speed for a short distance. They again come out at Guelph, where they are displayed on the banks of the Speed, near the divisional line between the fourth and fifth concessions, and at several places in the immediate vicinity of the town. The same rocks appear next on the Grand River, about two miles below the junction of the Irvine, and continue exposed in bold vertical cliffs on each side of the river, nearly up to the town line between Garrafraxa and Nichol, where they come in contact with the lower formation. They are likewise exhibited on the banks of the Rocky Saugeen, on the twelfth lot of the third concession of Bentick, and up the stream as far as about one mile east of the Owen Sound Road. Finally, an outcrop was observed on the Owen Sound Road, on or about the fourth lot of the first concession of Sullivan. From the latter point they probably run in a north-west direction to the Rivière au Sable (north) and Chief's Point on Lake Huron, but that portion of their course has not yet been examined.

The remarkable bivalve shell so characteristic of these beds, to which my attention was drawn by the Rev. Mr. Bell, who had collected many specimens of it previous to my first visit to Galt, and to which Hall has since given the name of *Megalamus Canadensis*, was observed at all the places above enumerated, in some instances in immense numbers, and in a tolerable state of preservation, while in others it was scarce and obscure-

ly recognizable, but in almost all instances it exhibited only inside casts. This shell appears to belong exclusively to the upper portion of the limestones, none having been observed in any of the lower beds. It was seen in greatest abundance at Galt and at Elora, on the Grand River, associated with numerous other organic remains, chiefly corals and spiral univalves; two among the latter are considered recognizable, as *Loxonema Boydii* and *Euomphalus sulcatus*, figured by Hall as characteristic fossils of the Onondaga salt group; both of them are met with in all the beds of this part of the formation in Canada, and are very numerous in most. From the obscure condition in which the *Megalamus Canadensis* frequently occurs, it is not improbable that while examining the coast of Lake Huron, between Cape Hurd and the Rivière au Sable (north,) this fossil may have been overlooked, and the resemblance in mineral character between the rocks now known to contain it, and the limestones that exist on that part of the coast, rather favors the supposition, that farther examination may determine some points to belong to this group; in the meantime, however, farther evidence is requisite before a decided opinion can be given.

On the banks of the Irvine and Grand River, near their junction below Elora, perpendicular cliffs of these limestones occur, varying in height from seventy-five to eighty or eighty-two feet in the following ascending order:

|                                                                                                                                                                               |       |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----|
| Pale grey or drab colored massive beds of limestone, with fossils, among which are numerous univalves resembling <i>Loxonema Boydii</i> and <i>Euomphalus sulcatus</i> ,..... | ft.   | in. |
|                                                                                                                                                                               | 56    | 0   |
| Buff colored coral limestone, with a stratum of about three feet, near the middle filled with <i>Megalamus Canadensis</i> ,.....                                              | 14    | 0   |
| Thin beds of compact drab colored limestone, with small cavities and cracks lined with calc-spar,.....                                                                        | 12    | 0   |
|                                                                                                                                                                               | <hr/> |     |
|                                                                                                                                                                               | 82    | 0   |

In the former Report, the shales and limestones with which the workable gypsum is found associated, were described as occurring on the banks of the Grand River, nearly all the way from Dunnville, in the township of Moulton, to some distance above Paris, in the township of Dumfries. They cross the River below Middleton Bridge, and then disappear below a vast

thickness of drift, composed of clay, gravel and sand, and they have nowhere been seen in place in any of the townships passed through northward, between that place and the Saugeen River, in the townships of Brant and Carrick.

The following ascending section was measured on the banks of the Saugeen, on the thirtieth lot of the first concession, south of the Durham Road in the township of Brant:—

|                                                                                                                                                                                | ft.   | in. |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----|
| Thin-bedded, greenish colored limestone, slightly bituminous,...                                                                                                               | 2     | 0   |
| Concealed, but holding a large accumulation of debris, chiefly fragments of red and green shale, and drab colored limestone, some of which was supposed to be water-lime,..... | 25    | 0   |
| Green shale with small quantities of red shale intermixed, holding one strong band of drab colored limestone about one foot in thickness,.....                                 | 25    | 0   |
| Drab colored limestone and shale, alternating in thin, close bands, some of the limestone holding small lenticular crystals of calc-spar, .....                                | 25    | 0   |
|                                                                                                                                                                                | <hr/> |     |
|                                                                                                                                                                                | 77    | 0   |

At the summit of the bank was found a small slab of dark buff colored arenaceous limestone, showing numerous casts of a small bivalve shell, resembling casts found at the top of the formation near Haldimand, and suggesting a comparison with *Cytherina alta* of Conrad.

In the bed of the Saugeen, on the second lot of the seventh concession of Mr. Brough's recent survey of Brant, near the commencement of a great bend, called by the surveyors the Ox Bow, there are beds of pale drab colored bituminous limestone, holding small lenticular cavities, frequently before remarked as common in the limestone rocks of the gypsiferous formation. These are overlaid by a bed of black bituminous shale, which is surmounted by buff colored very bituminous limestone, varying in the thickness of the beds from three inches to nearly two feet. Small lenticular crystals of calc-spar occur in these beds, and the cracks and divisional planes are marked by a thin coating of black bituminous matter.

No gypsum was observed in the localities of any of the above sections, nor were there rumours of its having been found in any part of the country along the line of strike between the

Grand River, near Paris, and Lake Huron ; nevertheless the character of the country, in many parts, is such as may be supposed to indicate its presence. Sharp conical hills and mounds, and large circular sinks or depressions, such as have been described in a former Report, as of frequent occurrence in the gypsiferous country, were observed between Bridgeport and Berlin, in the township of Waterloo, and in several parts along the course of the Saugeen ; and it is extremely probable that as improvement advances, and the hills are cut into where roads happen to intersect them, this useful mineral will eventually be found in many places.

Most of the beds of fossiliferous limestone, at the base of this formation, are well adapted for building and lime-burning, and are largely quarried for both purposes at Galt, Guelph, Elora and Fergus. At Guelph one strong band, of three feet or upwards in thickness, being of a finer grain and less fossiliferous than the others, may be wrought into an exceedingly handsome material for facing buildings, and is capable of being dressed to a very smooth surface.

Beds of hydraulic lime are occasionally found associated with the shales and limestones of the upper part of the group ; such beds were found at Point Douglas, on Lake Huron, in the previous year, and they are well known on the Grand River below Paris. Rock of apparently similar quality was observed among the shales of the Saugeen ; but unfortunately the specimens collected at the latter place, which were to have been forwarded through the kindness of Mr. Jackson, have not arrived, and no opportunity of testing their quality, therefore, has yet offered. A bed of excellent water-lime, belonging to the formation, was found on the fourteenth lot of the second concession of Brantford, the property of Lieut. Col. Burrows, on the left bank of the Grand River, a sample of which was tested by Mr. Hunt ; being burnt and pulverised, it set under water in the course of five minutes.

*Corniferous limestone*—Limestone holding fossils characteristic of the corniferous formation, was observed in two places near the Saugeen, both within a short distance of the town-line dividing Brant from Greenock. One of the localities was on the sixth lot of the first concession, south of the Durham Road

in Brant, the property of Mr. Johnson, where a well having been sunk by the proprietor, through eight or ten feet of soil and drift, a buff colored bituminous limestone was met with, highly charged with fossils, among which *Atrypa affinis* and other bivalve shells, several univalves, a trilobite and various corals occurred. The other locality was on the second lot on the line between the sixth and seventh concessions of the same township, in the bed of a small brook, which flows down the high bank of the Saugeen near the Ox Bow. Drab colored, thin bedded limestones were here met with, without fossils, and in mineral character resembling the upper portion of the Gypsiferous group, and they were overlaid by grey calcareous rocks, holding chert, and containing obscure fossils, chiefly corals.

A section of about twelve feet of the Corniferous limestone formation is displayed on the banks of the north branch of the Thames, at the village of St. Mary, between the seventeenth and eighteenth concessions of Blanchard. The rock is exposed for about a mile and a-half above, and about the same distance below the bridge, which crosses the river at St. Mary; its color is brownish-grey, occasionally weathering to a green tinge; it is very bituminous, and holds numerous fossils, principally a small species of *Leptena*, a shell resembling *Atrypa concentrica*, figured by Hall, and encrinites in smaller numbers.

Portions of the same formation have already been represented as occurring on the south branch of the Thames, near Woodstock, in the county of Oxford; but south from that place no exposures of any kind of rock have been met with or heard of in place, at any point nearer than Port Dover, on Lake Erie. From Port Dover the exposures occur at intervals along the coast, easterly to the termination of the lake at Fort Erie, and are usually very fossiliferous; among numerous other forms *Pterinea? cardiformis*, *Strophomena undulata* and *Hipparionyx (Atrypa) consimularis* of Hall, are considered recognizable.

The rock exposures in the western part of the Peninsula are remarkably few, and only one of any importance, belonging to the formation, came under my notice during the time I was engaged in examining that part of the country. This was on

the Sydenham River, on the twenty-eighth lot of the fourth concession of Zone, according to the old survey, but in the Township of Euphemia by the new, at Smith's mills, where there are about four beds exhibited in the channel of the river, each from sixteen to eighteen inches in thickness; the rock here is a blue limestone, very fossiliferous, the prevailing species being a *Spirifer*, of which some portions of the rock appear to be almost entirely composed. The dip of the beds here is nearly north-west at a very small rate of inclination, probably about forty or forty-five feet in a mile, and they pass below the black shales of the Hamilton group, which crop out on the next southerly reach of the Sydenham, above the Zone Mills.

Limestone, I was informed by Mr. Parr, appears likewise on the twelfth lot of the first concession, east of the communication road near Blenheim, in the township of Harwich, and on the twentieth or twenty-first lot of the eighth concession of Raleigh, but the information was not obtained, unfortunately, until I had passed through that part of the country.

*Hamilton shales.*—A portion of this formation was observed in the bed of the River Sydenham, at the Zone Mills, on the town-line between Zone and Dawn, and at intervals on the same stream for between four and five miles above that point, in a reach running nearly on the town-line for about that distance. The rock in this locality is a black, very bituminous, brittle shale, holding numerous nodules and crystals of iron pyrites, but no species of organic remains could be discovered in it. I was informed, however, that a form (which, judging from the description given, was probably a trilobite) was occasionally found, while the rock was being quarried for the purpose of underpinning some of the buildings then in the course of their construction.

The formation was not seen in place in any other part visited during the season: neither did I hear of any other locality in which it is known, but the bituminous springs, which probably owe their origin to it, and are known to exist on the line of strike, in the townships of Enniskillen, Zone and Mosa, may be fairly supposed as indications of its presence beneath, in which case it would appear probable that a belt of the for-

mation stretches across the point of the Peninsula and extends from Kettle Point and the Rivière au Sable (south) to the Rondeau, and may possibly skirt the coast of Lake Erie for some distance down.

The rock found at Zone Mills has occasionally been applied in a rude manner for building the foundations of wooden houses, but the nature of the material is by no means such as to render it generally useful for such a purpose, as on exposure to the atmosphere, it soon decomposes and crumbles to pieces.

*Drift.*—It has already been remarked in the Report of 1843, that a great deposit of loose detrital material, consisting of clay, sand, gravel and boulders, deeply conceals the older strata in a great many parts of Western Canada; and this remark is peculiarly applicable to the Peninsula between the Niagara Ridge and the St. Clair River. The lower portion of the more recent deposits as exhibited on the shore of Lake Erie, where the cliffs are in many parts over 150 feet high, is a blue calcareous clay, frequently holding pebbles and small boulders of limestone, and small rounded fragments of granite or gneissoid rock. Clay of an ash-grey color when dried, but presenting a light brownish color in the bed, succeeds the blue clay, and this again is overlaid by pale buff and occasionally yellowish tinged clay. Back from the lake these clays are capped with a stratum of sand, and the more elevated parts present beds of calcareous gravel.

No organic remains of either marine or fresh-water origin have hitherto been observed among the superficial deposits of the Western Peninsula, with the exception of the shells which constitute the fresh-water shell marls, and the impressions of leaves and moss which are frequently preserved in the tufaceous deposits around calcareous springs, and on the banks of rivulets, both of which are evidently of very recent origin. The marls are only found immediately below the vegetable mould, and contain only shells common to almost all the lakes and rivers of the country at the present day; and in the accumulations of calcareous tufa the impressions are only of such plants as now grow in the immediate vicinity of the springs and brooks, to which the deposits owe their origin.

The materials of economic importance, connected with the

superficial deposits, are brick clays, bog iron ore, shell marl, calcareous tufa and peat.

All the clays are more or less calcareous, but some portions of the deposit are nevertheless admirably adapted for the manufacture of bricks, and are used for that purpose over a great part of the northern country. In the neighbourhood of London, white bricks of excellent quality are extensively manufactured, among the best samples of which are those made at the brick yard of Mr. Griffiths on the thirty-fifth lot of the first concession of Westminster, near the Commissioners Road. The clay used by Mr. Griffiths, is taken from a bed about twelve or fourteen feet thick, in which it is invariably found that the lower portion makes a compact solid white brick, sometimes assuming a pale green tinge, while the middle part yields a white brick without any shade of green, and the upper stratum burns into a bright red brick. The first of these varieties of bricks is usually esteemed the most durable and the handsomest, and it is said to be capable of withstanding a very strong heat, as an instance of which the bricks have been used at Mr. Labatt's brewery, in London, in the construction of furnace hearths with perfect success, one hearth having stood for upwards of four years without repair.

Bog iron ore is found in many parts of the country in greater or less abundance along the edges of marshes or on the marshy banks of streams. It usually occurs in rough irregular detached masses, and of all sizes under one foot diameter, generally deposited on clay, and concealed by vegetable mould and marsh grasses. At one time this ore was extensively used at the foundry of Normandale, on the shore of Lake Erie, by Mr. VanNorman, who informed me that it had been found in several places in the townships of Charlotteville, Middleton and Windham. Mr. VanNorman had found and used the ore in four different localities in Charlotteville, namely:—the fourth lot of the third concession, and the sixth, thirteenth and fourteenth lots of the sixth concession. In Middleton it is known on the seventeenth lot of the first concession, north of the Talbot Road, and in the third concession south of the same road on Venison Creek. In Windham the ore has been found on the twelfth lot

of the fourteenth concession. At Thamesville on the Longwoods Road, behind London and Chatham, indications of the ore were observed on the banks of a small stream called the Mill Creek, which falls into the Thames on the thirteenth lot of concession B., of Campden; the ore occurred at intervals for about a mile above its exit, and it seems probable that it is in sufficient abundance in the locality to be worth working.

Fresh-water shell marls were observed at several places in the new townships of Bentick and Brant. One bed extending over between two and three acres, with a thickness varying from three inches to one foot, occurs on the property of Mr. Jackson, on the nineteenth lot of the first concession, west of the Owen Sound Road, within a mile of the village of Durham. Another bed occurs on the fifty-ninth lot of the first concession south in Bentick, on the Durham Road, the extent of which was not exactly ascertained, but it shews a thickness in several places on the side of the road of not less than two feet. A third bed was seen on the seventieth or seventy-first lot of the first concession south of the Durham Road in Brant; this bed is exhibited in the banks and on the bottom of a small tributary of the Saugeen, near its junction with that river, and is in some parts fully three feet in thickness. Indications of the presence of the same substance were observed likewise near the junction of the Rocky Saugeen and the main stream, and it is probable that it will be found to exist in many other parts of the region, where its value as manure will doubtless be sufficiently appreciated as the settlement advances in improvement.

These marls, which are almost entirely composed of an aggregate of comminuted fresh-water shells, are usually concealed by a rich black vegetable mould or peat. The ground is usually swampy and sometimes assumes somewhat the character of prairie land. I was informed of some instances in which the peat is sufficiently thick and free from earthy matter to be available as a fuel, but none of these came within my observation.

In respect to the tufa, none of the deposits that came within my notice, were of sufficient importance to be deemed of economic value, but indications of it were met with on the banks

of many springs and streams, and in consequence of the calcareous nature of the soil and the subjacent rocks in so great an extent of the Western Peninsula, large deposits of it may be looked for. The material is applicable as a mineral manure, and may be resorted to for lime for mortar.

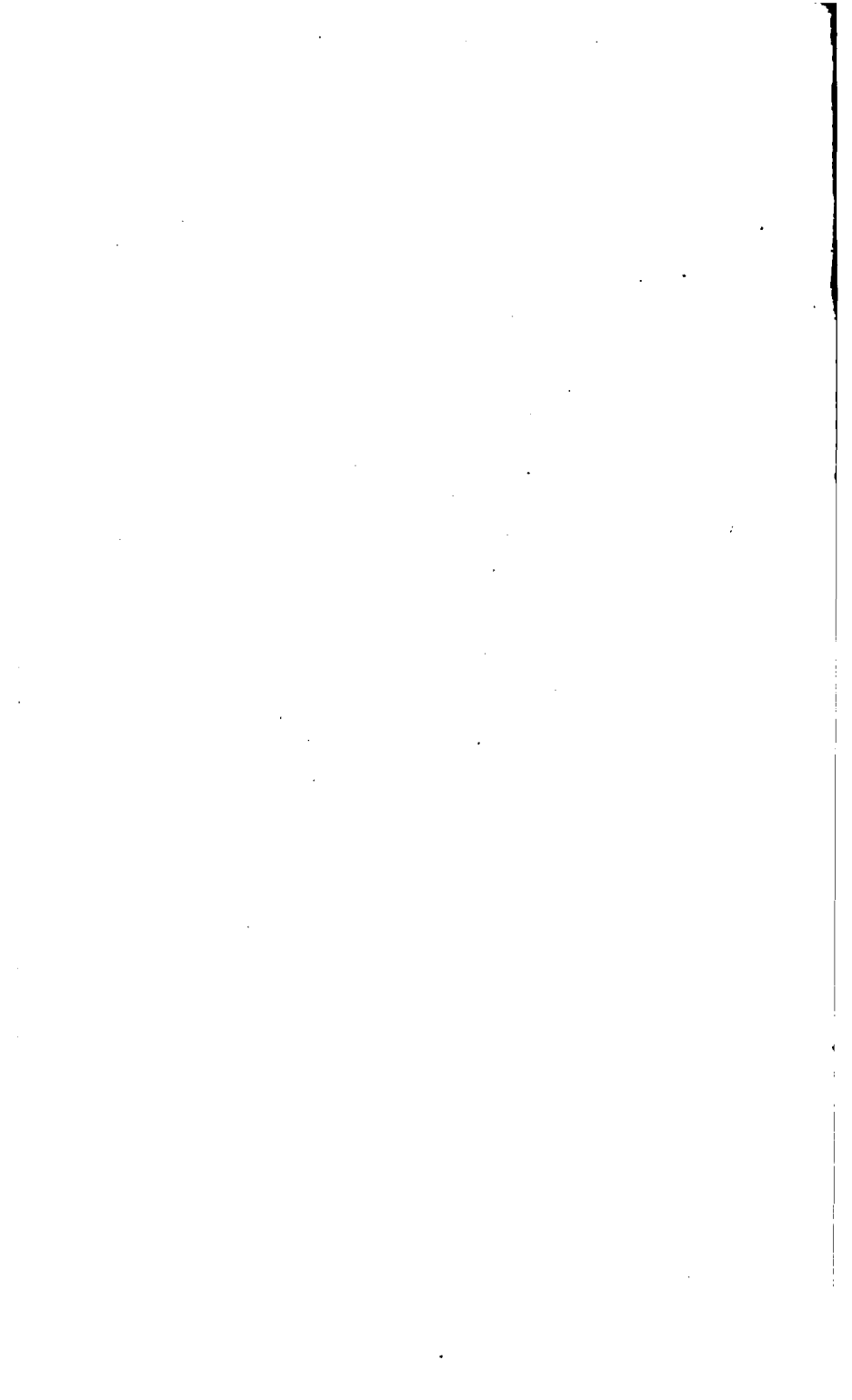
Springs of petroleum, commonly known in the country by the designation of *oil springs*, rise in the River Thames, near its right bank, on the twenty-eighth and twenty-ninth lots of the first range of Mosa, where the bituminous oil is frequently collected on cloths from off the surface of the water, and is very generally used in the neighbourhood as a remedy for cuts and cutaneous diseases in horses. Similar springs are known to exist in the township of Enniskillen, and a deposit of mineral pitch or mineral caoutchouc is said to extend over several acres on the seventeenth lot of the second concession of the township. A specimen of the latter was submitted to Mr. Hunt for analysis, and is described in his Report for 1849-50.

I have the honor to be,

Sir,

Your most obedient servant,

A. MURRAY.



# REPORT

OF

T. S. HUNT, ESQ., CHEMIST AND MINERALOGIST

TO THE

PROVINCIAL GEOLOGICAL SURVEY,

ADDRESSED TO

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

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LABORATORY OF THE GEOLOGICAL COMMISSION,

MONTREAL, 1st *May*, 1851.

SIR,—Having been occupied with you during the principal part of the summer of 1850, I proceeded in the month of September to make some examinations on the north shore of the St. Lawrence below Quebec, and after my return thence, commenced my winter duties in the Laboratory, a Report of the results of which, I beg leave to present to you.

The older crystalline rocks of the northern shores of the St. Lawrence and of the Ottawa, afford a number of interesting mineral species, many of which have been made known to collectors through the researches of Drs. A. F. Holmes, of Montreal and Wilson, of Perth. Some of these minerals were sent by them to Dr. Thompson, of Glasgow, who, from his examinations, inferred the existence of several new species, which were accordingly described by him as such. Owing, however, to an unfortunate want of precision in his mineralogical descriptions, their identification has been difficult, and mineralogists have been unwilling to concede to them a rank among established species; and the more, as the chemical composition assigned to several of them, seemed but little accordant with their general physical characters. Having, through the kindness of the two gentlemen first named, been put in possession of well authenticated specimens of the minerals in question, I have

submitted them to careful examination and have obtained the results subjoined.

*Felspar*.—Among the species of this genus, which is very common among the granitic and gneissoid portions of the formation referred to, I shall first notice that one which has been described by Dr. Thompson under the name of *Perthite*. It is found in the township of Burgess, and, mixed with quartz, forms a *pegmatite* rock, in which large cleavable masses of the felspar are occasionally met with. Its cleavage form is apparently monoclinic, and its hardness is 6 upon the scale of Mohs;—specific gravity from 2·576 to 2·579, of a darker colored fragment 2·583; lustre vitreous inclining to pearly; color light flesh-red alternating with reddish or pinchbeck-brown, the two colors forming bands from half a line to a line in width, coincident with one of the planes T, often however, interrupted and mingling one with another. The darker bands exhibit on the cleavage surface T, when viewed perpendicularly, a golden reflexion like the variety known as *aventurine felspar*, and polished specimens of the mineral in the possession of Dr. Wilson show that it is available for ornamental purposes. The colors of this felspar become much darker by exposure to the action of the weather. The analytical results which follow were obtained from freshly broken light colored fragments, and the mineral reduced to a fine powder by eleutriation, was dried in one analysis at 300° F., and in another at the ordinary temperature over a vessel of sulphuric acid. The earthy constituents were determined in the ordinary manner by fusion with carbonate of soda, and the alkalis by decomposing separate portions of the mineral with the aid of fluor-spar and sulphuric acid. One hundred parts of it gave:—

|                           | I.            | II.   |
|---------------------------|---------------|-------|
| Silica.....               | 66·44.....    | 66·50 |
| Alumina.....              | 18·35 } ..... | 19·25 |
| Peroxyd of iron.....      | 1·00 }        |       |
| Lime.....                 | ·67.....      | ·56   |
| Magnesia.....             | ·24.....      | ·24   |
| Potash .....              | 6·37.....     | 6·18  |
| Soda .....                | 5·56.....     | 5·56  |
| Water,(loss on ignition). | ·40.....      | ·44   |
|                           | <hr/>         | <hr/> |
|                           | 99·03         | 98·73 |

It is evident from these analyses, that the composition of this felspar is precisely that of *orthoclase*, to which species it had already been provisionally referred by Shepard, Dana and myself, (see my Report for 1847-48, p. 135.) The proportion of soda is larger than is generally met with in this species, but there are instances of orthoclase in which the greater portion of the alkali is soda. As it is, the quantity of potash present, and the extensive deposit of this felspar, are such as to make it worthy of attention as an economical source of this alkali, which in proportion as wood becomes scarce, is increasing in value, so much as to render its extraction from its mineral combinations a source of profit.

The second species to be noticed is that described by Dr Thompson under the name of *peristerite*, in allusion to the beautiful play of colors analogous to that of Labradorite, which it exhibits. The specimens from Bathurst furnished me by Dr. Wilson, as duplicates of those sent to Dr. Thompson, are composed of a mixture of quartz grains, readily distinguishable by their lustre, greater hardness and want of cleavage, disseminated through a felspar, which still so far predominates as to give distinct cleavages to the mass; such, from his analysis, also would appear to be the substance examined by Dr. Thompson. Specimens furnished me from the same locality exhibited the mineral in fine cleavable masses, free from quartz, and occasionally in consequence of an admixture of it, passing into the variety just described.

The crystalline form of the mineral shows it to belong to the triclinic system; the faces of cleavage give apparently the angles of albite, but do not admit of accurate measurement. The cleavage parallel with P and M is perfect, but less distinct with T. The surface P shows a fine play of colors like Labradorite, in which a delicate cerulean blue predominates, occasionally passing into light green and yellow; the face M is often marked with striae parallel to P. The same play of colors and striation on alternate surfaces are distinguishable in the quartzose masses. The hardness of the mineral is 6 and its specific gravity 2.625-2.627; lustre, vitreous inclining to pearly on P; color white, passing into pearl-gray, and reddish-white or flesh-red in the quartzose specimens; translucent, fracture uneven. Before the blow-pipe it fuses with difficulty,

and colors the flame strongly yellow ; the analysis of a pure specimen gave :—

|                       | I.         | II.   |
|-----------------------|------------|-------|
| Silica.....           | 66·80..... | 67·25 |
| Alumina.....          | 21·80      |       |
| Potash .....          | 0·58       |       |
| Soda .....            | 7·00       |       |
| Lime .....            | 2·52.....  | 2·03  |
| Magnesia .....        | ·20        |       |
| Peroxyd of Iron.....  | ·30        |       |
| Loss on ignition..... | ·60.....   | ·66   |
|                       | —          |       |
|                       | 99·80      |       |

The results of this analysis, conjoined with its physical characters, show this mineral to be *albite*. The purity of the silica obtained was verified by subsequent examination, and it may be remarked, that in the first analysis the small portion of silica, which is always precipitated with the alumina, was not separated. Thompson, in his analysis of the peristerite, gives a much larger proportion of silica, but as has been before observed, the specimens examined by him were the quartzose mechanical aggregate.

Shepard and Dana have referred the mineral to orthoclase, and Dana, in the last edition of his *Mineralogy*, by a mistake says, that I have confirmed the opinion, whereas I had only in the Report for 1847–48, alluded to the oblique rhomboïdal form of its cleavage, conjoined with its beautiful opalescence, (resembling the Fredericksvärn opalescent felspar, which has erroneously been referred to that species,) as leading to the supposition that it was Labradorite.

Another felspathic mineral, which was found as a boulder near Bytown, was described by Dr. Thompson as a new species under the name of *Bytownite*; it has been referred by other authors to a variety of species; Shepard includes it under pyroxene, and Dana at first classed it with scapolite, but in his last edition is inclined, from Thompson's analysis, to refer it to Barsoвите, a species proposed by G. Rose. The specimen which Dr. Holmes kindly placed in my hands, had been pronounced by Dr. Thompson to be the mineral described by himself under the name of Bytownite. It is massive, granular, strongly co-

herent, and with the exception of occasional disseminated grains of black hornblende, is homogenous. Some of the larger and more distinct grains, exhibit one perfect cleavage, and indications of another oblique to it, which is less apparent. Its hardness is 6.5, and its specific gravity 2.732-2.733. The lustre is vitreous, approaching to pearly upon the cleavage faces; it is translucent and of a greenish or grayish-white. The analysis was performed upon carefully selected grains, and the pulverised mineral, first dried at 212° F., was afterwards exposed over the surface of sulphuric acid. It gave:—

|                       | I.         | II.   |
|-----------------------|------------|-------|
| Silica.....           | 47.40..... | 47.30 |
| Alumina.....          | 39.45      |       |
| Lime.....             | 14.24      |       |
| Magnesia.....         | .87        |       |
| Protoxyd of iron..... | .80        |       |
| Soda.....             | 2.82       |       |
| Potash.....           | .38        |       |
| Water.....            | 2.00.....  | 1.80  |
|                       | —          |       |
|                       | 98.96      |       |

The water in this mineral seems chemically combined. Thompson in his analyses gives the same amount of silica and water as above, but for the rest, differs greatly as to the proportions of lime and alkalis. It is identical in composition with the *thiorsauite* from Iceland, which Rammersberg regards as *anorthite*, and in general aspect can scarcely be distinguished from the *amphodelite* of Uton in Sweden, which is also regarded as belonging to the same species. We are then authorized in considering Bytownite to be *anorthite*, with which it agrees in hardness and specific gravity. A slight excess of silica, as in thiorsauite, is to be ascribed to a small admixture of quartz with the granular felspar.

The mineral from the vicinity of Perth, which has generally been distributed among mineralogical collectors as the Bytownite, is finely granular, almost compact, and has a smoky blue color, with a hardness of about 6, and a specific gravity of 2.739. When viewed under a lens, it is seen to be a mixture of a light colored translucent granular mineral, apparently like the preceding, and exhibiting cleavages with a vitreous lustre,

intermixed with minute grains of what appears to be black hornblende. The specimens of it before me exhibit such a mixture that its analysis would be valueless.

The species of felspar, which was first discovered on the coast of Labrador, and has received the name of Labradorite, is common in boulders along the valley of the St. Lawrence from the Gulf to Canada West, but has not been found in place, except in a small island composed of Labradorite rock, observed by Dr. Bigsby, in Lake Huron, near Parry's Island. In the township of Drummond, C. W., large loose masses of the mineral are met with, (see report for 1847-48,) some portions of which exhibit a play of colors equal to the highly prized specimens from Labrador, and constitute a beautiful ornamental stone. A fragment from this locality was submitted to analysis; it had a hardness of 6 and a specific gravity of 2.697; its color was lavender-blue with pearly-gray iridescence. Analysis gave:—

|                       |         |
|-----------------------|---------|
| Silica.....           | 54.70   |
| Alumina.....          | 29.80   |
| Lime.....             | 11.42   |
| Peroxyd of iron.....  | .36     |
| Magnesia,.....        | a trace |
| Soda.....             | 2.44    |
| Potash.....           | .23     |
| Loss by ignition..... | .40     |

---

99.35

*Raphilite*.—This name was given to a species instituted upon specimens obtained by Dr. Wilson, in Lanark, C. W., and sent to Dr. Thompson by Dr. Holmes of Montreal; it is, according to Thompson's analysis, an anhydrous silicate of lime, magnesia, alumina and peroxyd of iron, with more than ten per cent. of potash. Dana, in the first edition of his *Mineralogy*, suggested that it might be a fibrous hornblende containing alkali, and analogous to the variety Arfvedsonite, to which species Shepard also refers it; while in his last edition, Dana, in conformity with a suggestion in my Report for 1847-48, regards it as tremolite. Being furnished with undoubted specimens of the mineral I have submitted it to a careful examination, the result of which confirms this opinion.

It occurs in delicate fibrous masses, slightly divergent, and often several inches in length; the fibres are readily separable, brittle, and somewhat elastic; hardness 5·5 on the scale of Mohs, or between apatite and felspar. Thompson gives 3·75, but the fibres scratch deeply the surface of a crystal of apatite; specific gravity in coarse powder 2·845, (2·850, Thompson). Lustre vitreous, silky; color grayish or greenish-white, becoming reddish on weathered surfaces; translucent. Analysis failed to detect more than very small portions of alkalis or alumina, and gave—:

|                       |                              | Ox. Ratio.  |
|-----------------------|------------------------------|-------------|
| Silica.....           | 55·30 containing oxygen..... | 28·7182 = 2 |
| Lime.....             | 13·36 " "                    | 3·7991      |
| Magnesia.....         | 22·50 " "                    | 8·7162      |
| Protoxyd of iron..... | 6·30 " "                     | 1·3982      |
| Alumina.....          | ·40 " "                      | ·1869       |
| Manganese.....        | traces                       |             |
| Potash.....           | ·25 " "                      | ·0424       |
| Soda.....             | ·80 " "                      | ·2064       |
| Loss on ignition..... | ·30                          |             |
| 99·21                 |                              | 14·3492 = 1 |

The mineral has therefore an entirely different composition to that heretofore assigned to it, and from the ratio between the oxygen of the silica and the protoxyds, evidently pertains to the type of hornblende, of which tremolite is a variety.

*Serpentine*.—This species is known to be common in the crystalline limestones which belong to the older metamorphic rocks of the Province. Specimens of it from the vicinity of Grenville, sent by Dr. Holmes to Dr. Thompson some years since, were by the latter regarded as a new species, and named by him *retinalite*. The species was based upon the pretended chemical composition of the mineral, which, according to Dr. Thompson, is a hydrated silicate of magnesia and soda, containing—

|                      |        |
|----------------------|--------|
| Silica.....          | 40·550 |
| Magnesia.....        | 18·856 |
| Soda.....            | 18·832 |
| Peroxyd of Iron..... | } ·920 |
| Alumina.....         |        |
| Water.....           | 20·000 |
| 99·158               |        |

This composition in a mineral, having the external characters of serpentine, seemed anomalous, and I was therefore desirous of submitting it to a further examination. Dr. Holmes had still in his possession a portion broken from the specimen which he sent to Dr. Thompson, and kindly placed it in my hands. I have also specimens collected by myself at the original locality. It there fills seams, or is diffused through a white crystalline limestone in the vicinity of a dyke of trap, and is most abundant nearest the intrusive rock. The mineral is massive without any trace of crystallization, and has a hardness of about 3.5 (3.75, Thompson). Its specific gravity is 2.494—2.525 (2.493, Thompson); another fragment of an olive green color gave 2.476. The lustre of retinalite is resinous, shining; streak, white; color honey-yellow, passing into oil-green and olive-green; it is translucent and has a conchoidal fracture. The first analysis is upon the original specimen which was honey-yellow, the second upon another of an oil-green color. The pulverized mineral was dried over sulphuric acid—

|                      | I.          | II.   |
|----------------------|-------------|-------|
| Silica.....          | 39.34.....  | 40.10 |
| Magnesia.....        | 43.02.....  | 41.65 |
| Peroxyd of iron..... | 1.80.....   | 1.90  |
| Soda.....            | traces..... | .90   |
| Water.....           | 15.09.....  | 15.00 |
|                      | 99.25       | 99.55 |

Another serpentine, closely resembling the retinalite, is found in nodular masses having a calcareous nucleus, at the Grand Calumet Island; it has a specific gravity of 2.362—2.381, and a pale wax-yellow color. Its analysis afforded me:

|                      |        |
|----------------------|--------|
| Silica.....          | 41.20  |
| Magnesia.....        | 43.52  |
| Peroxyd of iron..... | .80    |
| Water.....           | 15.40  |
|                      | 100.92 |

The analytical results of Thompson, upon which the species was established, were entirely erroneous, and these specimens, although the latter differs somewhat from the others in specific gravity, are nearly identical in composition with each other,

and with the marmolite of Hermann, but are distinguished from it in not being foliated. The proportion of water is intermediate between that of ordinary serpentine and the Deweylite of Emmons, from which latter these specimens are separated by their greater specific gravity. Dana has, however, in consideration of the wide latitude presented in the composition of this class of minerals, united marmolite with serpentine, and it would not, in my opinion, be advisable to retain retinalite, which is only a compact marmolite, as a distinct species.

The presence of traces of alkalies has not hitherto generally been recognized in this class of minerals, but Ficinus has observed from .50 to 1.33 per cent. of soda in the dermatine of Breithaupt, and Schmidt 1.98 per cent., in an asbestiform serpentine from Zobnitz.

*Zircon.*—The locality of this mineral at Grenville has been described in a previous Report (1847–48.) It is found associated with tabular spar, calcite, sphene, pyroxene, and plumbago, and forms crystals often half an inch in diameter, and an inch or more in length, with finely modified terminations. The specific gravity of these crystals is from 4.602–4.625; hardness 7; their color is brownish-red, passing into flesh-red and cherry-red, they are sub-translucent to transparent; analysis gave me :

|                 |       |
|-----------------|-------|
| Silica, .....   | 33.7  |
| Zirconia, ..... | 67.3  |
|                 | 101.0 |

The zirconia contained a trace of iron which was not separated.

*New Mineral Species.*—In a visit to the Grand Calumet on the Ottawa, in 1847, I observed, among the limestone exposed in constructing the timber slides, a mass containing pale green serpentine, a brown binaxial mica, pyrites, minute prisms of apatite, and a brown mineral somewhat resembling sphene, which I suggested in my Report for that year would probably prove to be a new species. The mica of this locality, which in larger crystals is found in the vicinity associated with crystallized pyroxene, has been optically examined by Professor B. Silliman, Jr.,

and determined to belong to the species *phlogopite*; the angle between the two optical axes is from  $13^{\circ}$  to  $13^{\circ} 12'$ .\*

The unknown brown mineral has also been submitted to examination by myself, and its claim to be considered a distinct species established. Its crystalline form is indistinct, but it appears to form oblique rhombic prisms replaced on the acute and obtuse lateral edges, and on the acute solid angles. The edges are generally rounded, and the secondary planes not well defined. The cleavage with the sides and base of the prism is distinct, that with the longer diagonal imperfect. Hardness, 3; specific gravity, 2.60–2.64. The lustre of the cleavages is vitreous, shining, the surfaces of the crystal are generally dull; the color is clove-brown to chocolate-brown, sometimes pale; streak and powder gray or grayish-white; sub-translucent, brittle, fracture uneven. The crystals, which are short and thick, are generally small, and so penetrated with the calcareous gangue, that great care was necessary in selecting specimens for analysis.

Before the blowpipe it loses color, and becomes grayish-white, but does not fuse; the powder heated in a tube gives off a large quantity of water with an empyreumatic odor; moistened with a solution of nitrate of cobalt, and ignited, it becomes deep blue. Acids take up magnesia, alumina, and protoxyd of iron, with a small but variable portion of lime, derived from the calcareous gangue, and leave pulverulent silica; the decomposition by this means is not, however, complete. Qualitative analysis showed the presence of no other ingredients than those already indicated, with the exception of a feeble trace of manganese. Regard was had in the examination to the detection of the rarer earths, the alkalies, and titanitic and phosphoric acids.

The finely pulverized mineral was heated to whiteness, and the loss thus sustained regarded as water, with the carbonic

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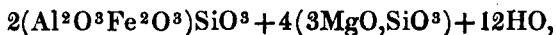
\*These crystals of mica have been alluded to in a former Report, and described as associated with pyroxene, and large crystals of idocrase; an examination of the crystallization of the latter shows that these beautiful and highly modified crystals have the forms of tourmaline; the size, color and general appearance are, however, so much like idocrase, that several practised mineralogists have at first sight fallen into the same error as myself, with regard to their nature.

acid, which was too small to be determined directly upon the portions of the mineral which my specimens afforded me. The farther decomposition was effected by fusion with carbonate of soda, and the silica and bases were separated by the usual methods. In analyses upon three different specimens there were obtained :—

|                          | I.         | II.        | III.  |
|--------------------------|------------|------------|-------|
| Silica,.....             | 32·84..... | 32·14..... | 33·17 |
| Magnesia,.....           | 35·12..... | 36·43..... |       |
| Alumina.....             | 13·37..... | 13·00..... |       |
| Peroxyd of iron.....     | 2·00.....  | 2·28.....  |       |
| Water and carbonic acid. | 17·02..... | 16·83..... | 16·50 |
| Lime.....                | ·96.....   | ·93.....   |       |
|                          | 101·31     | 101·61     |       |

If we subtract from the loss by ignition, the amount of carbonic acid required to form a carbonate with the lime, we have respectively 16·36 of water and 1·70 of carbonate, and 16·12 water, and 1·64 of carbonate. Calculating the oxygen ratio between the silica and the bases, we have for the first analysis 17·515 : 34·990 ; and for the second, 17·140 : 35·198. As it appears from the third analysis that the amount of silica given in the second is rather too low, we may take the first as expressing more closely the ratio, which is just 1 : 2, and which makes it on the nomenclature of Gerhardt a protosilicate, of the type  $\text{SiO}^3\text{M}^4$ .

The composition is very closely expressed according to the Berzelian notation by  $5\text{SiO}^3$ ,  $12\text{MgO}$ ,  $1\frac{3}{4}\text{Al}^2\text{O}^3$ ,  $\frac{1}{4}\text{Fe}^2\text{O}^3$ ,  $12\text{HO}$ , which may be represented among others by the formula



This affords by calculation the following numbers, which are compared with the first of the above analyses from which the carbonate of lime has been deducted.

|                      | Calculated. | Found. |
|----------------------|-------------|--------|
| Silica.....          | 33·29.....  | 32·84  |
| Magnesia.....        | 35·50.....  | 35·12  |
| Alumina.....         | 13·31.....  | 13·37  |
| Peroxyd of iron..... | 1·92.....   | 2·00   |
| Water.....           | 16·00.....  | 16·36  |
|                      | 100·02      | 99·69  |

The peroxyd of iron is to be regarded as replacing a portion of alumina, so that the mineral is essentially a hydrated silicate of magnesia and alumina, which, representing  $Al_2$  by  $al$ , will in the notation of Gerhardt be written,



The only mineral hitherto described which nearly resembles this in constitution, is chlorite, which belongs to the same type, and is represented by  $SiO^3(al\frac{1}{2}Mg\frac{1}{2}H\frac{1}{2})$ , the principal difference in chemical composition being in the proportion of water. The hardness and other physical characters of this mineral are, however, such as completely distinguish it from chlorite, and constitute it a new and distinct species, for which, to connect your name with the science, I beg to propose the name of *Loganite*.

#### MINERAL WATERS.

The mineral springs of the Province have continued to engage my attention, and during the past season I have examined the waters of several different localities. Apart from the value which these waters may have in a medicinal point of view, I have been incited in my examinations by the hope that a careful study of their composition, taken in connection with the nature of the different strata through which they rise, may lead to some generalizations which shall be of use to geologists. This is a line of inquiry which has not as yet been carried on systematically over a large extent of country, embracing a great variety of rock-formations, and the numerous mineral waters of this Province, existing under such varied conditions present a favorable field for the investigation. With this end in view, it has not in all cases been considered necessary to submit the waters of the different springs to quantitative analysis, although this has been done in very many instances. The analytical results obtained during the last year are here presented, reserving any general conclusions for a future occasion.

#### *Georgian Spring.*

The water of this spring, which is in the township of Plantagenet, was noticed in the last Report, and a qualitative analysis of it given, in which, by a mistake, the presence of a por-

tion of sulphates, which had been detected in the qualitative examination, was not indicated. The specimen of the water furnished me at that time, contained 11·84 parts of solid matter in 1000. In March last, the proprietor of the spring, Capt. Kains, sent me through Mr. Bowman, druggist, of this city, a cask containing several gallons of the water, which has enabled me to make of it a quantitative analysis. This water, probably, from the season in which it was collected, was less concentrated than the other. It had a specific gravity of 1008·78 and contained 10·98 parts of solid matter in 1000. 1000 parts of it gave—

|                                           |         |
|-------------------------------------------|---------|
| Chlorine, .....                           | 6·18600 |
| Bromine, .....                            | ·90250  |
| Iodine, .....                             | ·00157  |
| Sulphuric Acid, (SO <sup>2</sup> ), ..... | ·11333  |
| Soda, .....                               | 5·01580 |
| Potash, .....                             | ·06600  |
| Lime, .....                               | ·26880  |
| Magnesia, .....                           | ·48093  |
| Oxyd of iron, traces, .....               |         |
| Silica, .....                             | ·02050  |

These may be combined to give—

|                                                 |         |
|-------------------------------------------------|---------|
| Chloride of Sodium, .....                       | 9·46000 |
| “ of Potassium, .....                           | ·10400  |
| “ of Calcium, .....                             | ·04429  |
| “ of Magnesium, .....                           | ·49426  |
| Sulphate of Lime, .....                         | ·19292  |
| Bromid of Magnesium, .....                      | ·00288  |
| Iodid of Magnesium, .....                       | ·00172  |
| Carbonate of Lime, .....                        | ·29800  |
| “ of Magnesia, .....                            | ·36288  |
| Silica (and traces of Carbonate of iron), ..... | ·02050  |

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10·98145

### *Mineral Spring of Lanoraie.*

This spring is situated in the parish of St. Joseph of Lanoraie, on the Ruisseau St. Jean, a short distance to the west of the railway, and midway between the villages of Lanoraie and l'Industrie. The water rises through a bed of blue clay, and the supply is abundant; large quantities of carburetted hydrogen are evolved, and keep the fountain in constant agitation.

The water is transparent, and pleasantly but strongly saline to the taste ; it contains, besides the alkaline chlorids, those of calcium and magnesium, with bromids and iodids, and salts of the rare bases baryta and strontia ; these occur in part as chlorids, and in part as carbonates, which are thrown down on boiling together with a considerable amount of carbonates of lime and magnesia, and a trace of iron. These salts are held in solution as bicarbonates ; but there is no excess of carbonic acid in the water.

I visited the spring on the 15th of March last, and collected the water for the subjoined analysis ; the temperature of the water was then 42°, that of the air being 38° F. Its specific gravity was 1009·42.

1000 parts of it gave :

|                                   |         |
|-----------------------------------|---------|
| Chlorine.....                     | 7·20940 |
| Bromine.....                      | ·02460  |
| Iodine.....                       | ·00472  |
| Soda.....                         | 5·90660 |
| Potash.....                       | ·09200  |
| Lime.....                         | ·37520  |
| Magnesia.....                     | ·33840  |
| Baryta.....                       | ·03023  |
| Strontia.....                     | ·02160  |
| Silica, and a trace of iron,..... | ·05520  |

These ingredients may be combined so as to give the following salts for 1000 parts :

|                                                |         |
|------------------------------------------------|---------|
| Chlorid of Sodium.....                         | 11·1400 |
| “ of Potassium.....                            | ·1460   |
| “ of Calcium.....                              | ·2420   |
| “ of Magnesium.....                            | ·2790   |
| “ of Barium.....                               | ·0303   |
| “ of Strontium.....                            | ·0185   |
| Carbonate of Lime.....                         | ·4520   |
| “ of Magnesia.....                             | ·4622   |
| “ of Baryta.....                               | ·0106   |
| “ of Strontia.....                             | ·0137   |
| Bromid of Magnesium.....                       | ·0283   |
| Iodid of Magnesium.....                        | ·0052   |
| Silica, and a trace of Carbonate of iron,..... | ·0552   |

The amount of solid matter thus calculated, amounts to 12·883 parts in 1000, while direct experiment gave of a residue dried at 300° F. 12·800 parts; the water collected in the month of January previous gave 13·025 parts. The processes employed in analyses have been detailed in preceding Reports; the proportions of baryta and strontia in the precipitate of carbonates obtained by boiling the water, and in the soluble salts of the concentrated liquid, were separately determined like the other earthy bases; the amount of the salts of baryta and strontia is more considerable than in any other mineral water that I have yet examined.

### *Gillan's Spring.*

This interesting mineral spring is on the tenth lot of the second concession of Fitzroy upon the land of Mr. Francis Gillan. It rises through a stiff clay which here overlies the Trenton limestone. The spring discharges about 60 gallons in 24 hours. On the 24th of July the temperature of the water in the basin, which was seven feet deep and contained a large bulk of water, was 50° F. A cask of the water, which was brought to me by yourself, has been submitted to analysis.

The water of this spring is at once saline and alkaline to the taste; it has a specific gravity of 1006·24. By evaporation it deposits a considerable amount of earthy carbonates, and the liquid, which is strongly alkaline, yields prisms of carbonate of soda, mixed with cubes of common salt. It affords strong reactions of bromine and iodine, and when evaporated to dryness with the addition of acid, deposits a considerable amount of silica. A portion of silica is also thrown down in combination with the earthy bases, mixed with the carbonates, for on dissolving the matter precipitated by boiling, gelatinous silica separated, and when filtered from this and evaporated to dryness, a still farther amount of insoluble silica was obtained. A small portion of phosphates and traces of strontia, alumina, and iron were also detected in the precipitate, and a determinable quantity of phosphate of soda in the alkaline liquid. It was observed that a portion of the water evaporated to one-tenth, and filtered, became turbid when still farther concentrated, and deposited a flocculent precipitate,

which, by solution in hydrochloric acid, was found to consist of lime and magnesia, combined with a large proportion of silica ; 1000 parts of the water gave :—

|                                          |        |
|------------------------------------------|--------|
| Chlorine, .....                          | 4·0250 |
| Bromine, .....                           | ·0169  |
| Iodine, .....                            | ·0026  |
| Soda, .....                              | 3·7984 |
| Potash, .....                            | ·1160  |
| Lime, .....                              | ·0840  |
| Magnesia, .....                          | ·3806  |
| Phosphoric Acid, .....                   | ·0087  |
| Alumina, .....                           | ·0040  |
| Silica, .....                            | ·1330  |
| Oxyd of iron and Strontia, traces, ..... |        |

The phosphoric acid was determined by evaporating several litres of the water, with the addition of acid, precipitating the solution with a little perchlorid of iron and ammonia, and fusing the precipitate with silica and carbonate of soda in the usual manner. The amount of silica above given, was that obtained by directly evaporating the water to dryness with the addition of an acid, and the proportion of silica, combined with earthy bases, was determined by evaporating to a small bulk another portion of the water, and separating the silica of the insoluble portion ; it was equal to ·088 in 1000 parts, the entire amount being ·133. To estimate the amount of soda existing as carbonate, a litre of the water was evaporated to a very small bulk, and the filtered solution was mixed with one of chlorid of barium ; the precipitate of carbonate of baryta weighed 1·015 grammes ; in a second determination, the liquid was evaporated to dryness, before separating the earthy carbonates and silicates, and the amount of carbonate of baryta was 1·019 grammes. The mean of the two is 1·017, which, neglecting the phosphate, corresponds to ·5466 grammes of carbonate of soda. As a control upon this, the quantity of soda necessary to form chlorid, iodid, and bromid, was deducted from the amount of soda obtained, and there remained a quantity equal to ·5885 of carbonate of soda.

In calculating the combinations of these ingredients as they may be supposed to exist in the water, there are difficulties arising first, from the fact that a portion of the lime and mag-

nesia are separated as silicates of an unknown composition, and secondly, from the probable existence of a similar silicate of soda. If, however, we represent the whole of these bases as carbonates, and give the silica as separate and uncombined, we have the following composition for 1000 parts :—

|                                                    |         |
|----------------------------------------------------|---------|
| Chlorid of Sodium, .....                           | 6·53250 |
| “ of Potassium, .....                              | ·11600  |
| Bromid of Sodium, .....                            | ·02176  |
| Iodid of Sodium, .....                             | ·00323  |
| Phosphate of Soda, (PO <sup>5</sup> , 3NaO), ..... | ·01244  |
| Carbonate of Soda, .....                           | ·58850  |
| “ of Lime, .....                                   | ·15000  |
| “ of Magnesia, .....                               | ·78607  |
| “ of Iron and Strontia, traces,                    |         |
| Alumina, .....                                     | ·00400  |
| Silica, .....                                      | ·13300  |
|                                                    | 8·34750 |

The amount of solid matter, as directly determined by evaporation, was 8.200 ; the difference corresponds principally to the carbonic acid which is represented as combined with bases that really exist as silicates.

### *Mineral Water of Belœil.*

I have not visited this spring, but a small quantity of its water, in carefully corked bottles, was furnished me by the late Mr. Brault, of this city. It is alkaline and saline, resembling that of Gillan's spring ; the concentrated water contains a large amount of carbonate of soda, with chlorid and small portions of bromid and iodid of sodium ; there is besides a little soluble silicate. The precipitate, which forms on boiling, consists principally of carbonates of lime and magnesia ; when dissolved in hydrochloric acid, gelatinous silica separates on evaporation. The solution of the earthy chlorids filtered from the silica separated by evaporation to dryness, is not immediately rendered turbid by a solution of gypsum, but yields after a few minutes a precipitate of sulphate of strontian ; a small amount of carbonate of iron is also present.

One litre of the water evaporated to a small bulk, contained  $\cdot 064$  grammes of silica in solution, and the earthy precipitate afforded  $\cdot 050$  grammes, equal to  $\cdot 114$  grammes in all. The amount of alkaline carbonate was determined as in the preceding analysis by evaporating a portion to dryness and precipitating the dissolved and filtered residue by a solution of chlorid of barium; one half-litre gave  $\cdot 570$  of carbonate of baryta. In a second experiment, the solution filtered from the earthy residue after complete evaporation and resolution, was digested with the addition of carbonate of ammonia to decompose any alkaline silicate which might be present, but there was no separation of silica, and the evaporated mass gave  $\cdot 569$  of carbonate of baryta. The two precipitates were mixed and converted into sulphate and gave  $1\cdot 328$ , equal to  $\cdot 872$  of baryta; the same amount of pure carbonate should contain  $\cdot 8956$ , and the mean of these is  $\cdot 879$ , which corresponds to  $\cdot 6082$  of carbonate of soda. The amount of carbonate of soda calculated from the excess of sodium over the chlorine, was  $\cdot 5780$ . The proportions of bromine and iodine and of potassium, were not determined in this analysis. There were obtained from 1000 parts of the water.

|                                                 |         |
|-------------------------------------------------|---------|
| Chlorid of Sodium, with bromids and iodids..... | 5·9662  |
| Carbonate of Soda.....                          | ·6082   |
| Carbonate of Lime.....                          | ·1440   |
| “ of Magnesia.....                              | ·4756   |
| “ of Strontia.....                              | ·0250   |
| “ of Iron.....                                  | traces, |
| Silica.....                                     | ·1140   |

---

7·3330

The amount of solid matter determined by direct experiment was  $7\cdot 360$  parts in 1000. It would seem probable from the experiments detailed, that on complete evaporation, the entire amount of the silica is deposited with the earthy bases. This question is one of interest, and I propose at another time to pursue the inquiry.

*L'Original.*

A saline water, furnished me by Mr. Edward Langlois, of L'Original, was found to contain 6·4 parts of solid matter in 1000. It was composed of alkaline and earthy chlorids, with portions of bromids and iodids, besides carbonates of lime and magnesia, and traces of iron. The water contains no sulphates, and neither baryta nor strontia were detected.

*Bay St. Paul.*

At the Bay St. Paul I visited a very strong bitter saline spring, which yields by evaporation 20·68 parts of solid residue for 1000 parts of water. It contains besides alkaline chlorids, large quantities of chlorids of calcium and magnesium, with portions of bromids and iodids of these bases. No sulphates were detected, and but a small quantity of earthy carbonates was deposited on boiling; the water afforded traces of iron, but neither baryta nor strontia salts.

There are several sulphurous springs at Bay St. Paul, but the amount of sulphuretted hydrogen which they contain is not very considerable, and they are feeble as to saline ingredients. One near the mill was found to contain small amounts of alkaline and earthy chlorids, with traces of sulphates, and an insignificant quantity of earthy carbonates; neither bromine nor iodine were detected. Others upon the land of Mr. Thos. Poitvin, and of Mr. Tremblay, on the east side of the Gouffre, are still weaker in saline ingredients and but slightly sulphurous; they deposit films of calcareous matter along their channels.

*Les Eboulmens.*

At the foot of the hill, a little above the Pointe aux Eboulis, there are several sulphurous springs, most of which are very weak, but one of them is much stronger than those at Bay St. Paul, and was selected for examination; 1000 parts of it gave 70 of solid matter equal to 4·9 grains to the pound avoirdupois, consisting of earthy and alkaline chlorids, with traces of sulphates, and portions of carbonates of lime and magnesia; no bro-

mine or iodine was detected; 100 cubic inches of the recent water gave also .42 of a cubic inch of sulphuretted hydrogen gas.

Reserving for a future occasion some observations upon the probable geological relations of these various mineral springs, this Report is respectfully submitted.

I have the honor to be,

Sir,

Your most obedient servant,

T. S. HUNT,

RECEIVED,  
JUN 21 1907

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Gr  
HARVARD UNIVERSITY HERBARIUM.  
*Transferred from the Museum  
of Comparative Zoology.*

# GEOLOGICAL SURVEY

or

# CANADA.

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## REPORT OF PROGRESS

FOR THE YEAR, 1851-52.

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1852.

# GEOLOGICAL SURVEY OF CANADA.

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MONTREAL, 14th May, 1852.

SIR,

I have the honor to request that you will do me the favor to lay before his Excellency the Governor General, the accompanying Report of Progress made in the Geological Survey of the Province, during the year 1851-2.

I have the honor to be,

Sir,

Your most obedient servant,

W. E. LOGAN,

*Provincial Geologist.*

To the Hon. A. N. Morin,

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.

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*Montreal, 14th May, 1852.*

MAY IT PLEASE YOUR EXCELLENCY :

I have the honor of presenting to your Excellency the Report annually required, of the progress made in the Geological Survey of the Province. In doing so, I have to state that the district, of which the examination was last season assigned to my assistant, Mr. Murray, comprised the country lying between the Ottawa and the St. Lawrence, from the junction of these two rivers, to the neighborhood of Bytown on the one and Kingston on the other; and accompanying this, his Report on the district is transmitted to your Excellency. The labors of Mr. Hunt have been bestowed upon a continuation of his analyses of soils from both sections of the Province, as well as the investigation of various mineral waters and mineral substances, obtained in the examination of the rocks in different districts, and also of some of the rocks themselves, with a view of illustrating facts connected with their metamorphism. His Report on these subjects is now submitted to your Excellency.

Immediately after my return from the performance of the duties I had undertaken to discharge in England connected

with the Canadian mineral contribution to the Industrial Exhibition, my time was devoted to the investigation of the country lying between the Province line, in the county of Beauharnois, and the Rivière du Nord, in that of the Lake of Two Mountains. In the neighborhood of Beauharnois, my explorations were carried on in conjunction with Mr. Murray, and in the county of the Lake of Two Mountains by myself; and previous to the close of the season an opportunity was taken to visit the valley of the Chaudière, with a view of ascertaining facts connected with the gold washing on the Rivière du Loup, and to make an excursion to the Rivière Ouelle, to inspect a deposit which occurs there, holding nodules consisting of phosphate of lime.

The physical structure of the country between Beauharnois and the Rivière du Nord, is so connected with that of the district farther westward, which came more immediately under the notice of Mr. Murray, that a proper description of it must necessarily include the results of his examination. The same succession of formations spreads out under both parts, and they are in ascending order as follows:—

Metamorphic or Gneissoid group.

Potsdam sandstone.

Calciferous sandrock.

Chazy, Birdseye and Trenton limestones.

Utica. late.

The general mineral and fossil characters of these formations, in the area which came under my observation, do not differ materially from those which they possess in districts that have been noticed in previous Reports, nor from those in the district on the present occasion described by Mr. Murray. It is not necessary, therefore, that I should give all their features in detail, or do more than offer to your attention such peculiarities as may be additional to those heretofore mentioned; and these may be related in describing the geographical distribution of the formations.

The Potsdam sandstone formation, resting unconformably on the Metamorphic series (the latter consisting of gneiss and interstratified limestone) occupies a narrow strip on the north side of the St. Lawrence, below Montreal, at a variable dis-

tance of ten to twenty miles from the north bank, and sweeps round from the valley of this river to that of the Ottawa, the turn forming an obtuse angle on the Rivière du Nord. The same formation, in the same relation, proceeding from Keeseville in the State of New York, turns from the valley of Lake Champlain to that of the St. Lawrence, and, forming a sharper angle, is projected out across the county of Beauharnois towards the previously mentioned bend, in a long tongue of sandstone pierced near the extremity by Mont Calvaire, a protruding mass of the subjacent gneiss. From Beauharnois a broad belt of the sandstone has been traced in New York, by the geologists of that State, in a pretty straight line, at a variable distance from the bank of the St. Lawrence to Hammond, near which it reaches the river. It here crosses the river, and it will be perceived by Mr. Murray's Report, that he has traced it through the townships of Elizabethtown, Younge, Lansdowne, Bastard, and South and North Crosby. I am indebted to Dr. Wilson, of Perth, for pointing out to me, in the course of a previous season, its distribution through Burgess, Elmsley, Drummond and Beckwith, and to Mr. Dickson for facilitating the examination of its direction through Ramsay and Pakenham. It is subsequently seen in March and Nepean, and though the investigation of its course on the Ottawa is not yet complete, it has been met with in one spot tending to a junction by Grenville with the exposure on the Rivière du Nord.

The perimeter formed by the sandstone, or the gneiss beneath it, when the sandstone is wanting, gives the area within it the shape of a peninsula, the isthmus to which, between the Rivière du Nord and the border around Mont Calvaire, is about five miles across. Around the whole of this peninsular form the sandstone rests upon the gneissoid rocks, and it is followed by an interior zone of calcareo-arenaceous beds, bearing the fossils which characterise the Calciferous sandrock formation. Within this there is another zone consisting of limestone, corresponding in a considerable degree in its organic remains to the Chazy limestone, while the fossil contents of a large area in the centre correspond with those of the Birdseye, Black River and Trenton limestones; and surrounded by these, an area of Utica slate with its characteristic trilobites and graptolites,

extends from Bytown some distance eastward. This concentric geographic arrangement of the rocks, even without the dips, leaves little doubt that the organic rocks rest on one another in the form of a trough, reaching from North Crosby to Mont Calvaire in length, and from the Ottawa to the St. Lawrence or rather to the borders of the State of New York beyond it, in breadth, the whole superficies of which comprises about 10,000 square miles. Where the dips are appreciable they give a general confirmation of this structure, but they are for the most part small, and the strata over large areas have often to the eye the appearance of being quite flat.

This trough is divided longitudinally into two subordinate troughs, the anticlinal axis between which, striking in from the Lac des Chats, runs south of east, and parallel with Lake Chaudière, to the east corner of March, and thence turning more eastwardly keeps a course parallel with the Ottawa and comes upon Mont Calvaire. The anticlinal, in its effects, brings the Potsdam sandstone to the surface, through the succeeding formation, at Stony Swamp in Nepean, in the south part of West Gloucester and of East Hawkesbury, and it brings up an exposure of the still lower gneiss, south of the trap Mountain of Rigaud. It carries also from the main line of outcrop, at the extremities of the general trough, two projecting fingers of the Calciferous sandrock, which point at one another, the succeeding formations conforming round their extremities. The Utica slate appears to be wholly in the more northern and narrower trough; none of it was observed in the southern; but the southern trough is again subdivided into three shallow subordinate troughs, which, however, have little effect on the general configuration. The anticlinal forms which separate them, run nearly parallel to the previous one, and cause the Potsdam sandstone and subjacent gneiss to appear through the Calciferous sandrock; on the more northern axis, the exposures of these occur in the north-western part of Montague and North Elmsley and western part of Mountain; and on the more southern, in the southern part of Oxford and South Gower.

The eastern side of the Beauharnois tongue of sandstone is bounded by the same succession of formations, as that on the

western, as is proved by an examination of the sequent deposits on a line from Beauharnois to St. Louis Rapids, along the south side of Lake St. Louis. The sandstone of Beauharnois County, and the neighbouring State of New York, is from 300 to 700 feet thick. In the lower part it contains many beds of conglomerate with quartz pebbles; it has some red layers, but towards the top it becomes a fine grained hard white sandstone, and at the summit is interstratified with calcareous beds forming a passage to the rock which overlies it. In this part it is abundantly marked over considerable surfaces, by what the geologists of New York have called *Scolithus linearis*, which consists, when the rock is weathered, of straight vertical cylindrical holes of about the eighth of an inch in diameter, descending several inches into the stone; and when the rock is unweathered, of corresponding solid cylinders, composed apparently of grains of sand cemented by a slightly calcareous matrix, more or less tinged with peroxide of iron. The origin of these cylinders is not quite certain; some suppose them to be the remains of fucoids, others of corals, and they may be ancient worm-holes; but however impressed on the stone, they characterise the upper part of the formation very extensively.

With this part of the formation also are associated many indications of what have been considered fucoids or marine plants, and one form among others, in which they occur, presents a reticulating arrangement of stems spreading over some of the surfaces, the meshes of the net work being four, five or six sided, and sometimes when largest measuring fourteen inches in diameter, while the rope-like stems which divide them are an inch wide, standing out half an inch in relief on the sandstone. The mesh-like compartments are sometimes filled with shale, and the forms a good deal resemble crack-casts, and might be taken for such, were not similar forms sometimes traceable on splitting open closely fitting surfaces of sandstone, where no shale is present between; and were not smooth surfaces of an arenaceo-bituminous limestone in the succeeding formation met with, presenting thin black bituminous pellicles, arranged in similar reticulating figures both large and small.

In Lansdowne and Bastard, not only do scolithus and furoids exist in abundance in the upper part of the formation, but Mr. Murray has found associated with them *Lingula antiqua* characterising the rock, as this species does at Hammond in New York. No lingulæ came within my observation, but several surfaces were found impressed with the track and footsteps of an animal, which, from the interpretation given at a meeting of the Geological Society, by the distinguished comparative anatomist, Professor Owen, of the first specimen (a plaster cast of the original) placed before him, appeared destined to carry the vertebrated type of animal life back to a much more ancient date than had been supposed by most geologists.

The occurrence of the track near the mill on the St. Louis River at Beauharnois, had been pointed out to me by Mr. Abraham, then editor of the Montreal Gazette, who had introduced a notice of it in his Journal, in which he compared it to the track of a tortoise. Professor Owen's opinion tended to confirm this, but having lately submitted to him the original stone, as well as two additional original surfaces, and casts of a vast number of other impressions of the same order, discovered by Mr. Richardson, a very diligent and persevering explorer, who has been employed on the Survey for successive seasons, almost from its commencement, several of these gave much clearer evidence than the first specimen, and have induced Professor Owen to decide that the footsteps could not have been imprinted by any quadruped, and that analogies were most in favor of their resulting from some species of crustacean, but of a family wholly distinct from any thing that can be suggested by the crustacean forms of later rocks, or of the present day. The track and footsteps, when the specimens are most perfect, in general present a median groove more or less flat, and of different proportionate widths in different specimens, with a number of footprints on each side in answering pairs; certain sets or numbers of these answering pairs have homologous repetitions throughout the whole length of the track, as if they were the result of successive applications of the same impressing instruments, and the numbers of answering pairs in the homologues of different tracks are sometimes different, constituting something which may be con-

sidered analogous to difference of species. The homologues in different tracks appear to have sometimes seven and sometimes eight answering pairs of pits, and it is difficult to say whether the pits are to be taken as impressed by the extremities of so many legs, thus giving the animal fourteen legs in the one case, and sixteen in the other, or whether some of the impressing points are to be grouped in twos or threes, making some of the legs bifid or trifid, and thus diminishing their number, as Professor Owen is inclined to suppose. The impressions are generally of such a nature as to negative the supposition of the impressing instruments being of a padded character, and the depth and trenchant sharpness of the markings in the bottom of some would seem to be the effect of hard horny points. The median groove in most of the tracks is so uniformly in the middle between the footprints, as to favor the supposition that it may be occasioned by the effect of an immoveable breastplate or plastron, but in one remarkable instance, at a bend in the track, the groove gradually leaves the middle, and while it seems impressed with more than usual force, approaches and partially obliterates the footprints on the convex side, as if the impressing part had been the extremity of a tail, which, when the body turned to one side, interfered with the footprints in the rear, on the other. A feature common to all the grooves is, that each repetition or homologue of the footprints is accompanied with a deepening and shallowing of the groove, giving it the appearance of a chain of shallow troughs, which, when the impression is light, are separated from one another by intervals of the ungrooved surface. The groove is often but faintly indicated, and occasionally it is not perceptible; and frequently it happens when this occurs, that the footprints are stronger and deeper than when the groove is more conspicuously impressed. In some of the tracks, while the groove is straight, the exterior limits of the footprints offer a congeries of segments of a circle, convex on the outside, but those on opposite sides of the groove alternate, the segment on the one side, starting from the middle of the segment on the other, and giving to the whole series of footprints in the track a serpentine course, as if the animal had waddled in its gait. In one of the tracks there are three nar-

row grooves instead of footprints on each side of the main one, for a certain distance, as if the limbs of the animal had been dragged along the bottom, while the body was afloat. In conformity with these various differences in the tracks, Professor Owen has given separate specific provisional names to several of them, not for the purpose of indicating a positive specific difference in the animals which have impressed them, but for the convenience of reference. The generic term for the whole is *Protichnites*, and the specific names are, *P. septemnotatus*, *P. octonotatus*, *P. multinotatus*, *P. alternans*, *P. lineatus*. .

The surfaces on which the tracks of these animals are impressed, are sometimes smooth and sometimes beautifully ripple-marked. On the ripple-marked surfaces the tracks have often beat down the ripple, and the sand of the ridge has been dragged into the furrow, in such a way as to show the direction in which the animal was progressing.

The most abundant locality of these tracts was on the field of Mr. Hénault, about half a mile westward from that near the mill. There are here four exposed areas in the space of four chains. The first shows ten tracks, running in different directions and sometimes intersecting one another; they vary in breadth from four inches and a-quarter to five inches and a-half, and, added to one another, measure 108 feet in length; the second displays eleven tracks of five to six inches wide, and measuring about 108 feet; the third shows five tracks of from four to six inches wide and altogether sixty-one feet long; the fourth, five tracks from three-quarters of an inch to five and a-half inches wide, and giving an aggregate length of eighteen feet; and another area in the next field has ten tracks of four to six and a-half inches wide, with a total length of fifty-six feet.

The following is a section of the beds, as they succeed one another in descending order in the vicinity, the whole of them being fine grained.

|                                                                                                                                                                           | ft. in. |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| White sandstone, hard and compactly granular, with indications of closely soldered elementary layers.....                                                                 | 5 0     |
| White sandstone as above.....                                                                                                                                             | 1 0     |
| White sandstone with small ferruginous spots and indistinct traces of <i>Scolithus linearis</i> at the top; the joints in the rock are stained with peroxide of iron..... | 2 0     |

|                                                                                                                                                                                                                                                                                                                                                          |    |                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-------------------|
| White sandstone, even-bedded, and splitting into rectangular blocks, fit for building purposes.....                                                                                                                                                                                                                                                      | 1  | 6                 |
| White sandstone with very regular cleavage and bedding, fit for building, and glass-making; there are ripple-mark and reticulating fucoids on the top.....                                                                                                                                                                                               | 1  | 3                 |
| White sandstone with a smooth surface .....                                                                                                                                                                                                                                                                                                              | 0  | 7                 |
| White sandstone with ripple-mark and tracks.....                                                                                                                                                                                                                                                                                                         | 0  | 5                 |
| White sandstone with ripple-mark.....                                                                                                                                                                                                                                                                                                                    | 0  | 2                 |
| White sandstone with a smooth surface and tracks.....                                                                                                                                                                                                                                                                                                    | 0  | 2                 |
|                                                                                                                                                                                                                                                                                                                                                          | —  | 0 1 $\frac{1}{8}$ |
| White sandstone; this bed is made up of beautifully regular parallel layers of two to four inches, closely soldered together, but distinctly marked by very slight differences of color; the joints are remarkably regular and the bed would yield excellent material for glass-making and building, and perhaps for flagging.....                       | 3  | 0                 |
| White sandstone with broad ripple-mark on the top, measuring eight to ten inches from ripple-ridge to ripple-ridge.                                                                                                                                                                                                                                      | 4  | 0                 |
| Light grey limestone in patches running into sandstone, and displaying abundance of <i>Scolithus linearis</i> .....                                                                                                                                                                                                                                      | 0  | 4                 |
| White sandstone .....                                                                                                                                                                                                                                                                                                                                    | 5  | 4                 |
| White sandstone slightly calcareous, with a thin more siliceous bed at the top, varnished over with iron stain and marked by <i>Scolithus</i> .....                                                                                                                                                                                                      | 4  | 11                |
| White sandstone marked on the top with <i>Scolithus</i> .....                                                                                                                                                                                                                                                                                            | 1  | 1                 |
| White slightly calcareous sandstone with ripple-mark and <i>Scolithus</i> .....                                                                                                                                                                                                                                                                          | 1  | 6                 |
| White less calcareous sandstone with <i>Scolithus</i> .....                                                                                                                                                                                                                                                                                              | 0  | 6                 |
| White calcareous sandstone; the calcareous matter increases in patches, and the rock wears unequally.....                                                                                                                                                                                                                                                | 2  | 0                 |
| White slightly calcareous sandstone with <i>Scolithus</i> , prevailing in a few inches at the top.....                                                                                                                                                                                                                                                   | 2  | 2                 |
| White slightly calcareous sandstone with a <i>Scolithus</i> bed at the top .....                                                                                                                                                                                                                                                                         | 2  | 1                 |
| White slightly calcareous sandstone; <i>Scolithus</i> at the top...                                                                                                                                                                                                                                                                                      | 0  | 6                 |
| White sandstone with a <i>Scolithus</i> bed at the top holding calcareous patches .....                                                                                                                                                                                                                                                                  | 2  | 6                 |
| White sandstone with calcareous indications and a <i>Scolithus</i> bed at the top.....                                                                                                                                                                                                                                                                   | 2  | 6                 |
| Concealed .....                                                                                                                                                                                                                                                                                                                                          | 10 | 0                 |
| Greyish calcareous sandstone, with two bands of limestone pebbles towards the middle; the top and bottom surfaces of the bed are figured with large reticulating fucoids; some of the meshes of the network are fourteen inches in diameter, and the stems one and a-half to two inches wide; the forms of the meshes are sometimes four, sometimes five |    |                   |

and sometimes six sided; the part included within the mesh is filled with clay or rather a crumbling dark green shale, giving a brownish streak; when the shale is removed, the stems stand out in relief to the height of half an inch; geodes or nodules of reddish calc-spar occur in the bed sparingly disseminated .....

2 0

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 55 3
 

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The ripple-marks, which occur on surfaces so close in succession among the track-beds, run in a different direction on each surface, as if they had been caused not by a current in deep water, running in one general direction, but by a tide ebbing and flowing, and obeying the influence of varying local accidental causes. On one surface was observed the natural edge or termination of the ripple-ridges, with a track coming up to it and there ceasing, as if the wave had reached no farther, and one part of the surface had been dry while the water, operating on another close by, had obliterated the track in producing the ripple-mark.

Proceeding eastward from the exposure in Hénault's field to the tracks on St. Louis River, the sandstone marked by *Scolithus* can be followed along the shore for about a mile, and is very nearly flat. There is then an interval of about a mile without any exposure, beyond which the Calciferous sandrock first makes its appearance. Thin interstratified bands, more arenaceous than others, are still characterised by *Scolithus*, and the more massive beds hold abundance of two species of *Maclurea*, *M. matutina* of Hall, and a new and unfigured species. The strata are nearly flat, and seen at intervals, continue so for about six miles to the bridge over the Chateauguay River, in the first two of which the same two species of *Maclurea* are met with in several exposures, while the lithological character of the rock varies little the whole way. An exposure near the bridge displays *Pleurotomaria rotuloides* of Hall. In good limestone beds three miles farther east, and in the Caughnawaga quarries two miles beyond, the chief fossils are *Atrypa plena* and *Orthis pectinella*, and the beds appear to belong to the Chazy formation; while four miles farther, at the Sault St Louis, nine species

of Trenton fossils are met with. They are:—*Leptena sericia*, *L. deltoidea*, *Orthis testudinaria*, *Lingula quadrata*, *Murchisonia bicincta*, *Glyptocrinus decadactylus*, *Echincrinites anatiformis*, *Calymene senaria*, *Isotelus gigas*, besides the genera *Stromatopora*, *Orthoceras* and an unfigured species of *Encrineurus*. Beyond this again, the Utica slate appears below the St. Louis Rapids, and crossing the St. Lawrence can be traced along the shore of the island of Montreal to the city, displaying *Triarthrus Beckii* and *Graptolithus bicornis* in many places.

Passing westward from the track-bed at Beauharnois village, the Potsdam sandstone can be traced along the margin of Lake St. Louis two and a-half miles to the mouth of the Beauharnois Canal, and by a careful admeasurement of the distance and of the minute changes that occur in the very moderate dips prevailing, it can be determined that a surface shewing two tracks, in a field about a quarter of a mile from the margin of the lake, and on the north side of the road, is in about the same stratigraphical place with Hénault's beds, while geographically their positions are equivalent in relation to the Calciferous sandrock, which on each side bounds the more silicious formation. Proceeding from the position of this exposure, the more silicious sandstone can be followed with little interruption for a distance of three miles up the St. Lawrence, where it becomes interstratified with calcareo-arenaceous layers; but at St. Timothy, three miles farther, sandstone beds holding *Scolithus* are still met with, and *Raphistoma* occurs in the calciferous ones. For between four and five miles farther up the river, the strata are concealed by drift, until reaching Grande Isle, where quarries expose good limestone beds, resting horizontally on others of an arenaceous character, and containing *Raphistoma*, (two species,) *Murchisonia*, *Euomphalus* and *Cythere*, all unfigured; and at the head of the Beauharnois Canal, near Lake St. Francis, three miles still further up, besides *Raphistoma* there is a *Phacops* allied to *Downingii*, and *Isotelus gigas*.

This general line of section from Lake St. Francis to Saut St. Louis and the general configuration and relations of the tongue of sandstone projected across Beauharnois and extending to Mont Calvaire, shew that it has a flat anticlinal form. In

agreement with this structure, another track-bed locality mentioned by Mr. Murray, is met with in the vicinity of the Pointe du Grand Detroit, in Vaudreuil, and a bed of red sandstone occurring not far from it, probably occupies a lower stratigraphical position. This locality is about twelve miles from that near the mouth of the Beauharnois Canal; both are on the western side of the axis of the anticlinal. Another locality in which the same track-beds are met with, is on one of the Islands of St. Geneviève, between two and three miles east of St. Anne, at the upper end of the Island of Montreal. This spot is about seven miles from the exposures at Beauharnois village, and with them is on the east side of the anticlinal axis. If a line be followed obliquely across the anticlinal from the Canal track-bed to that of St. Geneviève Island, and pursued to the White Horse Rapid, between the Islands of Montreal and Jesus, a little below Isle Bizard, coarse sandstones would come from beneath the Canal track-bed about a mile out in St. Louis Lake. They are represented by the sandstones and conglomerates of Cascades Point and Cascades Island close by it, of which they would lie in the strike. A thickness of sixty-five feet of these coarser strata can be made out at the Point, and they are probably as much below the track-bed. The traverse line would cross Isle Perrot, which is all underlaid by nearly flat sandstone, and on reaching the track-bed of the St. Geneviève Island, not a mile on the north side of Perrot, we again find the rock marked by *Scolithus*, with which it is in some parts completely honey-combed to the depth of three feet, while it is also interstratified with irregular calciferous bands. St. Anne Point may be considered in the strike of the St. Geneviève Island, and here we still find the sandstone marked by *Scolithus*, while in Isle Perrot opposite, thin bands of red sandstone occur, similar to those of Pointe du Grand Detroit, and unworn fragments of the same are met with along the Montreal shore, beyond St. Anne. Proceeding from this towards Isle Bizard, we find immediately behind the village, the outcrop of the Calciferous sandrock, holding geodes of calc-spar, and in a quarry which has been resorted to for building stones, we meet with a *Murchisonia* like *gracilis*, but flat in the whorls, a *Pleurotomaria* like *subconica* but more depressed, *Cythere* the same as

that of Grande Isle, and *Orthoceras*. Farther on the road, about half a mile, an unfigured species of *Raphistoma* occurs in calcareo-arenaceous beds, which with their geodes of calc-spar are met in several places beyond. We then in a low escarpment come upon a rock composed almost entirely of *Atrypa plena*, a species characterising the Chazy limestone. The rock usually affords good building stone as well as stone for lime-burning, and it has been a good deal quarried at the village of St. Geneviève, just opposite the mid-length of Isle Bizard. The White Horse Rapid is situated about three miles to the east, and here on both sides of the Rivière des Prairies (a branch of the Ottawa,) black limestone beds, lying in the form of a shallow trough, and displaying fifteen species of Trenton fossils and one of Chazy, are surmounted by black bituminous shales holding *Triarthrus Beckii* and *Graptolithus bicornis* of the Utica slate.

The Trenton limestone of this part is no doubt connected with that of Lachine, about three miles from which village on the road to St. Anne, fourteen Trenton species have been met with, while in the quarries of Pointe Claire, six miles nearer St. Anne, we get three species characterising the Trenton, five of the Birdseye limestone, and one of the Chazy. The fossils are :—

|                                       |           |
|---------------------------------------|-----------|
| <i>Stictopora acuta</i> .....         | Trenton.  |
| <i>Leptena alternistriata</i> .....   | “         |
| ——— <i>alternata</i> .....            | “         |
| <i>Pleurotomaria umbilicata</i> ..... | Birdseye. |
| <i>Murchisonia perangulata</i> .....  | “         |
| <i>Modiolopsis obtusa</i> .....       | “         |
| <i>Favosites alveolaris</i> .....     | “         |
| <i>Phytopsis cellulosa</i> .....      | “         |
| <i>Atrypa plena</i> .....             | Chazy.    |

In the chief part of the district which came under my observation, the dip of the strata is so small that it is scarcely appreciable; the most gentle undulations completely disarrange any attempt to ascertain the thickness of accumulated strata by means of the slope, and it is only by geographical distribution and the evidences of fossils, that the structure can be made out. In a section measured on the Rivière du Nord, however,

the evidence of the dip and of the fossils came in aid of one another to prove the superposition in the lower part of the series. On the Rivière du Nord, not far above Lachute Mills, where the Potsdam sandstone makes its obtuse turn from the valley of the St. Lawrence to that of the Ottawa, the dip of the fossiliferous strata is south, at an angle of about four degrees; and we have first the contorted gneissoid rocks and their interstratified limestones, constituting a hilly country to the north; then the sandstone, not seen in actual contact with the gneiss, but forming an escarpment of between thirty and forty feet in height, between which and the gneiss there is a flat sandy valley, varying in breadth from a quarter to a-half a mile, in which the stream winds its course. The sandstone has been traced thirteen miles consecutively to the eastward, and is known much farther, and where the section was measured a track-bed occurs at the top of the escarpment, at a height of probably 250 feet over the gneiss, where the latter would be vertically beneath it. South of the out-crop of the track-bed, about 330 yards across a flat horizontal surface, another escarpment rises to the height of seventy feet. The white sandstone perforated with *Scolithus* is seen at the base, interstratifying calcareo-arenaceous beds for about twenty-five feet up, and then calcareo-arenaceous beds, holding geodes of calc-spar, compose the remainder of the rise. About 300 yards farther, after a very gentle slope, there is another smaller step composed of the same description of calcareous sandstones, and from this a level surface of about a quarter of a mile broad, in which similar strata are seen once, reaches a small rise of five feet, composed of an arenaceous limestone which is quarried for burning. In the quarry occurs *Ophileta levata* of Vanuxem (a Calciferous sandrock species,) and *Raphistoma*, the same as that of St. Anne; and the general dip in the section is such as to place the track-bed about 160 feet beneath the limestone.

Farther south, this section is covered up by sandy drift for several miles, but if we go about five or six miles to the westward, and, again starting from the gneiss, take a course at a right angle to the strike, three and a-half miles will bring us to a two-foot bed of good limestone, the out-crop of which, from its having been quarried for lime-burning in several places, has

been followed from Carillon to Grenville, thirteen miles. The dip of this bed, from its out-crop to the Ottawa (two miles,) is about seventy-five feet in a mile. That it overlies all the beds of the previous section is not considered uncertain; from the paucity of exposures, however, between it and the gneiss and the increased dip near the gneiss, it is not easy to state how much. It may be at least 150 feet, for there are seen in some of the exposed sections on the Ottawa, very nearly 100 feet of under-lying calcareous claystone, which, all weathering more or less yellow or brown, are in some parts bituminous and in others arenaceous, often presenting in the latter case geodes of calc-spar and heavy-spar, and none of these beds appeared in the Rivière du Nord section. Immediately beneath the two-foot bed of limestone there is a singular and extensively spread concretionary layer, in some large exposures of which, surfaces of half an acre shew the concretions, consisting of concentric layers, cut in half and closely packed together, some of them being two or three feet in diameter. The limestone bed is fossiliferous, and displays *Maclurea sordida*, *Pleurotomaria nodulosa*, *Raphistoma*, two species of *Murchisonia*, one of them a variety of *bicincta*, an *Atrypa* allied to *extans*, *Turbo*, *Orthoceras*, *Modiola*, *Cythere* in abundance, the same as that of Grande Isle, and a new species of *Paradoxides*; and at a short distance above the bed, there are about fifty feet of sandstone interstratified with green shale, holding a vast collection of fucoids, of which a bilobated species is most conspicuous. Some of the sandstone beds are porous and moderately fine grained, and yield good fire stones, while others are coarse and in addition to quartz pebbles, hold a multitude of phosphatic nodules mingled with small fragments of what appears to be a *Lingula*. At Grenville these beds have been most exposed by the cutting of the canal; they are found to cross the Ottawa to Hamiltonville in Hawkesbury, where they extend half a mile back from the River; and half a mile beyond them, a low escarpment in the rear of the first concession, presents the base of the Chazy limestone, composed, as in the St. Anne section, almost entirely of *Atrypa plena*. In this rock also small phosphatic nodules exist in some abundance, a few of which hold small fragments of shells.

Specimens of a conglomerate bed brought from the Allumette Falls, higher on the Ottawa, on a previous exploration, have also since been found to hold phosphatic nodules in abundance, some of them two inches long by half an inch in diameter. The conglomerate probably occupies the same stratigraphical position as the Grenville beds, but at the Allumette Falls, it rests upon the gneiss. Great numbers of one large species of *Lingula*, very like *parallela* of Phillips, and a few of *Pleurotomaria* or *Holopea*, occur in the nodules; every one of the lingulas is embedded in a coating of the phosphate of lime, and in one instance, a fragment of a lingula was found lying across the length of the nodule. The pleurotomarias are phosphatic casts of the interior of the shells.

I may here mention also, that much higher in the Lower Silurian series of strata, in fact, just above the Hudson River Group, but considerably removed from this locality, phosphatic nodules occur in great abundance; one of them was obtained at Rivière Ouelle, on the south side of the St. Lawrence, seventy-five miles below Quebec, whence the conglomerate limestones and sandstones, in which the nodules are imbedded, are traceable to Point Levi, opposite the city; the specimen so much resembles a fragment of cylindrical bone in appearance and chemical composition, that it was sliced for microscopical examination, in the full expectation that it would shew bony structure, but this being wanting, the specimen suggests the enquiry whether, confined in its stony mould, any chemical action might have been exerted to obliterate its original structure without destroying its form.

Mr. Hunt has given the analysis of these phosphatic nodules in his Report, by which it will be perceived that they yield from thirty-six to sixty-seven per cent. of phosphate of lime, and that they all, on being heated, give out ammonia and an animal odor like that of burnt horn.

#### ECONOMIC MATERIALS.

The materials capable of industrial application, which have come under my observation in connection with the investigations of the season, are magnetic iron ore, gold, iron ochre, stone and sand fit for glass-making, phosphate of lime, fire

stones, clay for common bricks and common pottery, with building and paving materials, and hydraulic limestone.

**Magnetic Iron Ore.**—This ore of iron was seen on the thirteenth lot of the fourth range of Grenville, the property of Mr. Eaton. It appears on the west side of the lot and about five acres from the front, in a mass of gneiss, the stratification of which runs with the ore and dips W. N. W.  $<56^{\circ}$ . At the base of the cliff in which it is seen, the seam of ore is four inches thick, but rising about fifteen feet to the summit, it increases to one foot, and it remained one foot as far as it could be traced on the summit, which was about twenty yards. In front of the cliff there runs a powerful dyke apparently of greenstone, much of which is fine grained and black. The course of the dyke appeared to be at right angles to the ore or nearly so, and therefore must be about W. S. W. and E. N. E. On the face of the hill, between the gneiss and the main road along the Ottawa, and about half a mile from the gneiss, white crystalline limestone prevails holding graphite, mica, serpentine, chondrodite, and a honey-yellow mineral resembling the chondrodite in color and the size of its grains, but more like the serpentine in its degree of hardness.

**Gold.**—No further examination was last season made in the distribution of the auriferous drift on the south-east side of the mountain range of the Eastern Townships, but the Government having granted a letter of license to Mr. Richard Oatey, giving him permission to collect the metal over a strip of five miles on the Rivers Chaudière and du Loup, at their junction, with a breadth of a quarter of a mile on each side, and a number of men having been employed by him, *streaming* for it during several months of the summer and autumn, an opportunity was taken to visit the locality, with a view of obtaining facts to form some estimate of the quantity the deposit might produce.

The working had been confined to a spot in the bed of the Rivière du Loup, about ten acres from its junction with the Chaudière. The stream is here about forty or fifty yards wide, and, like the rest of the country for a considerable breadth in this part, it is underlaid by clay slates, interstratified with occasional beds of more or less calcareous sandstone, varying in thick-

ness from a few inches to a foot. The slates at the spot cleave in the direction of the bedding, and the dip is about S. S. E. with a slope of sixty to seventy degrees. The ravine in which the river runs is in general narrow and deep, with some few open spaces, and the immediate banks often constitute precipices of 100 to 150 feet. At the spot chosen for working, the higher banks recede a little as they turn towards those of the Chaudière, and a flat extends between them and the edge of the stream. The chief part of the work had been limited to a space in the bed of the stream, extending from the left bank to a distance of about twenty yards towards the middle, with a length of about a hundred and twenty yards along it. Here the slates crossed the channel obliquely, and the river-drift was accumulated upon the uneven surface formed by them, to various degrees of depth. In some parts the rock was bare, and in others covered to the depth of a few inches, and in no part did the deposit exceed three feet, the average being about two feet. The whole of this loose material was removed, particular care being taken to scrape it from all crevices and deep holes; but of the rock itself, in the cleavage joints of which scales of the metal sometimes descend two or three feet, little more than one fifth had been taken from its place, and none of it during my presence, an intention being entertained, as I understood, to work the top of the slate when a convenient quantity of it had been cleared. The detritus consisted largely of coarse material, with which sand and clay were mixed in various proportions in different parts. Many vast boulders lay on the rock, or protruded from among the detritus, which were too heavy to be removed; smaller ones were still large enough to be removed with difficulty, and others of all sizes occurring among the drift, when they were seven to eight pounds in weight, the finer material being shaken from them, were thrown aside; but all of a smaller size were left in the detritus to be washed with it. As shewn after washing, the coarser material consisted chiefly of pebbles and fragments of slate and sandstone exactly resembling those on which the gravel rested; many, both ragged and rounded, consisted of white quartz, such as composes veins that are met with in the clay slates, and in the more

talcoſe ſlates of the mountain range to the north ; not a few were of ſerpentine, and ſome were of red ſlate, and of the peculiar mixture of epidote and jasper, deſcribed in a former Report as exiſting on the Rivière des Plantes in St. Joſeph Seigniory, and other places ; while many were identical with the various other kinds of rock, ſuch as corneous quartz, talcoſe quartz rock, and diallage rock, alſo deſcribed as preſent in the mountain range ; ſeveral were of a fine quartzoſe conglomerate, ſimilar to beds which occur north of the ſerpentine of Vaudreuil Beauce ; ſome few of gneiß ſimilar to that met with to the north of the St. Lawrence. Of the heavier component parts of the detritus, pebbles of magnetic iron occurred of twenty-five pounds weight, chromic iron of one to two pounds, and iron pyrites of four pounds ; and of theſe in ſmaller pebbles and in grains, with titaniferous iron and rutil of the like ſmaller ſizes, there was a conſiderable quantity, though I cannot pretend to eſtimate the per centage. Among the fine materials that could be examined after the waſhing, (the fineſt of all, ſuch as the clay, having been carried away down the ſtream by the water,) ſilicious ſand was in the greateſt abundance, and among the heavier fine materials could be ſeen a conſiderable amount of very ſmall red, pink, and lighter colored grains, which, in ſo far as their nature could be determined under microſcopic examination, were chiefly garnets, a few of them zircons, and ſome were ſuppoſed to be ſpinels.

In waſhing the detritus, the Corniſh *tye* was uſed, which conſiſts of a rectangular box about twelve feet long, two feet broad, and eight to ten inches high, open above, and ſupplied a few inches from the upper end with a diſiſion forming a well for the contrivance of a ſmall ſide ſluice to let off the ſtream of water when neceſſary ; and at the other with a groove in which could be let down a number of ſucceſſive ſtops, required as the box filled with the material operated on, to keep the ſurface of it an even inclined plane. The box being placed at a proper ſlope, with a proper platform of plank alongſide of it even with the top, a gutter made to convey the water to the upper end from the main run, and the water let on and allowed to fall over from the well into the box, a man with a

shovel supplied the upper end with the gravel and other materials, which were brought from the excavations and laid down on the platform near him by two others. The water acting on the gravel, which was slightly adjusted with the shovel to loosen it and give an even surface, carried away the lighter particles, while another workman, behind the first, assisted the progress of the larger washed pebbles by the light and rapid movement of a rake, by this means also keeping an even inclined surface on the accumulating material in the box, and thereby preventing unequal action of the water. The box being filled by this procedure, some nine or ten feet of the lower part of the contents called the *tail*, were thrown out of the box as of no more use; the remaining two or three feet were divided into two parts of a foot or eighteen inches each; the lower one, or the *second crop*, was added to the pile coming from the excavations, and the upper or *first crop* was made a separate pile of. When, by repeating the operation many times, a sufficient pile was made of the first crop, this was washed over by itself in the same way; the tail was thrown away, the second crop put with the first crop of the first *running* or washing, and the first crop of the second running again piled separately; these first crops of the second running were again washed separately, the tails thrown away, and the second crops added to the first crop pile of the second running, and the first crop placed by itself to be the subject of a different operation. This was washing it on what is called a *copper bottom*. The copper bottom consists of a small two-eared or handled tub about fifteen inches in diameter, and six inches deep, the bottom of which is a finely perforated sheet of copper with the burr inside, the holes being sufficiently large to allow the point of a pin to go through, but not the head. The pile of the crops from the third running being by portions placed in this tub or sieve, the sieve is forced down into water held in a *keeve* or large tub or species of vat; in this it is by a jerking motion raised and depressed, and turned partially round; the water driving up through the holes of the sieve has a tendency to push up the material lying on the bottom, the lightest the farthest up, and the jerking movement assists this. The gold being the heaviest substance, soon gets to the bottom, and

whatever is lightest to the top ; the top is every now and then scraped off and thrown aside, to be sent to the tye, and more stuff is added to that in the sieve, and the operation continued until all the material from the third running is exhausted, or it becomes necessary to empty the sieve. The reduced material taken from the sieve, among which the gold is now very perceptible, is subsequently placed on a shovel and *vanned* or separated by means of a little water, and a peculiar motion given to the shovel, which only a person dextrous from long practice knows how to wield. Through the small holes of the copper bottom a large quantity of fine black iron sand escapes into the vat or keeve, over which the instrument is used, and a quantity of fine gold escapes with it, which would have to be subsequently separated by some other process.

The whole quantity of gold obtained during the season was about 1900 penny-weights, and fifteen men were employed in the work, but it is not easy to state the exact time devoted to streaming. The full period of work was five months ; but a considerable deduction must be made for accidents. The whole gang was for some time employed in constructing a dam, which, when it was nearly complete, was carried away by a freshet, and many difficulties were experienced when the river was lowest, (which should have been the best period for working,) through the want of a proper supply of water at the height required to keep the tyes in full action. Something is to be allowed for broken time occasioned by rainy days, and much more for all those difficulties which are unavoidable in starting a new work in a new place, where a knowledge of the natural local impediments is only to be gained by experience, and none of those conveniences exist, which rise up only after operations have been carried on regularly for some time.

My visit lasted a week, during one day of which a heavy fall of rain prevented work ; but for the remainder of the time a regular account was kept by me of the gold collected and the wages paid. The quantity of gold amounted to  $1431\frac{1}{4}$  penny-weights, the price of which, stated to me subsequently by dealers in London, to whom a sample was submitted, was £3 10s. 6d. sterling per ounce, or about four shillings and fourpence currency per penny-weight. This would give a total value of

£31 3s. ; the wages paid were £15, leaving a margin for profit of £16 3s., by which it would appear that the deposit was yielding about double wages.

Resulting from the season's work on the Rivière du Loup there was about a ton of fine black iron-sand in the keeve or vat, over which the copper bottom was used. The unseparated quantity of gold in this after repeated trials, was ascertained to be 1.77 grains per pound avoirdupois ; this would give  $165\frac{3}{10}$  penny-weights to the ton, the gross value of which would be about £36. From among a few ounces of fine gold obtained from the sand, there were collected some small grains both of platinum and iridosmine, the value of the former being below, and of the latter double that of gold ; almost all of this fine gold was at first of so white a color that it was considered probable the circumstance might be owing to the presence of a very large proportion of silver ; some of the larger pieces also obtained from the copper bottom were spotted white from the same supposed cause ; but Mr. Hunt, on heating this white gold, found that it quickly turned to a good golden yellow, and that the discoloration was occasioned by a thin coating of mercurial amalgam. As the spots were perceived on some of the larger pieces immediately on their being first obtained by vanning on the shovel, it is supposed they must have been spotted with the mercury while still undisturbed in the drift ; and as no mercury had been used on the ground, it leads to the supposition that some ore of mercury may possibly be one of the mineral products of the country, though not a grain of cinnabar, the commonest form of the ores of mercury, has been observed in the gravel. Among the substances obtained in separating the gold, lead shot of various sizes, from partridge to swan shot, has been nearly as abundant as the gold. Not a vanning was made of the concentrated material without obtaining some of it ; its presence is no doubt due to the operations of those who have followed the chase, and to judge from the quantity of the shot the place must have been one of favorite resort. Whether the hunters may at any time have brought quicksilver with them and spilt it, is a question that cannot be determined.

It is impossible to say, without more widely distributed effective trials, whether this place is better or worse than others

in regard to the quantity of gold. Several *prospectors*, as they are called, both Canadian and American, traversed the country during the season, but I have not heard of any that paid their expenses, though of many that met with the precious metal. Their modes of washing, however, were of the rudest description, and were scarcely continued long enough and with sufficient regularity in any one place, to give fair results; but it appears evident that what is known of the deposit is sufficient to authorise the opinion that it will not in general remunerate *unskilled* labor, and that agriculturalists and others, engaged in the ordinary occupations of the country, would only lose their time by turning gold hunters.

Some regular work has been tried on the Touffe des Pins, in the Seigniory of Vauthreuil Beauce, but I am not aware of the quantity of gold obtained or the cost paid. I have, however, seen many pieces of the metal from the locality, and it appears to me there are a greater number of large pieces procured there than on the Rivière du Loup; the largest I have seen from the Touffe des Pins wants two penny-weights of four ounces. The largest piece obtained on the Rivière du Loup weighed under two ounces.

*Iron Ochre.*—Small patches of reddish-yellow iron ochre were met with on the thirty-fifth or thirty-sixth lot of the first concession of Hemmingford, by the margin of one of the small ponds which occupy the deep ravine called the Gulf or the Devil's Hole, in the Potsdam sandstone formation on the summit of Covey Hill or Hemmingford Mountain. The locality is close upon the Province line, and the deposit occurs in scattered patches of ten yards square and not over a couple of inches thick. The deposit, therefore, does not appear to be an important one, but the inhabitants of the vicinity resort to it for material to color the walls of their houses.

*Sandstone fit for Glass-making.*—From the proximity of the excellent sandstone fitted for glass-making, which is obtained from the bank of the Viviri above the Pointe du Grand Detroit, and has been practically applied at the glass manufactory in Vaudreuil, the same material may be looked for in a great many parts of the tongue of sandstone which crosses Beauharnois and runs beyond Mont Calvaire; indeed there would

be no deficiency of moderately good material in almost any position in which the upper part of the deposit is exposed ; but the best and whitest that has been seen is not far from the eastern side of the tongue in question, on the one hundred and thirty-seventh lot in the second range of Williamstown, in the Seigniorie of Beauharnois. The rock is situated about seven acres to the south-east side of the road, where from four to five feet of thickness are exposed, divided into beds varying from a few inches to two feet. The exterior is a very pure opaque white, and it appears to have been bleached a little under the operation of the weather. The interior beyond the reach of the weather is rather more translucent, and therefore not so dead a white ; the quantity of iron present is probably very small, but the stone has not yet been analyzed. The field was some years ago purchased by Mr. J. Dagg, of Montreal, for the purpose of establishing a glass factory on it, but the design, not however through any defect in the stone, never came into operation. The same rock on the Rivière du Nord would yield beds suitable for glass.

*Phosphate of Lime.*—The value of this substance as a mineral manure has been alluded to in several previous Reports, and the existence of imbedded crystals in the limestones of the Metamorphic series in several localities has heretofore been pointed out. During the past season it was interesting to ascertain its presence in nodules in rocks of the Lower Silurian age, in a condition indicating its probable connexion with the life of that period ; and although the quantity, in which these nodules has been found to enrich the rocks, is not yet known to give them much economic value, yet the fact of their presence in any stratigraphical position is worthy of notice, as it is quite possible that an attention awakened to the subject, may lead to the discovery of them in analogous geological place in other geographical positions, where the quantity may be more abundant.

Small black phosphatic nodules are mentioned by Mr. Murray as occurring at the base of the Chazy limestone, on the thirty-third lot of the seventh concession of Lochiel, where they are sparingly disseminated in the rock. They occur in precisely the same stratigraphical place, on the rear of the tenth

lot of the first concession of West Hawkesbury, where they are rather larger, but still in sparing quantity. As the nodules, however, when separated from the rock, hold, according to the analysis of Mr. Hunt, a large amount of the phosphate, they would probably render the limestone beds, in which they occur, of more than ordinary value, to be burnt for agricultural application when lime is required, as the phosphate can scarcely fail to be of additional service.

Small black phosphatic nodules exist also in thin sandstone beds interstratifying green slates at Grenville. These beds have been cut through in excavating the canal near the village at its exit, and slabs from them have been thrown out in some abundance on the bank of the river; their exact arrangement, however, in the shales has not been seen. They vary from one to six inches in thickness, and it is probable that the total vertical amount is not very great. The shale, however, is easily excavated, and the sandstone beds are very fully studded with the nodules. If the stone were burnt and ground it would afford an excellent manure for stiff clay soils; the sand would serve to loosen the clay, and the phosphate to fertilize it; but some experiments would be required to ascertain cost. Brown nodules of the same description, but larger in size, occur in a conglomerate supposed to be of the same age as the Grenville beds at the Allumette Falls on the Ottawa; but their character not having been ascertained until lately, and the extent to which they are disseminated in the rock not having been noted on the spot, I am not certain what importance to attach to the locality. In the specimens of the rock which are in the collection of the Survey, the nodules are abundantly disseminated.

Black phosphatic nodules are abundantly disseminated in scattered patches in a conglomerate limestone bed associated with other limestones, occurring at the point outside of the Rivière Onelle, in Kamouraska County. The geological place of the rock must be near the top of the Hudson River group, or the base of what in the nomenclature of New York is termed the Oneida or Shawangunk conglomerate; but the want of fossils in the section render it difficult to know the exact place which the rocks associated with the bed, occupy in the series,

no undisturbed locality to shew the complete sequence of the members of these two groups having yet been met with in Eastern Canada. The limestones, holding more or less of these nodules, are about eight feet thick, but in only one bed do they occur in abundance, and this is of an irregular thickness, swelling in the strike sometimes to one foot, and sometimes diminishing to only an inch or two. The calcareous beds are believed to be the same as those which occur at Point Levi, opposite Quebec; but to shew their relations at Rivière Ouelle, a section of the rocks above and below them is here given in descending order:

1.

|                                                                                                                                                                                         |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Hard dark grey sandstone in thin layers of four inches to one foot, separated by thin layers of dark grey and black shales with fine scales of mica.....                                | 32. |
| Hard dark grey sandstones and shales, with two hard dark grey beds which weather brownish, and are strongly calcareous .....                                                            | 5.  |
| Dark grey brownish weathering limestone of an arenaceous character .....                                                                                                                | 2.  |
| Dark grey brownish weathering limestone, and dark grey sandstone layers with dark grey and black arenaceo-micaceous shale.....                                                          | 4.  |
| Dark grey sandstone with dark grey arenaceo-micaceous shale .....                                                                                                                       | 10. |
| Dark grey fine grained thick-bedded sandstone very slightly calcareous; the band swells occasionally to greater dimensions in the strike, and diminishes occasionally to one foot ..... | 6.  |
| Dark grey thin sandstones and shales, a greater proportion of shales than in the previous beds.....                                                                                     | 27. |
| Grey fine grained calcareous sandstone in beds varying from four inches to one foot, separated by dark grey and sometimes black shales and occasionally by green shales.....            | 94. |
| Striped light and dark grey micaceous shales of an arenaceous character.....                                                                                                            | 6.  |

— 186.

2.

|                                                                                 |    |
|---------------------------------------------------------------------------------|----|
| Striped grey and red arenaceo-micaceous shales with beds of grey limestone..... | 4. |
| Red shale with grey limestone and dark grey sandstone layers .....              | 6. |
| Grey limestone beds, patches in which are of a conglomerate                     |    |

|                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| character, with small black phosphatic nodules, sparingly disseminated in them ; the beds are of one inch to one foot, and they are separated in the upper part by red shale, in the lower by green and black shale.....                                                                                                                                                                                                | 6.  |
| Green and grey shale with thin bands of limestone.....                                                                                                                                                                                                                                                                                                                                                                  | 2.  |
| Grey conglomerate limestone, with a few small black phosphatic nodules and with some shale above and below the band .....                                                                                                                                                                                                                                                                                               | 2.  |
| Grey and reddish-grey shale, with a band of grey limestone...                                                                                                                                                                                                                                                                                                                                                           | 4.  |
| Grey arenaceous limestone with bands of red and green shale                                                                                                                                                                                                                                                                                                                                                             | 6.  |
| Grey arenaceous limestone beds separated by red shale.....                                                                                                                                                                                                                                                                                                                                                              | 7.  |
| Grey arenaceous limestone with small thinly disseminated black phosphatic nodules.....                                                                                                                                                                                                                                                                                                                                  | 2.  |
| Grey calcareous sandstone and arenaceous limestone, separated into beds by grey arenaceo-micaceous shale.....                                                                                                                                                                                                                                                                                                           | 7.  |
| Grey calcareous sandstone and arenaceous limestone, separated into beds by grey and red shale.....                                                                                                                                                                                                                                                                                                                      | 9.  |
| Red shale with bands of grey limestone.....                                                                                                                                                                                                                                                                                                                                                                             | 5.  |
| Grey limestone beds separated by dark grey shale with a band of red shale at the bottom.....                                                                                                                                                                                                                                                                                                                            | 7.  |
| Green and red shale with a few bands of limestone.....                                                                                                                                                                                                                                                                                                                                                                  | 16. |
| Red shale with patches of conglomerate limestone, sometimes swelling out to a foot and sometimes diminishing to two or three inches; the pebbles of the conglomerate are chiefly limestone with a very few of red jasper, and they are mingled with a great multitude of <i>black phosphatic nodules</i> , or pebbles; some of them are as round as shot and some quite flat, while others are of irregular shapes..... | 2.  |

— 85.

## 3.

|                                                                                                                 |     |
|-----------------------------------------------------------------------------------------------------------------|-----|
| Red shale .....                                                                                                 | 6.  |
| Green shale .....                                                                                               | 12. |
| Red shale.....                                                                                                  | 4.  |
| Green shale .....                                                                                               | 10. |
| Red shale .....                                                                                                 | 14. |
| Green shale .....                                                                                               | 4.  |
| Red shale .....                                                                                                 | 1.  |
| Green shale .....                                                                                               | 28. |
| Red shale.....                                                                                                  | 10. |
| Red and green shale.....                                                                                        | 18. |
| Red shale .....                                                                                                 | 10. |
| Green shale .....                                                                                               | 2.  |
| Red shale with green stripes.....                                                                               | 46. |
| Red shale with irregular bands of yellow weathering grey sandstone, occasionally of a calcareous character..... | 12. |

|                                                                         |        |
|-------------------------------------------------------------------------|--------|
| Red shale with a bed of yellow weathering sandstone at the bottom ..... | 46.    |
| Red shale .....                                                         | 60.    |
| Red shale with beds of coarse dark grey sandstone.....                  | 12.    |
|                                                                         | — 295. |

## 4.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Greenish sandstone weathering reddish-drab; it is slightly micaceous with small black grains and occasionally small flat black pebbles of shale; the rock is in general slightly calcareous, and there are great and small subspheroidal shapes or portions which are very calcareous; in consequence of the presence of these calcareous spots, when several small ones are near together, the rock wears into a fretted and pitted surface like the pillar sandstones of Tourelle, (see Report for 1843-4.) The rock is thick bedded and the beds are separated by thin bands of green shale; portions of some of the beds are coarse, and have white quartz pebbles as large as peas, and at the base they become a fine conglomerate..... | 32.    |
| Red and green shale with three bands of sandstone occupying one third of the amount.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 4.     |
| Red and green shale with three bands of sandstone.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4.     |
| Red and green shale with a ten inch band of sandstone at the top.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 4.     |
| Whitish sandstone, hard and very quartzose, almost a quartz rock; to the eastward it swells to ten feet.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 4.     |
| Green shale .....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 4.     |
| Green shale and sandstone.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 4.     |
| Green sandstone .....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2.     |
| Green and red shale.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 5.     |
| Green sandstone.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4.     |
| Green shale .....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2.     |
| Green sandstone .....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2.     |
| Green shale with bands of sandstone.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2.     |
| Green sandstone.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 7.     |
| Green sandstones with one or two partings of green shale.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 7.     |
| Green sandstone with partings of green shale.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 43.    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | — 130. |

## 5

|                                                                            |        |
|----------------------------------------------------------------------------|--------|
| Red shale with a few bands of sandstone increasing towards the bottom..... | 144.   |
| Red shale and sandstone.....                                               | 24.    |
|                                                                            | — 168. |

## 6.

|                      |     |
|----------------------|-----|
| Green sandstone..... | 15. |
| Concealed .....      | 8.  |

|                                                                                                 |                 |
|-------------------------------------------------------------------------------------------------|-----------------|
| Greenish sandstone .....                                                                        | 3.              |
| Red shale .....                                                                                 | 1.              |
| Concealed .....                                                                                 | 6.              |
| Greenish sandstone .....                                                                        | 1.              |
| Concealed .....                                                                                 | 26.             |
| Greenish sandstone.....                                                                         | 8.              |
| Green sandstone and green shale.....                                                            | 11.             |
| Greenish sandstone, calcareous in spots and composed of fine<br>conglomerate at the bottom..... | 65.             |
| Greenish sandstone with bands of red shale.....                                                 | 2.              |
| Red shale with thin bands of sandstone.....                                                     | 2.              |
| Green sandstone sometimes very chloritic and dark colored; it<br>holds scales of plumbago.....  | 2.              |
| Red shale with thin bands of sandstone.....                                                     | 15.             |
| Concealed but supposed to be chiefly red shale .....                                            | 19.             |
| Greenish sandstone with red shale.....                                                          | 2.              |
| Concealed .....                                                                                 | 20.             |
| Greenish sandstone .....                                                                        | 13.             |
| Red shale with bands of green shale and a few bands of sand-<br>stone .....                     | 68.             |
| Dark iron-grey sandstone.....                                                                   | 3.              |
| Concealed .....                                                                                 | 2.              |
| Greenish sandstone .....                                                                        | 6.              |
| Red and green shale.....                                                                        | 34.             |
| Greenish fine conglomerate with white quartz pebbles as<br>large as peas and beans.....         | 14.             |
| Greenish fine conglomerate.....                                                                 | 11.             |
| Greenish sandstone and fine conglomerate.....                                                   | 22.             |
| Red and green shale and sandstone.....                                                          | 13.             |
|                                                                                                 | — 392:          |
|                                                                                                 | —<br>1256.<br>— |

*Clays for Common Bricks and common Pottery.*—In the counties of Beauharnois and the Lake of Two Mountains, clays fit for these purposes are so common, that it would, perhaps, be more difficult to state where they are not to be found than where they are. In the immediate neighborhood of the village of Beauharnois, the bank of clay which extends along Lake St. Louis, covers the Potsdam sandstone to the height of thirty to forty feet, and gives a level surface which runs far back into the county; it affords abundance of material for the manufacture of common red bricks, and about a mile below the village they are made by Mr. J. Wilson for the supply of

the neighborhood, from the lower part of the deposit, which is of a brownish or yellowish-grey color, and of good quality for the purpose. Sand to mix with the clay is obtained a short distance back from the edge of the bank, from a deposit which overlies the clay to the depth of one or two feet. In the interior of the country, bricks are made on the Chateauguay River, at the Portage near the line between Godmanchester and Ormstown, from a clay which appears to be of nearly the same character; they are also made at various other spots lower down the river and on the English River within a mile of St. Chrysostome. In the township of Chatham, bricks have been manufactured on the Grenville road, about a mile above the canal feeder, from clay obtained on the spot.

Clay fit for common pottery is met with on the eighth lot of the second concession of Chatham, the property of Mr. Renaldo Fuller, and it was applied to the manufacture of such at the spot some years ago. Three distinct beds, one of them lightish grey, another of a bluish cast, and a third of a reddish tint are said to be all applicable to the purpose, and I understand were all used, the reddish colored bed most. The business was discontinued, I am informed, merely from the want of a skilful and steady workman to conduct it. Common pottery is at present manufactured at Beauharnois by Messrs. Antoine and Pierre Lambert, from clay procured behind the village; the articles made are tureens, jugs, butter and cream jars, ginger beer bottles, and such like.

*Building Stone.*—Good stone for building occurs in abundance in the county of Beauharnois. There is little scarcity of it wherever the Potsdam sandstone prevails, particularly the upper part of it; the beds are in general even, and the thickness so various that it would not be difficult to obtain whatever courses might be required. The stone is capable of being split across by plugs and feathers to any required size, though with rather uneven faces, and the color in almost all instances, approaches to white. Some surfaces, indeed, are occasionally tinged with iron, but not to an extent, when care is taken, to greatly deteriorate the general aspect of a building. Though hard, the stone is capable of being smoothly dressed with a chisel, more difficulty being experienced in cutting across than

with the beds, and when dressed it preserves well its sharp edges for a long time. It is capable of resisting considerable heat, so much so, that in some parts of the formation on the south side of the Province line, it is used for furnace hearths ; and a benefit arising from this is, that though a building constructed of it may be burnt, the walls will still be serviceable. It is undoubtedly more expensive both to quarry and to dress, than the limestone which is so much used in this part of Canada, but it is a much more lasting and indestructible material. Wherever the stone has been mentioned as applicable for the making of glass, it yields the best building stones that can be obtained from it, and where it is not sufficiently free from iron for the former purpose, it is often still available for the latter.

A quarry is opened in the stone at Beauharnois Village, and the mill on the St. Louis River is built of the material procured there ; and though the interior was, some four or five years ago, destroyed by fire, the shell remained good, and the machinery and wood work were renewed within the same walls, the upper part of which alone required repair. A quarry is open in the upper beds on the one hundred and fifty-first lot in the second range of Williamstown, two houses erected from which in the vicinity have a very substantial appearance. Some beautiful stones, quarried from the formation for building a church, were observed on the eightieth lot in the second concession of Hemmingford.

I am not aware that any of the stone was used for the facing of the locks on the Beauharnois canal, for the supply of which, however, the exposures at the mouth of it would have been very well situated. The expense of working the stone was probably considered too great, and limestone from St. Geneviève, Caughnawaga, and Grande Isle was preferred. The Caughnawaga stone is grey, and with the St. Geneviève, coming from the same formation as the beds behind this city—the Chazy limestone—it is much of the same character. Large blocks, capable of receiving a good face from the chisel, have been obtained from both localities, as well as from beds equivalent to those they present, on the tenth lot of the first concession of West Hawkesbury, and the twenty-seventh or twenty-eighth lot of the first concession of East Hawkesbury. The Pointe Claire quarries yield a

black limestone which appears to me of too brittle a quality for building purposes; it was used, however, for some of the under-water work of the Lachine Canal.

The Grande Isle quarry yields good strong bluish limestone in beds of two feet thick, of which only two appear to have been worked. A limestone belonging to the same stratigraphical place has been traced from Carillon to Grenville. It is two to three feet thick and gives a good building stone; dressed specimens of it are seen in the corners of Mr. Cushing's store at Chatham.

*Fire Stones.*—Some of the beds of the sandstone which overlies the two-foot limestone bed of Chatham are of a loose and porous texture, and are much resorted to by the country people for backs to their chimney fire places. The stone is capable of resisting considerable heat, and it has been used with success and economy in the furnaces of the pyroligneous acid manufactory near Mr. Cushing's establishment in Chatham. The action of the fire turns the stone red, indicating the presence of iron, and as peroxide of iron is a flux for silica, it may be that the quantity of it is such as to render the stone unfit for foundry hearths.

*Quick Lime.*—All those purer limestone beds, which have been mentioned as yielding good building stone, yield also good lime; but for the facility with which it is burnt, and the superior whiteness of the lime, none of them equal the black limestone of Pointe Claire. The lime from it is so much esteemed for white-washing, that the inhabitants carry the stone to parts twenty miles from the quarry, on the south side of the St. Lawrence. The transport of it is effected on the smooth roads of winter, when the river offers a facility instead of an impediment as part of the road. Though the lime from the grey limestone of Caughnawaga and St. Geneviève is not quite so white, nor takes so much sand, it gives a rather stronger mortar than that of Pointe Claire. The lime from the stone of Chatham is yet a little darker, but gives a still stronger mortar, and being the only bed of good limestone on both sides of the Ottawa in a considerable area, it is much resorted to for lime.

*Hydraulic Lime.*—A bed of limestone was pointed out to me by Mr. Cushing, of Chatham, which he assured me had been

tried in the locks of the Cornwall Canal for the purpose of hydraulic lime, and proved successful. The bed is eighteen inches thick, and occurs below the saw mill, close by the margin of the Ottawa, by the waters of which it is very often covered, and its stratigraphical position must be about 100 feet beneath the two-foot limestone bed. When burnt, the stone by exposure to the atmosphere slowly air-slacks, and when completely slacked and mixed with sand it may make a strong mortar, but experiments with it by Mr. Hunt as a cement by burning, grinding and mixing into a paste with water were not successful. The mixture was still soft after remaining twenty-four hours under water.

*Flag Stones.*—The Potsdam sandstone is known to yield beautiful flagging at Malone, in the State of New York, and since the establishment of railroads, conveniently situated for the transport of it to a distance, a considerable traffic seems to be springing up in it. Not having visited Malone to ascertain the stratigraphical place of these beds, I am unable to state in what part of the Potsdam of Canada similar flagging may be looked for. The only beds thin enough for flagging that have been observed, are to the east of Covey Hill, on the eighteenth lot of the second concession of Hemmingford, and to the west of the same hill on the Russelltown and Huntingdon road, where the River Outarde cuts it, about a mile and a-quarter from the town line of Hinchinbrooke. In the first locality the thickness exposed is not great, the whole of the beds seen not exceeding seven feet, while only some of them varying from two to four inches are fit for flagging. In the second locality about eighteen feet of whitish-grey sandstone occur in alternating bands of thick and thin layers, there being three of each of between three and four feet. The thin bedded bands would give flagstones of one to three inches in thickness, but they would be inferior to those of Malone, being more brittle, less even and breaking into less regular shapes.

*Industrial Exhibition.*—A considerable portion of my time having been devoted to an endeavour to bring together such a collection of the mineral productions of Canada, as would fairly represent that branch of the resources of the Province at the Exhibition of the Industry of all Nations in London, and to

display them there in such an arrangement and with such explanations as would attract attention and render them intelligible, it may perhaps not be considered out of place that I should take this opportunity of stating to your Excellency how far this endeavour has been successful, and of shewing the extent to which the collection sent from the Colony may, in our present knowledge of these resources, be considered a full or deficient one, as well as how it compared with similar collections from other countries.

The simplest mode of shewing the nature of the collection will be to give a catalogue of the materials of which it was composed. Only such minerals were sent as were known to be capable of application to industrial purposes; they were contributed by twenty-nine exhibitors, but the chief part was collected by the officers connected with the Geological Survey of the Province. The arrangement adopted was similar to that given in the Catalogue of Canadian Economic Minerals, appended to the Report of 1849-50. It was thus purely technical, and the collection was divided into ten classes:—

- 1—Metals and their ores.
- 2—Minerals requiring more complicated chemical treatment to fit them for use.
- 3—Mineral paints.
- 4—Materials applicable to the fine arts.
- 5—Materials applicable to jewellery.
- 6—Materials for glass-making.
- 7—Refractory materials.
- 8—Grinding and polishing materials.
- 9—Materials applicable to the purposes of common and decorative construction.
- 10—Miscellaneous materials.

Thus classified the specimens were placed in regular sequence in the space allotted them, and each kind from each individual source was accompanied by a ticket which gave the name of the material, the quantity in which it occurred, the geological formation and the locality in which it was situated, with the facilities for working it, and the name of the exhibitor. As all these details, in regard to the various known mineral localities of the Province, have already been stated in

the various Reports of Geological Progress which have been transmitted to the Government, and particularly in the Catalogue of 1850, already alluded to, it will not be necessary in the present list to give more than the name of the substance and such a general indication of its locality as will facilitate a reference to what has been said heretofore, with the name of the exhibiter.

#### CATALOGUE.

##### *Metals and their Ores.*

- MAGNETIC IRON ORE.**—Large blocks from Marmora, Madoc, Bedford, South Crosby, Hull; smaller specimens from Portage du Fort, Bolton, Leeds, Sutton, New Carlisle.—*Geological Survey.*
- MAGNETIC IRON ORE.**—A large block from South Sherbrooke.—*Dr. J. Wilson, Perth.*
- SPECULAR IRON ORE.**—Specimens from Wallace Mine Location, Lake Huron.—*Geological Survey.*
- SPECULAR IRON ORE.**—A large block from McNab.—*A. Dickson, Pakenham.*
- BOG IRON ORE.**—A large block from Vaudreuil Seigniory.—*R. Lancaster, Vaudreuil.*
- A large block from Rivière du Chêne.—*J. Proulx, St. Eustache.*
- A large block from Portneuf Seigniory.—*F. Marcotte, Portneuf.*
- Large blocks from St. Vallier Seigniory.—*Capt. Morin, St. Vallier.*
- Small specimens from Stanbridge.—*J. W. & H. Desrivières, Stanbridge.*
- Small specimens from Camden, Eardley, Simpson, Ireland, Lauzon Seigniory.—*Geological Survey.*
- Small specimens from St. Maurice Forges.—*Hon. J. Ferrier, Montreal.*
- WROUGHT IRON.**—Square and flat bars, axe iron, plough-share plate, with cold-folded and cold-twisted bars manufactured from the bog ore of St. Maurice.—*Hon. J. Ferrier, Montreal.*
- CAST IRON.**—Pigs cast from the ore of Belmont and Marmora.—*Marmora Iron Company, Marmora.*
- TITANIFEROUS IRON.**—Large blocks and small specimens from St. Armand, Sutton, Brome, Vaudreuil Beauce.—*Geological Survey.*
- ILMENITE**, sometimes intermixed with **RUTILE.**—Large blocks from St. Urbain, Bay St. Paul.—*Geological Survey.*
- ZINC ORE (BLENDE).**—Specimens from Prince's Location, Pointe des Mines Lake Superior.—*Geological Survey.*
- LEAD ORE (GALENA.)**—Specimens from Prince's Location, Thunder Cape, Pointe des Mines Lake Superior, Bedford, Fitzroy, Indian Cove Gaspé.—*Geological Survey.*
- COPPER ORE (PYRITES.)**—Specimens from Pointe des Mines and Maminse Lake Superior, Root River, Echo Lake, Bruce Mines, Wallace Mines, Lake Huron, Bastard.—*Geological Survey.*

- (VARIEGATED.)—Specimens from Point Porphyry Lake Superior, Bruce Mines Lake Huron, Inverness.—*Geological Survey.*
- (VITREOUS.)—Specimens from Prince's Location, and Harrison's Location Lake Superior; Bruce Mines Lake Huron.—*Geological Survey.*
- (NATIVE.)—Specimens from Harrison's Location, Ewart's Location, Michipicoten Island.—*Geological Survey.*
- (ARGENTIFEROUS PYRITES.)—Upton; (AURO-ARGENTIFEROUS)—Ascott.—*Geological Survey.*
- COPPER ORE (YELLOW.)—Large blocks from Bruce Mines.—*Montreal Mining Company, Montreal.*
- COPPER (SMELTED.)—Tough cake from Bruce Mines, resulting from the pyritous ore.—*Montreal Mining Company, Montreal.*
- COPPER (NATIVE.)—Specimens from St. Ignace Island Lake Superior.—*Montreal Mining Company.*
- NICKEL ORE (SULPHURET.)—Specimens from Wallace Mine Lake Huron.—*Geological Survey.*
- SILVER (NATIVE.)—Specimen of  $3\frac{1}{2}$  per cent. ore from Prince's Location, Lake Superior.—*J. F. Badgley, Montreal.*
- (SMELTED.)—Specimens resulting from the ore of Prince's Location Lake Superior.—*J. F. Badgley, Montreal.*
- (NATIVE.)—Specimens from Prince's Location and Harrison's Location, Lake Superior.—*Geological Survey.*
- GOLD (NATIVE.)—Specimens from washings on the Touffe des Pins, Vaudreuil Beauce.—*Chaudière Mining Company, Quebec.*
- (NATIVE.)—Specimens from Lake Etchemin, Rivers Chaudière, du Loup, Famine, Poser's Stream, Bras, Guillaume, des Plantes, Metgermet, St. Francis, &c., &c.—*Geological Survey.*

*Minerals requiring more complicated chemical treatment to fit them for use.*

- URAN OCHRE.—Specimens shewing traces from Madoc.—*Geological Survey.*
- CHROMIC IRON.—Large masses from Bolton and Ham.—*Geological Survey.*
- COBALT BLOOM.—Specimens shewing traces from Prince's Location Lake Superior.—*Geological Survey.*
- WAD OR EARTHY MANGANESE.—Small specimens from Bolton, Stanstead, and Tring Townships, and the Seigniories of Aubert Gallion, St. Mary and St. Anne.—*Geological Survey.*
- MAGNETIC IRON PYRITES.—Specimens from Lanouaye and D'Autraie.—*Geological Survey.*
- MOLYBDENITE.—Specimens from Terrace Cove, Lake Superior.—*Geological Survey.*
- DOLOMITE.—A large block from Dalhousie.—*Dr. J. Wilson, Perth.*  
Specimens from Litchfield, Dunham, Leeds, and Stakely.—*Geological Survey.*
- MAGNESITE.—Large masses from Bolton, and large masses stained with oxide of chromium from Belton and Sutton.—*Geological Survey.*

*Mineral Paints.*

- IRON OCHRE.—Specimens from Seigniorv of St. Anne Montmorency.—*E. Caron, St. Anne, Montmorency.*  
 Specimens from St. Rose.—*L. M. Cyr, St. Eustache.*  
 Specimens from Pointe du Lac, County St. Maurice.—*D. G. Labarre, Three Rivers.*  
 Specimens from Petite Rivière Romaine Ibberville.—*G. Dubéger, Murray Bay.*  
 Specimens from Magdalene Islands and Gaspé.—*R. W. Kelly, Gaspé.*  
 Specimen from Durham.—*J. Hall, Melbourne.*  
 Specimens from Beauharnois, Stanstead, Durham.—*Geological Survey.*
- BARYTES.—Specimens from Baryta Island Lake Superior, Bedford, MacNab, Seigniorv of Vaudreuil Beauce.—*Geological Survey.*
- SOAPSTONE, TALCOSE SLATE.—Specimens from Stanstead, Leeds, Pottan.—*Geological Survey.*
- PHOSPHATE OF IRON.—Specimens from Vaudreuil.—*R. Lancaster, Vaudreuil.*

*Materials applicable to the Arts.*

- LITHOGRAPHIC STONE.—Blocks from Marmora, prepared, with drawings and illustrations.—*Geological Survey.*

*Materials applicable to Jewellery.*

- AGATES.—Cut and polished specimens from Michipicoten, and Simpson's Islands and North shore of Lake Superior.—*Geological Survey.*
- JASPER.—Pebbles cut and polished, and a boulder of Jasper Conglomerate Lake Superior.—*Geological Survey.*
- RIBBONED CHERT.—Specimens from Thunder Bay, Lake Superior.—*Geological Survey.*
- PERISTERITE, PERTHITE, LABRADORITE.—From Buthurst, Burgess, Drummond.—*Dr. J. Wilson, Perth.*

*Materials for Glass-making.*

- WHITE QUARTZOSE SANDSTONES.—Large slabs from the Ottawa Glass Works, Vaudreuil.—*Boden and Lebert, Vaudreuil.*
- WHITE QUARTZOSE SANDSTONE.—Small specimens from Ship Channel Lake Huron, Ham, Nepean, Isle Perrot, Rivière du Chêne, Stukely.—*Geological Survey.*
- PITCHSTONE.—Small specimen from Michipicoten Island Lake Superior.—*Geological Survey.*

*Refractory Materials.*

- SOAPSTONE.—Large thick slabs from Bolton, and small specimens from Seymour, Sutton, Brome, Pottan and Bolton.—*Geological Survey.*
- PIPESTONE.—Small specimens from Calumet Falls.—*Geological Survey.*

**PLUMBAGO.**—Large and small specimens from Grenville.—*Geological Survey.*

Large specimens from Grenville.—*Hon. R. U. Harwood, Vaudreuil.*

**WHITE SANDSTONE.**—Specimens dressed and undressed from St. Maurice.—*Hon. J. Ferrier, Montreal.*

**ASBESTUS.**—Large specimens from Dalhousie.—*Geological Survey.*

#### *Mineral Manures.*

**PHOSPHATE OF LIME.**—Large crystals in crystalline limestone from Burgess.—*Dr. J. Wilson, Perth.*

**GYPNUM.**—Large blocks from Dumfries, Brantford, Oneida and Grand River.—*Geological Survey.*

**FRESH-WATER SHELL MARL.**—A large specimen from Montreal.—*Mr. Sheriff Boston, Montreal.*

A specimen from Belleville.—*A. Yeomans, Belleville.*

Specimens from Gaspé.—*R. W. Kelly, Gaspé.*

Specimens from Vaudreuil.—*P. T. Delesderniers, Vaudreuil.*

#### *Grinding and Polishing Materials.*

**WHETSTONES.**—Sundry specimens from Madoc, Potton, Stanstead, Hatley, and Tingwick.—*Geological Survey.*

**MILLSTONE ROCK.**—Sundry specimens from Rouville, Stanstead, Brompton, and Seignior of St. Joseph.—*Geological Survey.*

**TRIPOLI EARTH.**—A specimen from Montmorency.—*Geological Survey.*

#### *Materials applicable to Common and Decorative Construction.*

**ROOFING SLATES.**—Specimens from Rivière du Loup, Tring.—*Geological Survey.*

Specimens from Kingsey.—*J. Hall, Melbourne.*

Specimens from Frampton.—*M. Quigley, Frampton.*

**RED GRANITE.**—Specimens from Bathurst.—*Dr. J. Wilson, Perth.*

**WHITE GRANITE.**—A cut specimen from Stanstead.—*J. Munroe, Stanstead.*

A large cubical split block from Stanstead.—*Geological Survey.*

**LIMESTONE.**—A cubic dressed block from Quebec.—*N. Aubin, Quebec.*

A dressed slab from Bytown.—*J. Scott, Bytown.*

Specimens from Thunder Cape, Battle Island Lake Superior; Rama, Madoc, Portage du Fort, MacNab, Wentworth, Rouville, Phillipsburgh, Montreal &c.—*Geological Survey.*

**HYDRAULIC LIMESTONE.**—Specimens from Brantford, Kingston, Nepean.—*Geological Survey.*

**SERPENTINE.**—A large block from Burgess, and a small polished specimen.—*Dr. J. Wilson, Perth.*

Large cut and polished slabs from Orford.—*Geological Survey.*

**MARBLE.**—Large cut and polished slabs from Dudswell, St. Armand, Packenham, Phillipsburgh, St. Dominique, Grenville, Portage du Fort.—*Geological Survey.*

BRICKS, WHITE AND RED.—Specimens from Camden.—*Geological Survey.*

*Miscellaneous Materials.*

MINERAL CAOUTCHOUC.—A large specimen from Enniskillen.—*Geological Survey.*

PEAT.—Specimens from St. Dominique.—*Dr. Boutillier, St. Hyacinthe.*

NOTE.—A map shewing the distribution of the Geological formations, of Canada, in so far as known, was submitted to the examination of the Jury; but it was not deemed expedient to make it a part of the public Canadian contribution as it is yet an imperfect document.

To indicate how this collection as a whole compared with those of other countries, it will perhaps be sufficient, instead of making any statement of my own in regard to its merits, to quote the opinion of the jury of the class comprehending mineral products, as expressed in their report by Mr. Dufrénoy, Juror for France, Member of the Institute of France, and Inspector General of Mines in that country, who was appointed to draw it up.

“Of all the British Colonies Canada is that whose exhibition is the most interesting and the most complete, and one may even say that it is superior, so far as the mineral kingdom is concerned, to all countries that have forwarded their products to the Exhibition. This arises from the fact that the collection has been made in a systematic manner, and it results that the study of it furnishes the means of appreciating at once the geological structure and mineral resources of Canada.”

The main object of the Exhibition being to display the condition of the Industrial Arts throughout the world, the examinations that were made with a view to honorary rewards, brought into comparison rather the skill and invention shewn in converting the rude materials of nature to use, than the rude materials themselves; and although the Jury had before them a multitude of the objects of natural history connected with the mineral kingdom, a large portion of them of vast size and great interest, and others of great beauty and rarity, they considered that they would not be justified in adjudging any reward to those who exhibited them, unless the specimens had been obtained by special research on the part of the exhibiter, or afforded especial information and instruction in the science to which they belonged. In consequence of this decision, isolated mineral or geological specimens, unless they were connected with some distinct operation, were excluded from competition.

But little industry being yet devoted in Canada to the application of mineral products, few rewards could be bestowed under the operation of this rule, on individual exhibitors, however various and excellent the collection. There were only three Canadian exhibitors, connected with mineral manufactures, whose products came before the Jury; to two of these prize medals were awarded, and honorable mention was made of the third. The two former were the Montreal Mining Company, noticed for their exhibition of tough cake copper, and the ores from which it was smelted, and the Hon. J. Ferrier, for his wrought iron from the St. Maurice forges, and the bog iron ore of which it was the produce; and the latter the Marmora Iron Company, for their cast iron extracted from the magnetic oxide. Honorable mention was also made of Dr. James Wilson, of Perth, who, in addition to magnetic iron ore from South Sherbrooke, exhibited phosphate of lime from Burgess, and other minerals from other places, all the results of his own researches; and ordinary mention was made of Mr. R. Lancaster, of Vaudreuil, and Capt. Morin, of St. Vallier, for their bog iron ores; of Messrs. L. M. Cyr, of St. Eustache, E. Caron, of St. Anne, Montmorency, G. Dubéger, of Murray Bay, and R. W. Kelly, of Gaspé, for their iron ochres; and of Messrs. Boden and Lebert, of Vaudreuil, for the white sandstones they exhibited, which were used by them in the manufacture of glass.

The whole collection as illustrative of the geological structure and mineral products of a large area, and as affording information of new sources of supply to those engaged in the application of such productions to the purposes of life, would probably have received a higher award than it obtained; but my own name being that most connected with it as a whole, while at the same time I had, without solicitation, been honored with an appointment as a juror in the class to which the collection belonged, my colleagues were precluded from bestowing on it a higher mark of distinction than a special notice in the report.

It appears to me that the mineral collection made as favorable an impression on the public at large as upon the Jury, and most of the metropolitan daily journals noticed it with appro-

bation ; a detailed description is given of it in the Hand Book to the Official Catalogue by Mr. R. Hunt, professor of mechanical science in the Government School of Mines, and the extent to which a knowledge of Canadian products generally has been spread, by the personal examination of the vast numbers before whose eye they were displayed, could not have been attained by any other means than the Industrial Exhibition.

The vast supplies of iron with which the collection gave evidence that the Colony is enriched, appeared to arrest the attention of all. The British miner accustomed to follow into the bowels of the earth, beds of ore of six inches to one foot, containing between thirty and forty per cent. of this important metal, naturally regarded with surprise huge blocks of it from beds of 100 and 200 feet in thickness, and yielding sixty to seventy per cent. ; the British smelter did not fail to admire the masses of ore, but directing his inquiries to the fuel required to extract the metal, and being informed that no mineral coal existed in the vicinity of the ore, he did not appear to apprehend that any competition would arise to interfere with the supply to the Colony of those qualities of iron which are made in the United Kingdom from the deposits of the carboniferous era. Some of the extensive Sheffield manufacturers of steel, who are supplied with the chief part of the iron on which they bestow their labor, from Sweden at prices varying, according to quality, from £10 to £33 per ton, appeared desirous of ascertaining the cost that would be required to smelt the magnetic oxide in Canada, and it seemed to them to be a question connected with the wages of labor rather than anything else, (if the requisite skill were once introduced into the country,) whether any competition could be established in favor of Canada, seeing that the ore and the fuel in the two countries are the same. The superiority of Swedish iron for steel is unquestionable ; its character for such a purpose stands higher than that of any other country ; it is made from the magnetic oxide, and between the magnetic oxides of Sweden and some of other countries chemical analysis, instituted for the express purpose of comparison, has, it is said, been unable to detect any difference. It might be supposed, therefore, that smelted with charcoal and generally treated in the same manner,

there ought to be no essential difference in the quality of the iron. Experiment, however, does not prove this to be the case, and there may be some delicate difference (possibly the presence of rare metals in small quantities,) which may yet have escaped the investigations of science to account for the results. The ores selected for comparative trial may have been the produce of geological formations different from those of Sweden, but it is not likely that this can give the essential cause of difference, as even in Sweden the ores of different mines in the same geological formation, all yielding good steel iron, give differences of quality which are so uniform as to produce a regular and constant difference in price. The geological formations yielding the magnetic oxides of Canada and those of the United States, where they prevail in equal abundance, are identical, and it is probable they are both of the same formation as that of the Swedish mines. The practical experiments on Canadian ores are still so few that nothing can yet be proved from them. But in the United States the American smelter has been able to compete with the Swedish, only on this side of the Atlantic, and that with the assistance of a considerable protective duty. The duty, however, is not sufficient to protect other qualities of iron from the interference of the cheap iron of the United Kingdom, made with mineral coal. Some specimens of iron exhibited from the United States were of admirable quality. The Canadian iron ores were examined with great care and attention by the agents of Russia; it seemed to strike them with wonder that such prodigious sources should be found in any country but their own, and the public in general, without taking into consideration the question of its present application to profitable uses, seemed to regard the great beds of magnetic oxide as national magazines in which was stored up a vast amount of a material indispensable to the comfort and progress of mankind, which it is always satisfactory to the inhabitants of a country to know is within their reach and control, should circumstances arise to render its application expedient or necessary. To metallurgists the good quality of the wrought iron of the St. Maurice forges appeared the more deserving of attention, as the ore from which it is derived being the hydrated peroxide, is usually accompanied by a small

amount of phosphorus in the form of phosphate of iron ; it is difficult to remove this impurity which in too large a quantity renders the metal cold-short. In cast iron, however, its presence in small quantities cannot be called prejudicial, as it serves to render the metal very fluid when fused, and thus to give a fine surface to the castings and bring out all the details of ornamental patterns in sharp relief, while it does not seem to render the casting brittle, or to deteriorate its power of resisting the effect of sudden heating and cooling. Large masses of bog iron ore were contributed from four or five important deposits, besides that of St. Maurice, but it has not yet been ascertained whether there is any essential difference of quality in these, as regards the amount of phosphoric acid. The peroxide of Manganab, contributed by Mr. Sheriff Dickson, of Pakenham, was regarded as a very beautiful ore, the uniform quality of which would render it one of much more easy fusion and management than the magnetic oxides, while it would probably produce an iron of excellent quality.

The copper ores of Lakes Superior and Huron were in general represented by cabinet specimens, which had been collected during the exploration of the shores of those lakes, by the officers of the Geological Survey. None of the lodes being worked, with the exception of those of the Bruce Mines, it was impossible without great expense to procure, except from the Bruce Mines, such large specimens as would have attracted effective attention. The whole, however, formed an illustrative collection, and the prize medal awarded the Montreal Mining Company for its exhibition of copper ores, and copper extracted from them, attests the interest with which the collection was examined. Of the remaining materials of this class of objects,—zinc, lead and nickel ore, with native silver and gold—the specimens with the exception of the last, were all of cabinet size, and those of them which excited enquiry were the sulphuret of nickel from the Wallace Mines, and the native silver from Prince's location. The specimens of gold from the Chaudière Mining Company's washings on the Touffe des Pins, were not equalled by any in the building, with the exception of a mass weighing eighteen pounds, from California, and with other *pepites* less in size and fewer in number

than those of the Touffe des Pins, from various of those localities which were cited in last year's Report, as affording indications, were eagerly inspected by the public; as already stated, honorable mention is made of those exhibited by the Chaudière Mining Company.

Of the second class of minerals the chromic iron was that which attracted most attention. The size of the specimens attested the importance of the beds or veins in the spots from which they were taken, and several of the manufacturers of the chromates of potash and of lead, made inquiry as to the general probabilities of the supply, the cost of mining, and carriage to a shipping port. One manufacturer has this season sent out an order to procure a quantity of the mineral, and has been supplied with about five tons of it, previously procured with the view of practically introducing the article into the English market. Some years ago the value of this mineral was £12 to £20 per ton, according to the percentage of the oxide of chromium in it, ranging from forty to sixty per cent. The value of it last year was about £6 to £8 per ton, but discoveries in the Mediterranean, and subsequent shipments from Smyrna, had reduced the price, in the beginning of this year, to £4 per ton, which may possibly be too low to permit of a profitable export of it from Canada.

In regard to the third class of minerals, I was informed by one of the principal manufacturers of paints in London, that the iron ochres from Canada were of the best usual description, and equal to those now imported from France. The French ochres imported into London in a crude state, and prepared there on a large scale, can be sold to a profit at £3 per ton; and the superiority of the English manufacturers over the French is such, that the latter preparing the material at home and exporting it to London, cannot obtain a profit unless they can sell the commodity at £6 per ton. The charges of freight may render it difficult to transport the Canadian ochre across the Atlantic to a profit, but the abundance of the material in the country should surely render it unnecessary that any should be imported into this or the neighboring colonies. In the Canadian collection there were no less than seven exhibitors of ochres from eight different localities, the deposits in most of

which are important in quantity. An enterprising American who attended the Provincial Exhibition in Montreal in 1850, immediately on observing the ochre exhibited by Mr. D. G. Labarre, from Pointe du Lac, went down to the spot and purchased the lot on which it there occurs; and I understand that he has since exported from it several hundred barrels of the ochre to the United States.

The lithographic stones from Marmora have been specially noticed in the report of the jury, for their homogeneousness and apparent good quality, and particularly for a point of scientific interest connected with them, which is that they belong to a formation of much older date than any lithographic stones heretofore discovered. Researches for them have heretofore been confined to the rocks of the Oolitic series, while in Canada they are found near the base of the Lower Silurian; this discovery widens the field in which those who practice lithography may seek for the stone.

A considerable number of agates, some of them of large size, obtained on Michipicoten and Simpson Islands, and various parts of the north shore of Lake Superior, in which places they abound, together with several beautiful specimens of perthite and peristerite, (different species of feldspar contributed by Dr. Wilson,) were placed in the hands of a London lapidary to be slit and polished for exhibition, and their addition to the collection, as materials applicable to jewellery, served to embellish its appearance.

The white quartzose sandstone exhibited by Messrs. Boden and Lebert, as the material from which they manufacture glass at Vaudreuil, is, as already stated, mentioned by the jury in their report. But as indicative that others as well as the jury appreciated its good quality, and that the appreciation was not of a mere transitory character, I may mention, that in the last and present months, a respectable firm in Baltimore has been twice instructed by a large manufacturing house in England, to make enquiry of me at what cost this sandstone can be placed on board of sea-going vessels in this port, for the purpose of being transported to the United Kingdom, and the firm states at the same time, that if the price suits, several large orders would follow. A suitable material for making

good glass may thus become an important article of export. In the American division of the exhibition, a large sample of a remarkably pure white silicious sand for glass making, was shewn from some part of the interior. It was so much admired by glass makers, that arrangements were immediately made, which, I understand, have originated a trade to England in the article.

Among the refractory materials, were exhibited large slabs of soapstone from Potton, and a moderately large sample of plumbago from Grenville. The plumbago was found to resemble that from Ceylon, and from Devonshire, and properly cleaned, it would probably be fit for crucibles. The opinion of some of the great pencil makers of the Metropolis was obtained in regard to its applicability to the purposes of their trade. There are points of grit or stony matter partially disseminated through the plumbago, similar to the gangue in which it is enclosed, but this, I was informed, can be separated by washing, and the pure plumbago after being ground very fine, solidified by pressure, after the plan of Mr. Brockedon, who received a council medal for the blocks of artificially solidified plumbago he exhibited. For the best pencils, the very blackest plumbago is used; that of Borrowdale in Cumberland, is nearly as black as mineral coal, and none in the world equals it, but the color of the Canadian is grey, and though pencils could be made of it, they would be considered of inferior quality. The value of Cumberland lead is from twenty to thirty shillings per pound. Some of the best foreign samples sell for £20 per ton, while that from Canada would not bring more than £3 to £5 per ton.

All the mineral manures attracted attention, and particularly the phosphate of lime from Burgess, exhibited by Dr. Wilson, of Perth, the specimens of which were not only considered economically, as applicable to agricultural purposes, but admired mineralogically, as affording splendid examples of crystallized apatite. The abundance of fresh-water shell marls was indicated by supplies from four exhibitors, and the great blocks of gypsum, for four of which (one of them weighing a quarter of a ton,) from the townships of Dumfries, Brantford and Oneida, I was indebted to the kindness of Mr.

Gilbert Burrows, are especially mentioned in the jury's report, by which it will be perceived that the gypsum is considered sufficiently pure for the purposes of statuary plaster.

Some of the whetstone rock from the Eastern Townships was considered of excellent quality, but the collection was not sufficiently extensive, nor were the specimens put into such a form as to deserve notice in the report of the jury, while several large collections from Belgium received only an honorable mention. A prize medal was awarded to the collection of hones and grindstones exhibited in the English division by Mr. C. Meinig, proprietor of one of the most important establishments in England, for the preparation of such stones. He imports stones from all parts of the world, and in the report of the jury, I observe mention made of hones from the banks of the *Niagara*. The name did not attract my attention while inspecting the collection, and I have not since been able to ascertain whether the *Niagara* indicated is that which joins Lakes Erie and Ontario. If it be so, I am not acquainted with the rock from which the stone has been derived, unless it be the grey band, which is used for grindstones in some parts of the country, but which does not appear to me to be of a sufficiently fine quality for any of the stones exhibited by Mr. Meinig. The oil-stones of his collection were very numerous, and of the grindstones there were upwards of 200 different kinds, varying from the size of two inches to that of two feet in diameter, of all degrees of hardness, and adapted to all purposes. The collection awakened the attention to the value that may belong to rocks fitted for such purposes. The tripoli earth from Montmorency, from its infusorial character, excited the interest of those practised in observing with the microscope.

None of the rocks of the Eastern Townships, which are fit for the purposes of roofing slates, being yet practically worked, the samples exhibited from them were necessarily all more or less weather-worn specimens from the crop, and merely sufficient to shew that such a material existed in the country. They certainly presented but a rude appearance, when compared with the magnificent display from the Festiniog quarries of North Wales; but this admirable collection, upon the spe-

cimens of which a great amount of skilful labor had been expended, while it threw into the shade the rude materials from Canada, and even the collections from extensively worked quarries in other countries, afforded a most instructive and satisfactory lesson of the variety of useful purposes to which so cheap and easily wrought a stone could be devoted. Not only is it applied as a covering for houses, but it is employed as walls for cisterns to hold water, slabs of fifteen feet by eight feet being sometimes used for the purpose ; in smaller dimensions, it is used for wine coolers, dairy dressers, kitchen and hall flooring, tables, chimney mantles, and a multitude of other purposes where surface is required. In its application as tables and chimney pieces, it is capable of receiving a great degree of decoration ; the tables, after being dressed to the smoothest possible surface, are embellished with gilding or with paintings in colors resisting fire, showing landscapes, or imitations of stone, and a silicious varnish being applied, the stone is subjected to a heat which melts the varnish into an enamel, and produces a brilliant result. Chimney pieces in the same way are enamelled over the natural color of the stone, or over a fancy color given to it. When the color is black, it is difficult to distinguish the slate from a brilliantly polished and valuable black marble, while the cost is comparatively small. The great number of purposes to which good slate is applicable, render the rock of great economic importance, and well worthy of research. The experiments, however, that are required to test the material before it can be ascertained beyond doubt, that it is of good and fit quality, and particularly to reach the stone in a part free from injury by weather, are greater than the ordinary expenses of a geological survey would permit, and it cannot be said that proper trials have yet been made on the slates of Canada.

In respect to the building stones of the country, I must confess my disappointment that a better collection was not forwarded for exhibition. Considering the abundance of excellent material the Province affords, fitted for the purposes of construction, the great amount of it that has been used in various public works, such as canals, bridges, court houses and gaols, as well as the erection of churches and private edifices, and

the consequent knowledge of the material that must be in the possession of proprietors, engineers, contractors and builders ; I had expected contributions from many sources in the form of dressed blocks, and endeavoured in some instances by solicitation to procure them, but with the exception of a very handsome dressed block of limestone of a foot cube, from Mr. N. Aubin, of Quebec, a dressed slab of granite from Mr. Munroe, of Stanstead, and a smaller one of limestone from Mr. J. Scott, M. P. P., of Bytown, I was under the necessity of representing our building stones by such shapeless fragments of suitable material as had been collected on the Survey for rock specimens. In the English division of the mineral department there were some admirable collections of building stones, and so important a branch of objects were the building stones considered, that a prize medal was awarded to the best collection, and honorable mention was made of several others. Some single blocks of cut granite in the best collection weighed no less than thirty-one tons, and of this species of rock there were many splendid examples from Devonshire, Aberdeen, and other places ; but none of them in respect to the even grain of the stone and its general aspect as a material for construction, appeared to me to equal the granite of the Eastern Townships, an undressed block of which measuring upwards of a foot cube, procured from the vicinity of Stanstead, was much admired.

Several considerable blocks of limestone and serpentine, fit for the purposes of marble, carried across the Atlantic in the rough, were sawed and polished in London. They were all from the Eastern Townships, and though selected hastily and without previous trial of the stone, most of them gave very fair results, and one of the serpentines from Brompton Lake, shewing a dark green ground with black spots, was of a peculiarly beautiful character. I was informed by the marble manufacturer, a highly respectable one, who cut the stone, that large blocks of such a description would command a ready sale in the metropolis, and when we consider the great extent to which the serpentine ranges through the townships, 135 miles, the results of these trials give hopes that much stone of a valuable description may be obtained from that region.

Before quitting the subject of the Industrial Exhibition, I

am desirous of expressing to your Excellency how much I feel myself indebted to Mr. Henry Houghton, the gentleman to whom was committed, in the first instance, the general arrangements of the Canadian division, for the ready and uniform attention with which he met all my demands upon his time; in regard to what was required in the mineral department. His judicious distribution of the space allotted to the contribution, and his taste in deciding upon appropriate decoration, added greatly to the attraction of the whole collection, and the minerals participated in the effect of this upon public attention. I have to thank for their kindness also those gentlemen who were with myself subsequently joined with Mr. Houghton as commissioners; and I am further bound to express my obligation to Mr. Alfred Perry, whose zeal in the performance of the duties assigned to him in the Canadian division, was of great advantage to all the Canadian exhibitors.

*Museum of Economic Geology.*—The act making provision for a Geological Survey of the Province, contemplates as one of its objects the establishment of a Provincial Museum for the purpose of illustrating by maps, specimens and descriptions, the geological structure of the country, and of affording a view of its mineral resources; and the government having placed at the disposal of the Survey a building, in which the arrangement of the materials that have up to this time been brought together can be commenced, it may be proper to draw your Excellency's attention to the subject. Of the utility of such a museum for the purposes of instruction, if the arrangement of its detail is properly carried out, there can be no doubt; and one branch of the subject which it appears to me should be especially attended to, is that which relates to economic geology. In museums connected with educational institutions, minerals are usually exhibited as they are related to one another in chemical composition, in crystalline form, or other outward mark by which they are distinguished; such collections are useful to enable a learner to acquire a general knowledge of mineralogy. Or they may be arranged in their geological relations, shewing how the minerals are grouped in the veins or beds which contain them, what species of rocks the veins cut, and the attitude of both the veins and the strata;

and if to this be added the order of sequence in the strata, as they are marked by their fossils, the collection would teach geology, including the art of discovering useful minerals. But another arrangement of which mineral substances are capable, and which is not found in ordinary educational institutions, regards their application to the purposes of life ; it is particularly in the exhibition of the useful minerals of the country, and the illustration of their applications by examples, that a collection connected with a geological survey is of essential advantage ; and it is while a geological survey is an operation that such a collection can be best acquired.

Including this branch of the subject, the collection of the Survey would show the mineral and mechanical character of the rocks of the Province, their sequence in the order of superposition, the fossils they contain, by which nature has marked them as with a brand, rendering them recognizable wherever they are met with, the attitude they have beneath the surface, their geographical distribution, and with that, the geographical distribution of the useful materials they hold, and then the purposes to which these materials can be applied. To illustrate these uses properly, would necessarily require a good deal of the manipulation of the artizan. It would be necessary to saw and polish blocks of marble and other stones, to dress and prepare slates, to dress building materials, in short to give to each substance the various useful forms, which it is capable of receiving. To do this in the most effective manner, it would sometimes be requisite to have recourse to artizans at a distance, and the cost attending it being additional to the ordinary expenses of a geological survey, would require some aid from the government, beyond that devoted to the Survey at present, which is chiefly spent in exploration and chemical analyses. The building in which the government have at present lodged the Survey, is as well calculated for the display of these various objects as any one not expressly erected as a museum can be expected to be, but some outlay would be required for fittings. It may, however, be a consideration whether a growing country like Canada could not afford to anticipate what its future importance may require in the nature of a national museum, and at some time not far distant, erect an appropriate edifice especially planned for the purpose.

In the arrangement of the Provincial collection, the Museum of Practical Geology in London, which is connected with the Geological Survey of the United Kingdom, under the Commissioners of Her Majesty's Woods and Forests, is an institution of the order which I would recommend for imitation. The popularity of this Institution attests the amount of instruction derived from it, and the Industrial Exhibition itself was nothing more than a grand and instructive display of the same kind, in which the idea was carried beyond minerals, to all substances which nature yields, and to all the applications of which they are capable,—beyond the materials and industrial arts of one country, to those of the whole globe.

In a new country, just beginning to ascertain its possession of useful minerals, one of the most difficult things possible is to introduce the skill requisite to make them available. Descriptions of them, and their applications, may be printed and published, but it is not easy to get the descriptions read; indeed a vast number of those whose labor might be available to turn the materials to profit, can read with difficulty or not at all; but it requires little tuition to comprehend the objects of industrial art when addressed to the eye, and imitative skill is more excited by the sight of such objects, than by written descriptions even when understood. In a collection of them, many persons, to whom the knowledge would in no otherwise come, may recognize substances which they have in abundance at their own doors, but of which they know not the use. The examples which show their uses, may prompt attempts to make them available, and the collection thus becoming a school of mineral arts, would be a means of exciting native industry.

I have the honor to be,

Your Excellency's

Most obedient servant,

W. E. LOGAN

# REPORT

OF

ALEX. MURRAY, ESQ., ASSISTANT PROVINCIAL GEOLOGIST,

ADDRESSED TO

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

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WOODSTOCK, 29th January, 1852.

SIR,—I have the honor to lay before you the result of my investigations during the summer and autumn of 1851, in connection with the Geological Survey of the Province under your direction.

With the exception of a short excursion to the township of Enniskillen, in the Western District, made chiefly for the purpose of ascertaining the extent of a deposit of mineral pitch, mentioned as occurring in last year's Report, in that township, my time has been almost exclusively employed in examining the country lying between the Rivers Ottawa and St. Lawrence, taking the confluence of these rivers as the eastern, and a line from Gananoque to Bytown as the western, limit of exploration.

In the interior of this portion of the country, much difficulty is encountered in tracing out the boundaries of the more ancient fossiliferous formations, in consequence of the great accumulation of loose comparatively recent deposits of clay, sand and gravel, which cover them up over very extensive areas; and the difficulty is enhanced by the nearly horizontal attitude of the more ancient formations themselves, which in general prevents them from exhibiting distinct ridges and valleys, or forming any conspicuous feature in the country; so evenly do these strata lie hidden under the drift, that the inhabitants appear to remain unconscious of their existence, until some accidental circumstance, such as sinking for the foundation of a house, or digging for a well, reveals it; and where

their presence has been determined in such ways, it is often no easy matter to get evidence of the nature of the rock by specimens, or a correct instructive description. Large portions of the territory too are still unoccupied, and dense forests and extensive swamps frequently interrupt the progress of the explorer; so that from all these circumstances, points in the line of the actual contact of any two formations being but rarely to be seen, and the exposures on each side of it often at a considerable transverse distance apart, the geographical limits of the formations can be only approximatively ascertained. In the whole of the area, comprising about 10,000 square miles, it may be said that there is only one exception to its general horizontality; this is found in the Mountain of Rigaud, composed of trap, the summit of which is 538 feet above the Rivière à la Graise, at its foot, where this stream joins the Lake of Two Mountains, while the land for nine miles southward from the summit maintains a considerable elevation, overlooking the level tract beyond, up and across the St. Lawrence. As illustrative of this horizontality, you have already stated in the Report of your exploration of the Ottawa, that the Petite Nation River, which unwaters the chief part of it, taking its rise within a mile of the St. Lawrence, and discharging into the Ottawa, has a fall of only ninety feet in ninety miles; and the following levels taken on the proposed line of the Bytown and Prescott Railroad, and kindly furnished me by Thomas Keefer, Esq., C. E., will exhibit the same thing in another part. The levels are given in feet over the Ottawa at Bytown:—

|                                                                                         | Rise.<br>Feet. | Fall.<br>Feet. | Height.<br>Feet. |
|-----------------------------------------------------------------------------------------|----------------|----------------|------------------|
| Lot O, Bytown,.....                                                                     |                |                | 62-24            |
| Billings', Gloucester, lot 17, Rideau front.....                                        | 58-36          |                | 120-60           |
| Cumming's, W. Gloucester, lot 17, con. 13.....                                          | 124-00         |                | 244-60           |
| Rossiter's, Osgood, lot 3, con. 5.....                                                  |                | 69-60          | 175-00           |
| Kemptville, Oxford, lot 27, con. 3.....                                                 |                | 30,00          | 205-00           |
| Edwardsburgh, lot 27, con. 10, 12½ miles from St.<br>Lawrence.....                      |                | 35,00          | 240-00           |
| Edwardsburgh, lot 30, con. 6, on Petite Nation<br>River, 8 miles from St. Lawrence..... |                |                | 73-00..167-00    |
| Petite Nation River, 10 miles from St. Lawrence.                                        | 8-00           |                | 175-00           |
| St. Lawrence, at Prescott.....                                                          |                |                | 57-00..118-00    |

A less important set of levels taken during the season on the Rivière de l'Isle, joining the St. Lawrence below Lake St. Francis, shewed the bed of this tributary at Dalhousie Mills on the ninth lot of the eighth concession of Lancaster, to be fifty-nine feet above its mouth at the Coteau Rapids, which would give three and a-half feet per mile as the fall in the river, the distance being seventeen miles. The mouth of the Rivière de l'Isle is fifteen feet below Lake St. Francis; the bed at Dalhousie Mills, therefore, is forty-four feet above the Lake. The highest point on the road about a mile and a-half north from the Mills, and commanding the country around for a considerable distance, is eighty-two feet over the stream, and thus 126 feet over Lake St. Francis, the chief rise being immediately near the Lake; and though there are some few distant points of country rather higher than this, they probably do not exceed 150 feet above the lake.

This plateau is of a good agricultural character where it is cleared, and produces much heavy pine timber in its forests. The country which flanks it to the westward is hilly, but not mountainous, and the exposures of rock are more numerous than is satisfactory to farmers; that on the north is still more rugged, while on the south in the United States, there rises a mountainous tract with many points several thousand feet in elevation; the geological formation on all these sides is the same.

#### *Distribution of the Formations.*

The rocks of the area constitute a trough, of which those that underlie the level part are determined by their organic remains, to be of the Lower Silurian age, while those composing the hilly or mountainous rim are a highly crystalline, unfossiliferous, Metamorphic series of greater antiquity.

My examination of the Metamorphic series has been chiefly confined to the western limit of the plateau, including the shore and islands of the St. Lawrence, between Brockville and Gananoque, and the townships north from the river, lying between it and the Rideau Lake. The character of the mass in the Thousand Islands, and on the immediate north bank of the St. Lawrence, is that of micaceous and hornblendic gneiss,

the elementary minerals of which prevail more or less in all the layers, and according as some one of such minerals preponderates in a bed, it gives it a micaceous, hornblendic, feldspathic, or quartzose character. Such beds are variously interstratified with one another, and some occur which are a nearly pure quartzite. In some parts there occurs an alternation of white and grey quartzite, the former sometimes very pure white, and occasionally vitreous, perhaps fit for glass-making, as at Block-house Island, and the main shore near Brockville.

When the elementary minerals are much mixed, the beds are generally fine grained, and they frequently hold small crystals of tourmaline ; but there are large grained masses running with the stratification, very feldspathic, sometimes grey and sometimes white, the latter consisting almost entirely of large individuals of white feldspar ; but these, notwithstanding their apparent conformity with the beds, may in reality be dykes. On the north bank of the river, about a mile below the village of Gananoque, a fine grained yellowish or cream colored crystalline magnesian limestone occurs, associated with white quartz and large grained feldspar, the latter in spots and patches through the calcareous matrix, which is also dotted with small spangles of graphite.

In Escott, on the sixteenth lot of the second concession, in flesh colored feldspathic beds, interstratified with more micaceous bands, a string of magnetic iron ore was met with, running in the trough of a fold, and small granite dykes occurred cutting the gneiss transversely ; both the dykes and the beds were marked by the presence of small crystals of copper pyrites.

On Charleston Lake, situated in the northern concessions of Escott and Lansdowne, the prevailing rock, on the numerous islands and on the shores, is whitish or greyish quartzite, associated with masses of white feldspar rock and white crystalline limestone. On a point about half-a-mile south-west from Charleston village, and on an island half-a-mile beyond, called Bluff Island, there is a rock consisting of a mixture of a pale green indurated talcose mineral resembling serpentine, and grains of crystalline translucent quartz, colored red with oxide of iron, which has resulted from the decomposition of portions

of the rock itself, or has been infiltrated, and has stained it throughout.

Masses of large grained granite, probably dykes, often holding crystals of black tourmaline, are likewise associated with the quartzite, and are largely displayed near the northern part of the bay generally known as Carrying Place Bay by the inhabitants of the neighborhood.

Near Furnace Falls, on the second lot of the eighth concession of Lansdowne, there is a considerable display of crystalline limestone, holding as usual spangles of graphite and mica, with grains of quartz, and the mass is of a decomposing crumbling nature. The strike of the beds is north-east and south-west, and they are cut by a transverse vein of calc-spar and heavy-spar, sometimes the one mineral and sometimes the other prevailing; through both are disseminated crystals of galena with iron pyrites, and probably copper pyrites, the latter indicated by stains of green carbonate of copper, arising from the decomposition of the sulphuret.

Crystalline limestones are also extensively exhibited in the neighborhood of Beverly, township of Bastard, and of Newboro', in South Crosby. Their color is usually white, but sometimes greyish-white, or white with grey bars or stripes. Small scales of graphite are invariably disseminated through the rock with serpentine, mica, and iron pyrites; and in the twenty-seventh lot of the third concession of South Crosby chondrodite is of frequent occurrence, the disseminated mineral alternating with bands containing mica. The texture of the limestone is usually coarse, but near Beverly the best beds are worked as a marble for common purposes. These are greyish-white in color, and are strongly coherent, but they contain small spangles of yellow and white mica and graphite; nodular masses of vitreous white quartz, surrounded with thin layers of brown mica, and both enclosed in foliated green pyroxene, are met with in some of the beds.

On the twenty-fourth lot of the tenth concession of Bastard there is an unmistakable bed of conglomerate, interstratified between two beds of the highly crystalline limestone, shewing the sedimentary origin of the Metamorphic series. The dip

of the strata at the spot is N. 55 E.  $< 30^\circ$ , and the following ascending section demonstrates the character and relation of the beds.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <i>ft. in.</i> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Pure white, highly crystalline, coarse grained limestone with small disseminated scales of graphite running in layers, and rounded grains of mica .....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 5 0            |
| An aggregate of colorless translucent quartz, containing cleavable forms of white feldspar, readily decomposing by the action of the weather into kaolin, with patches of greenish chloritic limestone containing brown mica; in some parts the feldspar is replaced by a soft greenish-white sub-translucent unctuous mineral, having a somewhat columnar structure, and a waxy lustre resembling indurated talc, and there are present occasional scales of graphite, and grains of copper pyrites decomposing into the blue carbonate.....                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0 4            |
| A fine grained and more calcareous aggregate of quartz, with cleavable forms of feldspar and calc-spar, and scales of graphite; green stains occur in patches.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0 2            |
| Coarse conglomerate, of which the matrix is a fine grained quartzose sandstone, somewhat calcareous, and still containing white feldspar, which occurs in the forms of grains and pebbles, associated with well defined large and small pebbles of vitreous, milk-blue, translucent and sometimes opalescent quartz. There are pebbles of fine grained homogeneous greyish sandstone more calcareous than the matrix; some similar to these, but nearly white and more pulverulent, afford to chemical tests a small quantity of phosphate of lime, and others of yellowish-grey sandstone are finely but distinctly laminated, the laminæ being shewn by intervening bands of a white color; one of the laminated pebbles is characterised by a layer of coarser pebbles in one of the divisions. The sandstone pebbles are flat, and lie on their flat sides in the general plane of the stratification. Mica is disseminated in considerable abundance, and there are a few scales of graphite..... | 1 6            |
| Fine grained calcareous sandstone.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0 2            |
| Fine grained, very hard, crystalline, arenaceous bluish-grey limestone, weathering reddish, with a few scales of graphite.....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0 4            |
| Pure white, highly crystalline, coarse grained limestone with scales of graphite in some abundance, and rounded grains of mica, besides small grains of amber colored chondrodite running in layers .....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 6 0            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 13 6           |

A portion of the Metamorphic formation is seen near the eastern extremity of the trough, in the seigniory of Rigaud, flanking the Rigaud Mountain on the south. The mountain itself, as observed in your Report on the Ottawa, is a trap, the character of which varies considerably in different parts. The north-west side, directly over the village of Rigaud, was found to consist of an aggregation of pinkish or flesh-colored feldspar and smoky quartz, sometimes holding grains of magnetic iron. At the summit, on the north-west end, the rock is porphyry, having a dark bluish-grey syenitic base with grains of magnetic iron disseminated through it, and holding greyish or yellowish-white crystals of feldspar. Another kind occurs on the south side of the mountain, where it is a reddish or yellowish-white feldspar, with disseminated crystals of brilliant black hornblende, and grains of transparent quartz, the exterior surface of the rock weathering very white. At the eastern end of the mountain, the rock is composed of large sized individuals of reddish and greenish-white feldspar, stained red with infiltrated peroxide of iron, and among them are disseminated grains of translucent quartz, and occasional strings and bunches of specular iron; the rock is cut by small veins of compact brown jasper.

On the south side of the mountain, on the twelfth lot of the Côte Guillaume, there are gneissoid beds consisting of an aggregation of flesh colored grains of feldspar, and in lesser quantity of small grains of translucent white quartz and black hornblende, with the addition of small grains of magnetic iron. These beds are interstratified with others of a different character; one set is composed of small cleavable forms of black hornblende with grains of translucent yellowish-white feldspar weathering opaque white, and crystals of brown mica. Another consists of greyish-green cleavable pyroxene, with individuals of greenish feldspar weathering white, and largely disseminated grains of magnetic iron; and a third consists of translucent albite, with black hornblende and magnetic iron ore disseminated, alternating with micaceous layers. All these beds are intersected by transverse dykes, some of which are of fine grained greyish-black trap, probably a greenstone, with disseminated grains of calc-spar, while others are porphyritic,

having a fine grained blackish-green base, with individuals of greenish-white translucent feldspar. Flesh colored feldspathic veins likewise intersect the bedding, and titaniferous iron occurs in patches in some of these dykes, as well as in some of the beds. The run of the gneissoid ridge is nearly N. E. and S. W., and the beds shew a dip to the south.

The Lower Silurian group of rocks, underlying the more level parts of the district, are agreeably to the nomenclature of New York, and in ascending order as follows.

Potsdam sandstone.

Calciferous sandrock.

Chazy limestone.

Birdseye, Black River and Trenton limestones.

Utica slate.

*Potsdam sandstone.*—Towards the western end of the trough which the group forms, this rock, resting unconformably on the previously described Metamorphic series, is traceable by a multitude of exposures running in a meandering course from Brockville to the vicinity of Perth, the bays and promontories of its geographical distribution being occasioned partly by inequalities in the surface of its gneissoid base, and partly by very gentle undulations in itself; on the eastern side it can be followed from the Cascades, by Vaudreuil to Rigaud.

The cliffs below Brockville expose a sequence of seventy-five to eighty feet thick, consisting of the sandstone, with interstratified calcareous bands at the top, and a coarse silicious conglomerate at the base; and about two and a-half miles above the town, an outlying patch of the formation comes in on the river bank, and occupying it for seven miles up, occasionally shews the silicious conglomerate in unconformable contact with the Metamorphic series below. Many of the upper and finer beds of these exposures exhibit fucoids on their surfaces, and a number of small cylindrical holes, recognised as the *Scolithus linearis* of Hall; fragments of shells also occur in some of the interstratified calcareous layers, but they were invariably found to be too obscure to be identified.

At Charleston Lake there is an extensive development of the formation on the north shore, and outliers occur on many of the numerous islands which stud the lake. On one of these

islands already mentioned as a mile south-west of Charleston Village, and commonly called Bluff Island, the following descending section occurs :

|                                                                                                                                                                                                                                                      | Ft. | In. |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| Sandstone, blood-red at the top and chocolate colored at the bottom, with nodules or concretions of quartz, weathering brown on the upper surface.....                                                                                               | 4   | 0   |
| Thin bedded white, red, and chocolate colored sandstone.....                                                                                                                                                                                         | 4   | 0   |
| Red and greyish or white sandstone in alternating stripes .....                                                                                                                                                                                      | 4   | 3   |
| Dark brown sandstone of a pink or reddish hue, and occasionally striped with decided red.....                                                                                                                                                        | 5   | 7   |
| Red and dark brown sandstone.....                                                                                                                                                                                                                    | 5   | 0   |
| Blood-red coarse sandstone with concretionary nodules.....                                                                                                                                                                                           | 2   | 0   |
| Dark brown, red and yellow banded coarse grained sandstone, dividing into thin layers .....                                                                                                                                                          | 11  | 0   |
| Red and yellow sandstone in alternating stripes, divided into thin layers.....                                                                                                                                                                       | 7   | 3   |
| Red and yellow striped and mottled sandstone of a coarse grain, not well exposed.....                                                                                                                                                                | 11  | 0   |
| Coarse red sandstone with quartz pebbles scattered through it...                                                                                                                                                                                     | 2   | 6   |
| Coarse dark yellow sandstone striped and mottled with red ; the upper part is red, and holds large pebbles of quartz scattered through it .....                                                                                                      | 3   | 6   |
| A conglomerate bed, with a matrix of dark brown or yellowish coarse silicious sandstone, sometimes tinged with pink, and holding pebbles chiefly of quartz, in irregular layers ; the largest pebble or rather boulder is one foot in diameter ..... | 8   | 0   |
| Coarse dark brown sandstone or fine conglomerate, with pebbles chiefly of white quartz .....                                                                                                                                                         | 2   | 11  |
|                                                                                                                                                                                                                                                      | 71  | 0   |
| Red talco-quartzose rock of the Metamorphic series.....                                                                                                                                                                                              |     |     |

The infiltrating iron oxide, which has stained the red talco-quartzose rock at the base of the section, seems to have imparted its color to the overlying mass, and on some parts of the lake, the color of all the lower beds, both sandstones and conglomerates, is deep blood-red, which gives place gradually in the ascending strata, to white with red stripes and spots, and then to white alone. On the eleventh lot of the eleventh concession of Lansdowne, at the head of one of the northern bays of the lake, there is a section of about forty feet thick, consisting of white sandstone, with shaly and slightly calcareous layers at the top, and conglomerate below, which is seen in contact with the Metamorphic rocks, but, (in consequence of

the uneven surface of these,) at a higher level than the highest beds of the previous section, and it is probable that these white beds are additional strata ; the two together would thus give a total thickness of at least 110 feet. Fucoids, *Scolithus linearis* and *Lingula antiqua*, are found associated together in abundance in the upper slaty calcareous part, though sometimes rather obscure.

There is likewise a large display of sandstones and conglomerates in the township of Bastard near Beverly, where the red color prevails near the contact with the crystalline rocks. One exposure occurs on the line dividing the twenty-fourth and twenty-fifth lots, in the tenth concession of the township, near the town line of Lansdowne, where there is a cliff of sandstone of from twenty to thirty feet high. The rock lies in massive beds, occasionally measuring four feet and upwards in thickness ; they are all ferruginous, and passing upwards from a yellow or light brown into a deep red color, they present small seams and patches of specular iron. On the ninth lot of the twelfth concession of Lansdowne also, the same rocks contain streaks and patches of specular iron, a short distance from their junction with the crystalline limestone. North from Beverly, on the twenty-second lot of the ninth concession of Bastard, white sandstone beds, which must be higher than the preceding, contain fucoids, *Scolithus linearis*, and in a full state of preservation and great abundance, *Lingula antiqua*, with another and rarer species much less tapering to the beak. They occur also in a cliff near Newboro', a short distance from the town line between North and South Crosby.

In the townships of Elmsley and Montague, sandstones were observed encircling a dome of Metamorphic rock, which rises on the twenty-eighth lot of the seventh concession of Montague ; and portions of the formation, holding *Scolithus linearis* and fucoids, come to the surface on the crown of an anticlinal form, on the twenty-fourth lot of the fourth concession of West Gloucester ; the anticlinal appears to run parallel with the Ottawa, and again bringing to the surface an exposure of white sandstone, on the thirteenth lot of the eighth concession of East Hawkesbury, makes for the trap mountain of Rigaud and its accompanying Metamorphic rocks. In following the sandstones of

the Potsdam formation from the Cascades to Rigaud, they were found to assume a reddish tinge, on the road in the vicinity of Pointe du Grand Détroit, and to hold frequent small decomposing grains of reddish feldspar; patches of conglomerate occur in some of the beds, the pebbles of which are chiefly of vitreous quartz. In a position supposed to be geologically superior to these, about twenty-five acres above the Pointe du Grand Détroit, fine grained white quartzose sandstones were met with in beds of from six inches to two feet thick. Some surfaces displayed ripple-mark, and on one, trails and footprints of a species of animal exist, similar to the tracks occurring at Beauharnois, in the same description of beds. The largest of the tracks measures eight and a-half inches across, and the trail is visible for four feet, and gradually becomes obliterated at each end. On the same surface, twenty yards farther up the stream, three additional tracks of the same sort were observed, each one traversing the other two; two of these measured four inches across, and the third four and a-half inches; the last is distinct for three feet in length, and the other two, one foot eight inches, and one foot three inches respectively. The groove in the middle between the footprints on each side, so frequently seen at Beauharnois, occurs only in one of the smaller trails.

*Calciferos sandrock.* Resting on the sandstone just described, and frequently capping the cliffs composed of it, are a set of calcareous sandstones and impure arenaceous limestones, which follow its meandering outcrop. The calcareo-arenaceous beds hold geodes and patches of white and smoke-brown calc-spar, sometimes of gypsum, and display convoluted shells of the genera *Raphistoma*, *Maclurea* and *Euomphalus*, and less frequently spiral ones of the genus *Murchisonia*, with fucoids, all of these organic remains being often very obscurely weathered out. Ascending the St. Lawrence, the first intimation of the presence of this formation, connected with the western part of the trough, occurs in the vicinity of the village of Johnstown and on some of the islands opposite. At Battle Windmill, a little over a mile below Prescott, the following descending section was measured:—

|                                                                                                                                |         |
|--------------------------------------------------------------------------------------------------------------------------------|---------|
| Pale grey arenaceous impure limestone, weathering bright yellow,<br>and rapidly disintegrating on exposed surfaces; the bed is | Ft. In. |
|--------------------------------------------------------------------------------------------------------------------------------|---------|

|                                                                                                                                                             |    |       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-------|
| filled with concentric concretionary balls, the concentric layers of which are frequently interlined with white calc-spar.....                              | 1  | 2     |
| Grey less impure limestone.....                                                                                                                             | 0  | 5     |
| Grey arenaceous limestone, with many geodes of calc-spar, and cracks lined with the same mineral.....                                                       | 0  | 7     |
| Drab colored calcareous sandstone, with a large quantity of calc-spar in geodes.....                                                                        | 1  | 5     |
| Compact pale grey, yellow weathering arenaceous limestone, rapidly disintegrating on the surfaces.....                                                      | 0  | 8     |
| Compact pale grey arenaceous limestone with geodes of calc-spar; a thin division of greenish-brown shale lies between it and the previous bed.....          | 0  | 10    |
| Dark blue arenaceous limestone.....                                                                                                                         | 0  | 8     |
| Brownish calcareo-arenaceous shale.....                                                                                                                     | 0  | 3     |
| Dark blue arenaceous limestone, with small geodes of calc-spar.....                                                                                         | 0  | 6     |
| Dark blue arenaceous limestone of a crystalline structure, sometimes tinged with red, and separated into beds by thin layers of a very dark blue shale..... | 1  | 2     |
| Brownish-grey rather coarse textured limestone, with obscure convoluted shells.....                                                                         | 4  | 6     |
| Dark blue arenaceous limestone with occasional large concentric balls.....                                                                                  | 2  | 0     |
| Arenaceous limestone.....                                                                                                                                   | 3  | 6     |
|                                                                                                                                                             |    | <hr/> |
|                                                                                                                                                             | 17 | 8     |

The dip of the measures here is nearly east, at an angle of two to three degrees; ascending the river, lower beds are alternately concealed and exposed, but there are probably several gentle undulations in the strata, and the following descending section, as measured a short distance above Maitland, is supposed to begin about where the former ends.

|                                                                                                                                                 | Ft. | In. |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| Dark blue arenaceous limestone with geodes of calc-spar; there are exposed on the surfaces of the beds, fucoids and many convoluted shells..... | 5   | 0   |
| Dark brownish-grey silicious limestone in irregular layers.....                                                                                 | 2   | 6   |
| Dark bluish grey arenaceous limestone.....                                                                                                      | 3   | 0   |
| Grey quartzose sandstone, weathering brown.....                                                                                                 | 2   | 0   |
| Dark grey calcareous sandstone.....                                                                                                             | 2   | 6   |
| Concealed.....                                                                                                                                  | 6   | 0   |
| Bluish-grey slightly arenaceous limestone.....                                                                                                  | 0   | 6   |
| Pale grey or drab colored sandstone in thin beds.....                                                                                           | 3   | 0   |
| Concealed.....                                                                                                                                  | 6   | 0   |
| Pale grey arenaceous limestone with great quantities of fucoids on the upper surfaces.....                                                      | 3   | 0   |

|                                                                                                       |    |       |
|-------------------------------------------------------------------------------------------------------|----|-------|
| White sandstone, calcareous on the upper part.....                                                    | 4  | 0     |
| White sandstone, with soft brown-stained vertical streaks probably<br><i>Scolithus linearis</i> ..... | 5  | 0     |
| Concealed .....                                                                                       | 10 | 0     |
| Brownish-grey calcareous sandstone.....                                                               | 2  | 0     |
| White quartzose sandstone, with some thin interstratified calcareous<br>bands .....                   | 5  | 0     |
|                                                                                                       |    | <hr/> |
|                                                                                                       | 59 | 6     |
|                                                                                                       |    | <hr/> |

This section, it is evident, is at the base of the formation, where it begins to form a passage to the sandstones beneath, and exposures of this part are very frequent along the whole line of the sandstone outcrop. Towards the interior, however, where the Calcareous sandrock formation approaches the overlying more calcareous series, the investing drift of the country permits fewer opportunities of observation. Exposures were met with at Spencer's Mills on the South Petite Nation, at Grant's Mills lower down, and on the first lot of the seventh concession of Edwardsburgh; in Oxford on the twenty-sixth lot of the tenth concession, and the thirtieth lot of the eighth concession, not far from a denuded mass of quartz rock, belonging to the Potsdam sandstone or the Metamorphic series beneath; again near Kemptville, on the twenty-fourth and thirtieth lots of the third and fourth concessions, and in South Gower on the tenth lot of the ninth concession. In Yonge the rock occurs on the eleventh lot of the eighth and of the ninth concessions, at Loyedu Lake, in the rear of the township, and in Kitley, near the village of Kitley Corner. On the Rideau Canal, it is seen at Smith's Falls, in a cliff of thirty feet, and at Kilmarnock, Merrickville and Nicholson's Rapids. In the south part of the township of Gloucester, it forms a cliff of thirty to forty feet, running from the fourth concession to the town line on the sixth, a distance of ten miles, and the Potsdam sandstone coming out at the base of the cliff, forms an anticlinal arch, which has been already alluded to. In the supposed continuation of this anticlinal in East Hawkesbury, it appears on the thirteenth lot of the seventh concession, where it constitutes a well marked ridge for several miles across Lochiel.

Very few beds belonging to the formation yield good lime; such, however, do occur in some parts, as at Brockville and

Merrickville ; the lime produced from them is dark colored, but is effective in giving strength to the mortar made from it. Stone for building purposes is abundant in the formation ; many of its beds yield a tough, solid and strong material, but it turns yellow under the influence of the weather. Some of the locks on the Rideau Canal afford good examples.

*Chazy, Birdseye, Black River and Trenton limestones.*—On Sheik's Island, opposite Mille Roches, in the higher part of the township of Cornwall, there occurs a grey limestone almost entirely composed of multitudes of a species of bivalve shell (*Atrypa plena* of Hall), and there are present with it a few examples of an unfigured species of *Cythere*. The rock rests upon greenish shale, abounding with fucoids, and it constitutes the base of the Chazy limestone formation, which succeeds the formation previously mentioned. On the twenty-fourth lot of the fourth concession of Cornwall, about a mile and a-half or two miles north of Mille Roches, a quarry is opened in massive beds of black limestone highly charged with iron pyrites ; the fossils of the rock are chiefly a large *Orthoceras*, of which the chambers hold indurated bituminous matter, *Streptoplasma crassa*, *Schizocrinus nudosus*, *Leptena alternata*, *L. sericea* and *Orthis testudinaria*, shewing the rock to belong to the Trenton limestone, of which it is probably near the base. In the apparent strike of these beds, on the sixth lot of the fourth concession of the same township, in a quarry where the stone has been extensively worked for the construction of the canal locks, the same description of black massive beds occurs ; and its fossils are *Columnaria alveolata* holding an indurated bituminous matter in the cells, with fragments of *Stictopora acuta*, *Schizocrinus nudosus* and *Isotelus gigas*, as well as the genera *Chætites*, *Leptena*, *Atrypa*, *Murchisonia* and *Cythere* ; orthoceratites also occur, and one of the forms appears to be *Ormoceras tenuifilum* ; some of these species characterise the Birdseye and others the Trenton limestone. Farther on in the strike, on the twenty-second lot of the second concession of Charlottenburgh, black and dark grey beds shew *Leptena sericea*, *L. deltoidea*, *Orthis testudinaria*, *Schizocrinus nudosus*, with *Pleurotomaria*, *Cyrotolites* ? and *Orthoceras*. Turning more northward, and proceeding to the thirtieth lot of the seventh concession of Lan-

caster, on the River Baudette, black beds probably of the Birdseye or Black River limestone, give *Pleurotomaria*, *Murchisonia*, *Lituites*, *Isotelus*, and *Cythere*; and across the stratification to the westward, on the eighth lot of the seventh concession of Charlottenburgh, *Leptena sericea*, *L. alternata*, and *Orthis testudinaria* occur in grey and black Trenton beds. Farther northeast on the River de l'Isle, which at its mouth and for some distance up, runs on the Calciferous sandrock, containing convoluted shells, are large angular blocks of grey limestone filled with *Atrypa plena*. This is on the seventh lot of the eighth concession of Lancaster, and about a mile below Dalhousie Mills, and the blocks probably mark the vicinity of the Chazy formation. Following the river up transversely to the stratification, at and near Alexandria on the eleventh lot of the first, and thirty-fourth and thirty-eighth lots of the second concession of Lochiel, and farther up on the Garry, on the fourth and sixth lots of the second concession of Kenyon, good fossiliferous Trenton limestone is exposed with characteristic remains. From Dalhousie Mills, the base of the Chazy sweeps round to the thirty-third lot of the seventh concession of Lochiel, where it holds *Atrypa plena* and exhibits small black nodules with a large percentage of phosphate of lime. North from this, about two miles, on the thirty-second lot of the seventh concession of Lochiel, the direction being at right angles to the stratification, there is an exposure of Trenton limestone, in which in addition to most of the characteristic species mentioned, a *Lingula* occurs as large as the largest *quadrata* figured, and like it in shape, but without the radiating striæ, and also *Conularia gracilis*; in the space between these two last spots, the Calciferous sandrock occupies the crown of the anticlinal arch which was before mentioned in connexion with that formation. In the ninth concession of Lochiel the strata strike for McDonnell's Mills, on the eighteenth lot of the seventh concession of East Hawkesbury, on the Rivière à la Graisse, where good massive beds of Trenton limestone again occur, within half a mile south of which, the same anticlinal as before, brings up the Potsdam sandstone.

Proceeding in a westerly direction from Cornwall, the Chazy limestone was not anywhere observed, and its position

must be taken as occupying the belt of country that lies between the exposures of the Calciferous sandrock on the one hand, and those of the Birdseye, Black River and Trenton limestones on the other. Black limestones belonging to the last of these formations, crop out on the twenty-sixth lot of the fifth concession of Osnabruck, and shew *Leptena sericea*, *L. alternata*, *L. filitexta*, *Orthis testudinaria*, *Lingula elongata*, *L.* like *quadrata*, but without the radiating striæ, a large bivalve like *Avicula elliptica*, and *Chatites lycoperdon*. Similar beds extend nearly across Winchester on the Petite Nation River, and quarries in them are opened in several places near Armstrong's mills on that stream. On the eleventh lot of the second concession, they hold *Cythere*, and from the twentieth lot of the second concession, black limestones characterised by Trenton fossils occur at intervals to Crysler's Mills in Finch, the whole of which township appears to be underlaid by such strata. At Crysler's Mills on the twelfth lot of the tenth concession of the township, a section shews alternations of grey or bluish and black limestones, dipping N. 50 E. at an inclination of a little over forty feet in a mile. Lumps of iron pyrites occur in the rocks, and the strata are intersected by a set of parallel small veins of calc-spar, running N. W. and S. E. At the High Falls on the seventeenth lot of the sixth concession of Cambridge, the rock is a bluish-grey bituminous and nodular limestone, divided into beds by thin partings of bituminous shale. The dip of the beds below the mill-dam, where the river runs on the face of one of them for 300 yards, is N. 7. E. inclining at an angle of about ninety feet in a mile, and the fossils they contain are *Leptena sericea*, *L. alternata*, *Orthis testudinaria*, *O. lynx*, *O. subquadrata*? *Streptoplasma crassa*, and the genera *Bellerophon*, *Murchisonia* and *Orthoceras*.

Thin bituminous leaves not only part the beds, but irregularly penetrate the rock, and in this position, probably replacing fucoids, they give the rock its nodular character. To the westward of the High Falls, at Cooke's Mills on the Castor, in the eighth lot of the ninth concession of Russell, which would be in the strike of the strata, there is an escarpment of about five feet, consisting of dark blue limestone alternating with black or

very dark blue shale. Several of the shale beds are very fossiliferous, the shells in most abundance being *Leptena sericea*, *Orthis testudinaria* and *O. pectinella*. On the south bank of the Castor, in the next concession to the west, thick beds of dark blue limestone dip N. 30 W.  $<20^{\circ}$ , and farther west at Louck's Mills, on the eleventh lot of the fourth concession, the dip which on the south side of the stream is S. 43 W. at an inclination varying from sixty to five degrees in the distance of a hundred yards, on the north side is N. 30 W.  $<17^{\circ}$ ; and while the north bank is occupied by thick bluish beds of granular limestone, the section on the south is as follows, in descending order:—

|                                                                                                                                                                                                                                                         | Ft. In. |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Black shale supplied with one species of coral in great abundance; the upper part holds large concentric concretionary spherical nodules of a fine-grained black limestone, passing in some parts into a bed of black limestone eight inches thick..... | 3 6     |
| Dark blue or black limestone holding <i>Cythere</i> in abundance, some of them of a quarter of an inch long .....                                                                                                                                       | 1 10    |
| A strong bed of black bituminous limestone, somewhat nodular in structure .....                                                                                                                                                                         | 3 0     |
| Black shale .....                                                                                                                                                                                                                                       | 0 4     |
| Dark blue limestone, with imperfect divisions of black shale.....                                                                                                                                                                                       | 1 6     |
| Dark bluish-grey black weathering limestone, with divisions of calcareous shale holding imperfect fossils .....                                                                                                                                         | 2 4     |
|                                                                                                                                                                                                                                                         | 12 6    |

The black or dark blue limestones traced thus far, were found where quarries existed, and wherever they had been tried, to yield good material for building, as well as admirable for lime, and the blacker the stone in general the whiter the lime. In many places, by carefully selecting blocks free from calcareous spar, which frequently invests cracks, and fills the organic remains, and avoiding pieces charged with iron pyrites, handsome blocks for the purpose of marble may be procured.

The Trenton limestone and its associated rocks are extensively developed on the banks of the Ottawa near Bytown, where the whole group comes in, and must attain a thickness of pretty nearly 400 feet; but the irregularities occasioned by a succession of dislocations by which the strata are several times partially repeated, disabled me from ascertaining cor-

rectly the exact amount, to determine which will require some additional examination. On the Barrack Hill there was measured an uninterrupted succession of beds, in all making 187 feet of thickness, and on the west side of a fault running S. 78 E., which occurs about 500 yards above the Barrack cliff, throwing down the strata on the south-west side about seventy feet, the beds continue to accumulate (deducting this amount,) at a pretty regular rate for nearly a mile, and a considerable distance beyond the Grande Chaudière Fall. The measures exposed in the Barrack Hill are for the most part more or less bituminous, and very fossiliferous; the upper portions which crown the cliff in the immediate vicinity of Bytown, are of a nodular structure, having the beds usually parted by black bituminous shale. The lower part of the section consists of strong bands highly charged with black chert, and underlaid by beds crowded with stems of encrinites, many of which are of large size, and in a good state of preservation. The rocks above the fault at the Barrack Hill cliff, consist of grey, yellow-weathering bituminous limestone containing numerous fossils, especially corals and spiral univalves; these being usually replaced by dolomite spar, which is less soluble than pure carbonate of lime, weather in relief on the exposed surfaces, and becoming brown from the presence of a small quantity of peroxidised iron, are strongly contrasted in color with the matrix in which they lie.

The Barrack Hill section after a small dislocation, seen a little below the mouth of the canal, parallel to the previously mentioned one, apparently producing a downthrow on the north-east side, is continued in the cliff which forms the bank down to, and for some distance beyond, the mouth of the Rideau River. At the Rideau Falls the strata are in descending order:—

|                                                         |                |
|---------------------------------------------------------|----------------|
| Nodular limestone .....                                 | Ft.<br>35      |
| Thin bedded limestone, parted by bituminous shales..... | 16             |
|                                                         | <hr/> 51 <hr/> |

*Utica slate*.—About half a mile up the Rideau River the black bituminous shales of this formation, holding *Triarthrus*

*Beckii* and other fossils characterising it, are found resting on the nodular limestone above mentioned, and with these nodular beds, were traced to the eastward as far as the twelfth lot of the second concession of East Gloucester, keeping a course nearly parallel with the bank of the Ottawa, and dipping very gently in a direction from it. Ascending the Rideau, between four and five miles higher than the half-mile previously mentioned, these black shales, after repeated exposures in the interval, shew a last one a little above Billings' Bridge on the seventeenth lot of the Rideau Front, while the first succeeding limestones appear nearly a mile above, on the twentieth lot; and a couple of miles further up, in the first and second lots of the second concession of West Gloucester, they constitute an escarpment of a hundred feet; at the lower of these calcareous exposures, the dip which is N. N. E. increases from eighteen up to forty-five degrees in inclination in a transverse distance of 200 yards, and the beds are probably in the vicinity of an upthrow dislocation, or a violent twist which will limit the shales on their southern side; the dip at the upper calcareous exposure is N. 45 E.  $> 5^{\circ}$ , and the ridge formed by the limestones it discloses, running south-eastward, crosses the Prescott Road between the tenth and fifteenth lots of the fourth concession of West Gloucester. On the flat land in front of the north-eastern slope of the ridge, a well, sunk by Mr. Walkely on the first lot of the third concession of the township, penetrated through fifteen feet of the black shale, and the foot of the ridge in its continuation westward, may be taken as the south limit of this trough of Utica slates. Between the highest and lowest exhibitions of it on the Rideau, the outcrop runs round the western extremity of the trough, but the rim it presents, is broken by the two dislocations which have been mentioned, and the effect of a third one, of which the course is about S. 55 E. throwing the measures down about a hundred feet on the southwest side, is seen on the southern edge of Dow's Swamp at St. Louis Dam, bringing the shale on the south abruptly against the limestone on the north.

How far this trough of black shales extends to the eastward, the season did not give me time to ascertain, but from information derived from various authorities and particularly from Mr.

Slater, C. E., the northern outcrop, running nearly parallel with the Ottawa, and crossing Cumberland, must reach far into Clarence, underlying the flat swampy tract of country, well known to occupy these townships a few miles south of the river.

*Drift.*—The superficial deposits which spread over the area between the Ottawa and St. Lawrence, and generally conceal the older formations, consist of clay, gravel, and sand; the first greatly prevailing on the eastern side, the last, in the western and higher portions of country, especially towards the shores of the St. Lawrence. They were observed on this river as high as Dickenson's Landing, where a brownish or drab colored calcareous clay is overlaid by a coarser clay, holding various pebbles and boulders, derived chiefly from the Calciferous sandrock, mingled with many which have been carried from the crystalline members of the Metamorphic series; and they compose, in a great measure, the banks of the river down to the Cascades. They occupy much of the south bank of the Ottawa, and are exhibited on all the tributary streams in the seigniories of Vaudreuil, Soulanges, and Rigaud, as also on the south Petite Nation and its tributaries. On the Rivière à la Graise, in Rigaud, (which probably owes its name to the greasy character of the material through which it flows), there are extensive exposures of clay, the lower portions of which are of a blue or greyish color, exceedingly fine in texture, calcareous, but apparently free from limestone pebbles or other coarse materials. The blue clay is surmounted by clay of a brownish color, in which a red band is interstratified of from eighteen to twenty-four inches; both of these likewise are calcareous and fine textured. Sections of clay are exhibited far up the Graise in Hawkesbury and Lochiel, as also on the Rivières de l'Isle and Baudette, which maintaining a character very similar in all respects to that displayed in Rigaud, suggest the probability that the whole belong to one set of deposits. No fossils were met with in these clays; but clays occur higher on the Ottawa, in the vicinity of Bytown, at the mouth of the Gatineau on the north, and of Green's Creek on the south side, which in addition to marine shells, of the species *Saxicava rugosa*, yield in the

latter named locality two species of fish, the *Mallotus villosus* or common capeling, and *Cyclopterus lumpus* or lump-sucker, both of which are still inhabitants of northern seas; the capeling still frequents the Gulf of St. Lawrence in great numbers, and the lump-sucker, the northern coasts of Scotland and America. Their fossil representatives are always enclosed in nodules of indurated clay of reniform shapes, and they appear to occupy a bed nearly on a level with the water of the Ottawa, about 118 feet above the tide level of Lake St. Peter; the same sort of nodules frequently enclose fragments of wood, leaves of trees, and portions of marine plants; among the last is one of the species of littoral algæ still found near the coasts of arctic seas.

Whether these fossiliferous clays are equivalent to the unfossiliferous clays lower down the river, requires a greater number of facts to determine than are at present in my possession; but though these marine remains were absent from the clays that came under observation, they were by no means so from deposits which overlaid them.

The greatest accumulation of sand that came under my notice was in the townships of Edwardsburgh, Augusta, and the southern part of Oxford, where it occupied the whole of the higher portions of country, frequently being drifted up into dunes of considerable elevation. It is usually of a light yellow color, principally of silicious grains, with a small amount of fine particles of limestone, evidently for the most part the ruins of the Potsdam and Calciferous sandstones. Near Dickenson's Landing, above the Long Sault Rapid, sand of this quality was found resting on the clay.

Besides the stratified deposits of clay and sand, there is a deposit of clay drift, holding pebbles and boulders sometimes angular, but generally rounded, shewing no decided lines of stratification, but irregularly associated with isolated beds of gravel and sand, among which great quantities of marine shells of comparatively recent origin are frequently found. One of the localities where this was particularly observed, was on the Prescott Road, about a mile and a-half from Kemptville, which would be about the eleventh lot of the fifth concession of South Gower. In this spot a vast accumulation of sea shells,

consisting almost entirely of one species, *Tellina grænlandica*, overlaid a two feet bed of limestone gravel, the latter resting on gravel of a still coarser quality, and of more angular fragments, and irregularly mixed up with sand and clay. The angular fragments of this bed consisted of impure limestone holding calc-spar and fossils of the Calciferous formation, and the rounded pebbles and boulders (which were in a smaller quantity,) of gneiss, some of the boulders being from six to ten inches in diameter. The height of this locality might be about thirty to forty feet over the Rideau Canal, at Kemptville, or about 250 feet over Lake St. Peter. Another locality was about the twentieth lot between the fifth and sixth concessions of Winchester, near Armstrong's Mills. Here the shells, which were much broken, were associated with sand mixed with loam, and appeared to be chiefly *Saxicava rugosa*. The height may be about thirty to forty feet over the Petite Nation, at Armstrong's Mills, and is estimated at about 300 feet above Lake St. Peter. In Kenyon, *Saxicava rugosa* and *Tellina grænlandica*, were met with on the seventh lot of the second concession in the bed of the Garry River, mixed with fine sand, and no boulders were observed near the spot, the height of which is estimated at 130 to 140 feet over Lake St. Francis, or about 270 feet over Lake St. Peter. *Saxicava rugosa* was met with also on the road between the fifth and sixth concessions of the township, on the nineteenth and the twenty-first lots. They were associated with sand derived from the gneiss, mixed with scales of a greenish shale, probably from the base of the Chazy limestone: large boulders of gneiss, mica-schist and hornblende rock were scattered over the fields, and the height of the locality may be 330 to 340 feet over Lake St. Peter. Two localities occurred in Lochiel, one of them on the fifteenth lot of the first concession, within a mile of Dalhousie Mills, where *Saxicava rugosa* was mixed with sand, and the height was ascertained by admeasurement to be 126 feet over Lake St. Francis, or 264 over Lake St. Peter; the other on the fifth lot of the same concession, where the same *Saxicava* was mingled with sand immediately under the vegetable mould; many boulders or fragments of sandstone and limestone lie on the surface of the surrounding country, and the height of the spot is about 280 to 290 feet over Lake St. Peter.

On Rigaud Mountain there is a set of plains, paved with an accumulation of well rounded boulders, which begin on the north side, about 200 feet over the level of the Rivière à la Graise at its junction with the Lake of Two Mountains, or 262 feet over Lake St. Peter, and extend over a large area, filling up hollows between elevated summits of trap; these plains rise gradually to the south, until they reach their maximum elevation of about 280 feet over the Graise, beyond which they slope gently off to the south, and the boulders are found scattered over a large portion of the seigniory of Rigaud. By far the greater portion of the boulders are the ruins of the trap of the mountain, but there is likewise a small proportion of sandstone. On the northern side near the summit, these rolled stones are arranged in parallel ridges, separated from one another by distances varying from twenty to thirty paces, their direction being N. 40 to 57 W., and S. 40 to 57 E. The size of the boulders is seldom less than three inches, or more than eighteen inches in diameter, and the depth of the hollows between the ridges is from four to six feet. Curiosity has induced some persons to remove many of these round stones, for the purpose, it is supposed, of ascertaining the depth of the accumulation, and they have gone down about seven or eight feet, without reaching the solid rock. It is worthy of remark, that while the greater part of the upper portions of the mountain and a large extent of the country south from it, were found thickly strewed over with boulders of its own debris, there were scarcely any of that character seen on the northern flank or on the flats between the mountain and the Ottawa River; on these the erratic blocks, consisted chiefly of large angular masses of sandstone, apparently of the Potsdam formation, and rounded fragments of the Metamorphic group.

#### ECONOMIC MATERIALS.

The substances under this head, occurring in the district under description, to which I have to draw your attention, are ores of iron, lead and copper, iron ochre, sulphate of barytes, sandstone and sand for glass-making, shell marl, materials for ornamental and common building purposes, and mineral pitch.

*Magnetic Iron Ore.*—This ore of iron was found very ge-

nerally disseminated in small quantities through the rocks of the Metamorphic series, and so far as my observation went, it thus appeared more particularly to characterise the beds of gneiss rather than those of limestone, though I am aware that in those parts of the province in which large workable masses of it exist in this formation, they frequently are bounded on one and sometimes on both sides, by limestone. No masses of it, however, of a workable character came within the range of any examination, with the exception of a very remarkable one on the twenty-sixth lot of the sixth concession of South Crosby, where on an island in Mud Lake, not far from Newboro' on the Rideau Canal, and near the crystalline limestone of the vicinity, a mass of considerable purity running north-east and south-west, and apparently coinciding with the stratification, has a breadth of about seventy yards. Understanding that you have yourself visited the locality, it is scarcely necessary for me to state, that the great supply of ore that might be here obtained, the proximity of wood in abundance for fuel, and the existence of water power at no great distance, combined with the advantage of a navigable canal, the water of which is in contact with the ore, render the locality well worthy of attention, to such as are disposed to attempt the smelting of iron ore in the Province.

Magnetic iron ore exists on the seventh lot of the second concession of Escott on the property of Mr. W. Way. The rock at the spot is gneiss, the beds of which are composed chiefly of reddish colored feldspar with small grains of translucent white quartz, and an occasional interstratified layer of mica schist. The general strike of the beds is north-east and south-west, and they dip at a high angle to the north-west, but shew various complicated twists, and are traversed by numerous small veins composed of flesh colored feldspar and white quartz. The ore with small specks of copper pyrites, occurs both in the beds and in the veins, and the largest mass is clasped in one of the folds of the strata and runs in its axis. In this position it lies in reticulating strings, and the whole quantity exposed, occupies a length of about fifty yards, by a maximum breadth of six to seven inches. A small mining trial has been made at the spot by a company of gentlemen

from Brockville, but although the ore is of high percentage, and excellent quality, it does not appear to me that the quantity is sufficient to promise a remunerative return.

*Specular Iron Ore.*—The specular oxide of iron, which has been mentioned in connection with the sandstones and conglomerates of the Potsdam formation, requires a further notice in relation to its economic bearing. The cliff of ferruginous sandstone, which occurs on the twenty-fifth lot of the tenth concession of Bastard, displaying a vertical height of about thirty feet, brown in the lower and deep red in the upper part, owes its color to the presence of peroxide of iron, which is mingled with the silicious grains, apparently cementing them together, and sometimes becoming pulverulent, staining the fingers with a red shining powder. In a three feet bed, which occurs within about three feet of the top, the oxide passes into the form of strongly coherent *scaly red iron ore*, in which thin seams and spangles of crystalline specular iron ore occur. The parts so marked run in layers in the bed, and alternate with layers of the sandstone of a yellow and less ferruginous character. The concentration of the ore is greatest towards the middle of the bed, where nodules and patches of pure red hematite, running with the stratification, occur at intervals of a few inches, the thickness they display not exceeding a couple of inches. About forty years since an attempt was made to mine the ore for the supply of a furnace erected at Furnace Falls, but the quantity in the locality worked was not sufficient to give a profitable result. The Potsdam formation is similarly characterised on the twenty-third lot of the same concession of the township, and also on the ninth concession of Lansdowne, and the ferruginous deposit would thus seem to extend over a considerable area; and although no evidence was observed of the fact, it may be the case that in some part of the distribution, the quantity of ore may increase to a productive amount. In the State of New York, an iron ore of this description, occurring under similar circumstances in the same formation, has been made economically available, and in those parts of the district under consideration, in which a deep red color characterizes the formation, it merits attention.

*Bog Iron Ore.*—This species of ore was observed in the

Seigniory of Vaudreuil, on the sixteenth and seventeenth west lots of Côte St. Charles, the property of Mr. R. Lancaster. This locality has been mentioned by yourself, in the Report of 1845-6, but the thickness of four feet there given to the ore, was doubled in the small brook in which a section of it was exhibited to me, as it there measures fully eight feet. It has been struck in various places around the spot immediately under the soil, over an area of three acres, and it probably extends much farther. An analysis by Mr. Hunt, shewed the presence of some amount of phosphoric acid in the ore, which, when in excess, is considered by manufacturers to render the metal cold-short. The bog ore used at the St. Maurice forges near Three Rivers, is however known to produce an iron of excellent quality. An analytic comparison between the ores of the two localities yet remains to be made.

Bog iron ore is known on the sixteenth east lot of Côte St. Charles, (possibly an extension of the same bed, as before mentioned,) and in the centre of the Seigniory on the west side of Côte St. Louis.

Having been informed of the existence of a bed of the ore in the neighbourhood of Côte St. Guillaume, in Rigaud Seigniory, search was made for it, but the only indications observed were small loose fragments strewed over the ground, on the south side of the road on the twelfth, thirteenth and fourteenth lots.

A bed of bog ore was observed on the twenty-first lot of the seventh concession of Bastard, not far from Beverly. It was found to be about two feet thick in one spot ; on one side it was limited by an escarpment of rock, but its extent in other directions I was unable to ascertain.

*Lead Ore.*—A well defined vein of calc-spar and heavy spar, intersecting coarse disintegrating crystalline limestone of the Metamorphic series of rocks, occurs on the second lot of the eighth concession of Lansdowne. The vein runs nearly due N. W. and S. E., with an average width of about two feet for a quarter of a mile. Galena is disseminated irregularly through the vein in crystals, which are for the most part small, and similar crystals are not uncommon in the limestone on either side. Some years ago, this vein was uncovered, and

a few trial shafts sunk upon it, with the expectation that it might prove a profitable lode of lead ore, but the quantity found appears to have been too small to give any encouragement, and the work was abandoned.

*Copper Ore.*—Having been given to understand that a good vein of copper pyrites had been some years ago discovered at Beverly in Bastard, and that a trial shaft had been sunk upon it, a visit was paid to the locality with a view to its examination. The locality is on the twenty-fourth lot of the tenth concession of Bastard, where the interstratification of a bed of sandstone and conglomerate in the limestone of the Metamorphic series occurs, as already described. The dip of the strata, as before stated, is N. 55 E.  $<30^\circ$ , and they are intersected by a vein of calc-spar of between two and three inches wide, with several still smaller veins of a similar kind, close by. A shaft of about twenty feet had been sunk on this, and two others from seven to eight feet; but neither in that part of the vein which was on the exterior surface, nor in that cut in the shaft, were more than small disseminated crystals of copper pyrites, coated with green carbonate, observed. It is said, however, that a string or vein of ore of an inch or two in diameter was followed down the shaft, and this seems at the bottom to have turned aside into a thin vein or sheet of calc-spar, which separated from the main one, and ran in between two of the strata. No indications of this remained in the shafts, in which there did not appear an amount of ore sufficient to justify the expectation of a favorable result. It is probable that the trial had been induced by the previous discovery, on Gananoque Lake near the locality, of some loose masses of very fine and rich copper pyrites, of considerable size. One of these procured at Beverly for the Provincial Collection, weighs several pounds. From what place these loose pieces had been drifted, it is at present impossible to say; they are identical in color, brilliancy and general character with the produce of the shaft; not a particle of the gangue is attached to the specimen procured, but it is very evident from the impressions or moulds left on those parts of the mineral which were in juxtaposition with the gangue, that it was calc-spar and heavy spar; it is not improbable that the source of the loose masses is not far removed from the position

in which they were found, and that they occur in some calca-reo-barytic vein cutting the Metamorphic limestone.

*Iron Ochre.*—This mineral paint was met with in Vaudreuil, on the lot belonging to Mr. Lancaster, which holds the eight-foot bed of bog iron ore; the deposit lies on the top of the ore, and is about a foot thick. The color is an ochre-red, and a material might be obtained, by simply washing the deposit, and freeing it from roots of plants and such like impurities, that would quite equal any of the imported paints of this description.

*Phosphate of Iron.*—This mineral which is used as a pigment, is of a blue color, and is sometimes found in the vicinity of bog iron ore; it is so on Mr. Lancaster's lot, where it exists at the edge of the ore deposit, apparently underlying it, in a bed, the thickness of which it was not easy to ascertain, as it was covered by water; it does not, however, appear to be considerable.

*Sulphate of Barytes.*—Of this mineral, which is used for the manufacture of *permanent white* and *Dutch white*, the latter consisting of a certain mixture of it with white lead, has been mentioned under the name of heavy spar, as constituting, in conjunction with calc-spar, a vein holding specks of galena on the twenty-fourth lot of the tenth concession of Bâstard. The vein was traceable for a quarter of a mile; no part of it was free from sulphate of barytes, and in one place, where a shaft had been sunk eight to ten feet in search of lead ore, eighteen feet of the lode, in addition to ten feet more, occupied by the shaft, with a breadth of two feet and a quarter, consisted, to the full depth of the shaft, of highly crystalline, almost colorless sulphate of barytes, of which the vein in this part would yield about ten tons to a fathom forward by a fathom vertical. The value of the crude material is said to be eight to ten dollars per ton to the manufacturer, and the manufactured article thirty dollars per ton.

*Stone and Sand for Glass-making.*—Being aware that good pure white sandstone, fit for the purpose of glass-making, existed in the Potsdam formation in Vaudreuil, and other parts of the eastern extremity of the district which has engaged my attention, a similar quality of stone was searched for in the western;

but in this part, as has already been stated, a large portion of the formation is strongly impregnated with iron, and though the beds thus characterised are surmounted by others which are of a general pure white color, these are almost invariably penetrated with what has been called the *Scolithus linearis*, supposed to be the remains of a plant. Where the rock is weathered, these are hollow cylindrical tubes piercing the stone vertically for some distance, and they are always lined with a brown color, which is diffused a little way into the stone. Where the cylinders are not weathered, they are filled with sand rather more calcareous than that around them, and there is still a slight discoloration in the part corresponding to what becomes the interior of the tube. The brown discoloration arises from the presence of iron, and the remains are so abundant that they would probably render the white beds unfit for glass-making.

In the subjacent Metamorphic series, however, some of the beds of quartzite, that have been mentioned in the geological division of the Report, furnish a material that appears to me well worthy of being submitted to an effectual test, with a view of ascertaining its qualities for that purpose; an example of it occurs on Blockhouse Island opposite to Brockville, and on the main land at the west end of the town, where the rock is a white close grained translucent semi-vitreous quartz. It is exceedingly hard, and would be expensive to quarry, and there are a few small yellow specks in it, owing their color probably to oxide of iron, but it would require a chemical analysis, for which there has yet been no opportunity, to determine the quantity. There would be no deficiency in the supply of the material, should it prove suitable.

A fine white silicious sand was met with on Rabbit Island, near the south-east shore of the main body of Charleston Lake, which, while I was on the spot, was supposed from its general aspect to be sufficiently free from impurities to fit it for glass-making; but on closer examination afterwards, small red and black grains were perceived disseminated through it, and to chemical tests it yielded more iron than the best material for glass-making should contain. This sand is probably derived from the disintegration of the white beds of the Potsdam formation, and it occurs in great abundance in the various bays and

inlets of the lake. The red bed of the Potsdam and the magnetic iron of the Metamorphic series, may be the source of the impurities.

*Feldspar.*— Understanding from you, that some economic process has been discovered for the separation of the potash in feldspar, and that rocks of pure feldspar, sufficiently rich in potash, have in consequence assumed a commercial value, I would suggest an analysis of some of those large feldspar masses which have been mentioned as running with the stratification of the gneiss near Brockville; should the percentage be found sufficient, these masses are very conveniently situated for working, and a large supply of the rock might be obtained.

*Fresh-water Shell Marl.*—Of this mineral manure, deposits were met with in three localities. One of them is the thirteenth lot of the eighth concession of Yonge, where the marl occurs in a swamp, which, when visited by me, was almost all under water; the deposit, however, was struck with a pole and penetrated to the depth of six or seven feet, and I was informed by Mr. Landon, of Farmersville, that in some parts its depth had been ascertained to be fourteen to fifteen feet, and that the area the marl was known to occupy, was between twenty and twenty-five acres. Another locality is in another lake in Elmsley, where the material is exposed in the bays on the south side, giving a thickness where penetrated with a pole of from three to four feet; the marl extends into the lake, but was not seen above its level. The third locality was on Mr. Delesderniers' farm, near Point Cavagnol, in Vaudreuil Seigniory, and here the marl, of a yellowish color, extends over about twenty acres, with a thickness varying from a foot to eighteen inches. Mr. Delesderniers, acquainted with its value as a manure, uses it largely and beneficially on his farm.

*Marble.*—White limestones of the metamorphic series of rocks were occasionally seen of a quality capable of taking a polish, but they were invariably too coarsely crystalline to be suited to the more elegant purposes to which marble is devoted. They moreover frequently inclose various minerals, such as serpentine, mica, quartz, pyroxene, tremolite, chondrodite, and graphite, which materially injure the appearance of the

stone, after it has received the smoothest surface which can be given to it. Near Beverly this limestone is quarried and applied to some of the purposes of marble, being cut and polished for tablets, tombstones, and the like. On the north side of Charleston Lake, similar limestones were observed, portions of which might equally be applied to the same purposes.

Limestone which appears to be of a sufficiently fine texture to admit of a good polish, is occasionally found in various parts among the fossiliferous rocks. The quarries opened for building in the black beds of the fourth concession of Cornwall are of this quality, and stones of the same color and as fine a grain were seen in the eleventh lot of the seventh concession of Charlottenburgh, the twenty-ninth and thirty-fourth lots of the seventh concession of Lancaster, the seventeenth lot of the second concession of Winchester, and at Crysler's Mills, on the Petite Nation River in Finch. For ornamental purposes, the material from the black limestone beds would require to be very carefully selected, as it frequently happens that the fossils, especially the orthoceratites and corals, are replaced by calc-spar, which would injure the homogenousness of the surface, and parts of the beds are often highly charged with iron pyrites, which would render the stone useless.

*Building Stone.*—The stone used for building purposes at Brockville and Prescott, is taken from the beds of the Calciferous sandrock formation, which at the former place is extensively quarried on the second lot of the first concession of Elizabethtown, the property of Mr. Perry, and on some of the adjoining lots. The beds here selected as giving the most durable stone, and the handsomest when faced, are those which contain the largest amount of calcareous material, and they are worked in courses that are one foot to fifteen inches thick. At Prescott there is abundance of good material of much the same character, between Battle Windmill, about two miles below the town, and the upper windmill, about two miles above; the stone at present used is quarried at the lower windmill. The beds of the Calciferous sandrock formation have been extensively used in the construction of some of the locks of the Rideau Canal, and these in general afford good examples of the stone. It is a strong tough sufficiently durable

material, grey when first wrought, but soon turning yellowish under the influence of the weather.

The black limestones which run through the township of Cornwall, afford an excellent building material. The quarries opened on the fifth and sixth lots of the fourth concession of the township, expose an average thickness of about seven feet in two compact beds of three and a-half to four feet each, and it was from these quarries that the stone was procured for the construction of the locks of the Cornwall Canal, which afford a good example of its quality. Near Mille Roches, on the twenty-fourth lot of the fourth concession of the township, a quarry has recently been opened, which exposes a band of black limestone, averaging upwards of four feet in thickness; the general quality of the stone is very similar to that in the previous quarries, but in some parts of the bed it is deteriorated by the presence of iron pyrites. Another quarry of black limestone is opened on the eleventh lot of the sixth concession of Charlottenburgh, from which a handsome stone is procured from a bed of about fifteen inches thick. It has been used in the construction of the Roman Catholic Church of St. Raphael, in that part of the township; and beds producing a similar quality may be obtained in those parts of Lancaster, Winchester and Finch, which have already been mentioned for black marble. Such beds are quarried on the seventeenth lot of the second concession of the second named of these townships, where the rock has been sunk through for eight feet; the bed that is used for building purposes is two feet thick.

In this last mentioned quarry, a grey bed overlies the black one used, and it is stripped off for the purpose of exposing the black one. The grey bed does not seem to be used for building, but in the strike of the rocks of this part of the township, there are good grey beds for building in Lochiel and Kenyon, on the de l'Isle and Garry, near Alexandria. A quarry has been opened in this part by Colonel Fraser, on the fourth lot of the second concession of Kenyon, which gives a good solid grey stone of about two feet thick, with another not quite so good of one foot. These grey beds appear to belong to the Trenton formation, and probably a high part of it, as the black beds seem to have a considerable thickness beneath them; but

there is another set of grey beds beneath the black ; these belong to the Chazy division of the calcareous group ; they have yielded good stone at Caughnawaga, at St. Geneviève and other places on the Island of Montreal, and there is every probability, though I was not so fortunate as to meet with them of good quality in place in the district examined, that they will be found in it. The large loose blocks mentioned as met with on the River de l'Isle, upwards of a mile and a-half below Dalhousie Mills, belong to this desirable part of the Chazy formation, and loose blocks of a similar character were found on the fifth lot of the second concession of Cornwall, both localities being near the position in which the Chazy limestone might be expected. The rocks in place on Sheik's Island are probably rather too near the base of the formation to yield the best building stone, which in this part is probably covered by the waters of the St. Lawrence or the drift on the left bank, but how deep it is impossible to say.

*Bituminous Shale.*—Although no analyses have yet been made of any of the bituminous shales which have been met with in the progress of the Survey, and it is therefore uncertain whether the amount of bitumen that would result from any of them could be turned to profitable account, I yet consider it proper that they should not be passed by without mention among the economic materials, as attempts have within a few years been made in England on a practical scale, to distill bituminous products from rocks of such a character. The shales of the Utica slate formation, are usually very bituminous, and in some parts of the province, as on the Great Manitoulin Island, so much so as to give small springs of petroleum ; and though no indications of such springs were observed in the black shales of the neighborhood of Bytown, these shales were always of a deep black color, and constantly yielded a strong bituminous odor ; such was the character of the fifteen feet of shale sunk through in the well on Mr. Walkley's farm, already mentioned as occurring on the first lot of the third concession of West Gloucester, with the exception of a foot or eighteen inches at the top, which weathered of a rusty brown, and seemed more gritty than the part below. A precisely simi-

lar character obtains in a section of from ten to seventeen feet on the seventeenth lot Rideau front, where an excavation has been made for the foundation of a mill building, on a small brook which falls into the Rideau above Billings' Bridge. The shales that crop out on the bank of the Rideau between Billings' Bridge and the Falls at the mouth, are likewise jet black and bituminous, but in some specimens of these submitted to Mr. Hunt, the deep black color appears to indicate the presence more particularly of carbonaceous matter, than any very large amount of bitumen.

*Mineral Caoutchouc.*—The black shales of the Hamilton group, in the Western Peninsula, are in general probably more bituminous than those of the Utica slate. Several places in their distribution are characterised by bituminous springs, and a visit was made in the early part of the season to a bed of nearly pure bitumen, of which the existence has been noticed in previous Reports, including that of last year, in which the range of the Hamilton group in the Western Peninsula is given. This bed of bitumen, which in some parts has the consistency of mineral caoutchouc, occurs on the sixteenth lot of the second concession of Enniskillen in the county of Kent, but its extent does not appear to be so great as we were at first led to understand. It does not seem to exceed half an acre, extending five chains in a north-east direction, with a breadth of rather less than half a chain. By different trial holes which have been sunk through the deposit, it would appear to have a thickness of two feet over about twenty feet square, towards the south-west end, from which it gradually thins towards the edge in all directions, varying in some parts along a low ridge which it forms, from a foot to four inches. The bitumen is underlaid by a very white clay, which I was informed had been bored through in one part for thirty feet. The upper portion of the clay was observed to be more or less penetrated with petroleum, and small black globules of the same were seen scattered through the mass for a depth of four or five feet. Bituminous oil was observed to rise to the surface of the water on the Black Creek, a branch of Bear Creek, in two places on the seventeenth lot of the third concession of Enniskillen, and I

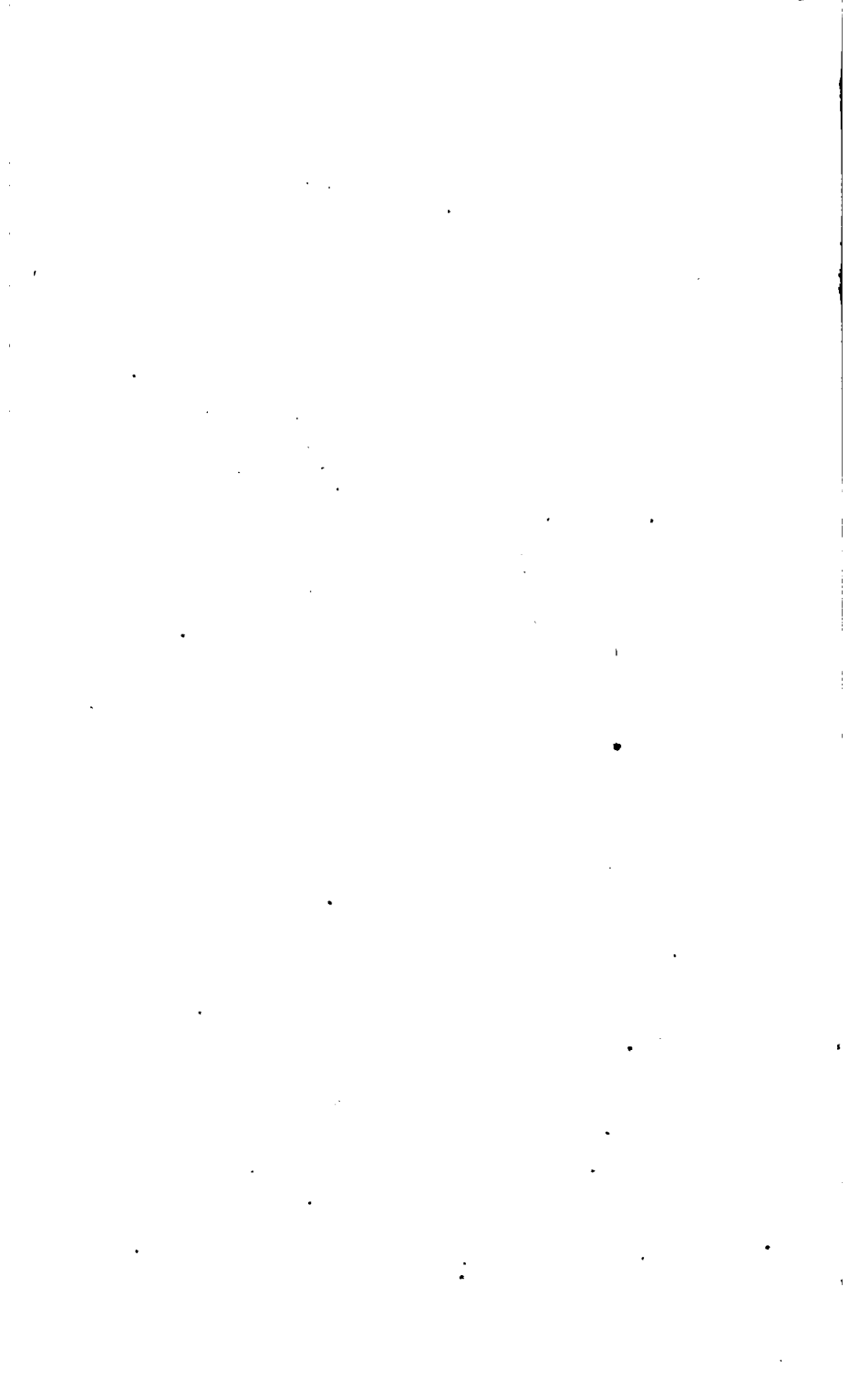
was informed that it had been observed at other parts further down the stream, but to what amount the material might be daily collected at any of the places, I am quite unable to say ; a freshet prevailed in the river at the time of my visit, the current of which swept away the oil as fast as it rose.

I have the honor to be,

Sir,

Your most obedient servant,

A. MURRAY.



# REPORT

OF

T. S. HUNT, ESQ., CHEMIST AND MINERALOGIST TO THE  
PROVINCIAL GEOLOGICAL SURVEY,

ADDRESSED TO

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

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LABORATORY OF THE PROVINCIAL SURVEY,
MONTREAL, 1st *May*, 1852.

SIR,—During the summer of last year, I was for a great portion of the time engaged with Mr. Murray in his explorations between the St. Lawrence and Ottawa Rivers. I however found time to make some examinations upon the Richelieu, in the vicinity of Quebec at St. Nicolas, in the county of Kamouraska, and in some other localities. The results of these observations, and of the examinations of soils, rocks, and mineral waters collected on these excursions, I propose to present as far as yet completed, in this Report, in connection with some other results of my labors in the laboratory during the past winter.

In the first place I beg leave to call your attention to the peculiar nature of the metamorphosed shales of the Hudson River Group, which with their associated sandstones, are exposed upon the south shore of the St. Lawrence, near the village of St. Nicolas. You had drawn my attention to the fact, that an intrusion of trappean rock in this vicinity had produced an alteration in the texture of the shales, and in some instances converted them into a substance resembling serpentine. As the results of our researches in the Eastern Townships had demonstrated that the serpentines of that metamorphic region, really belong to the series of Lower Silurian rocks, called the Hudson River Group, and as the exposure of shales and

sandstones at St. Nicholas is but a prolongation of these same rocks, it was to be hoped that a careful chemical examination of the altered shales in the vicinity of the intrusive rock, and a comparison between them and the unchanged shales near them, would throw some light upon the difficult questions of the nature of these changes, and the origin of serpentines.

Reserving to yourself the more particular geological description of these rocks, I will only mention, that between beds of greenish sandstone of from one to three feet in thickness, are interstratified greenish or bluish and reddish shales, generally in thin layers. Their colors seem dependent upon local causes, and connected probably with the different states of oxydation of the iron which they contain. The green color is sometimes observed in small oblong rounded patches in the red slates, and where in a mass of the latter, a thin layer of from half an inch to an inch of calcareous material occurs, it is bordered on each side by a layer of green slate, sometimes no more than a quarter of an inch in thickness. In a section near Point Levi, the green color was seen following down a rift or joint in the red slates, across the stratification, and spreading irregularly on either side. Such modes of occurrence suggest a local deoxydation of the red slates, by imbedded or infiltrating organic matters.

In the immediate vicinity of the intruded rock, it is observed that thin layers of schist are converted into a soft greenish translucent matter resembling serpentine, which sometimes is an inch in thickness. The adjoining sandstones seem to have undergone a similar change, or at least, to be covered with a film of the greenish translucent mineral, and often exhibit a concretionary or mammillated structure upon their surfaces. In one instance, the thickening of a stratum of shale, forms a mass of several inches in diameter, which is earthy and opaque within, but upon the surface contiguous to the overlying rock, assumes the translucent serpentine-like character already alluded to, and in a continuation of the layer, where it becomes thinner, the transformation is complete. In the interstratified sandstones, which sometimes assume a conglomerate character, cavities are seen filled with a similar mineral, and fragments of bright red and much indurated shale, were found

at the foot of the hill, having fallen from the cliff above, which contained in their fissures the same soft green mineral.

The careful analysis of this substance has shown that it is entirely distinct from serpentine, and not a magnesian mineral; it is essentially a hydrous silicate of alumina, protoxyd of iron and potash, with small portions of soda, lime and magnesia. It is also distinguished from serpentine by a lesser hardness and a greater specific gravity, the hardness of serpentine being from 3· to 4·, while that of the new substance is 2·5, rarely 3·; the specific gravity of serpentine is always below 2·6, and generally 2·5, while the mineral from St. Nicolas has a specific gravity of 2·7. To distinguish it, I shall provisionally adopt the name of *parophite*, to express its similarity to ophite or serpentine. Some results of the analysis of it, and of the accompanying schists are subjoined.

No. 1.—Parophite in schistose fragments; texture granular and exceedingly fragile, especially when moistened; color pale greenish-white, streak white; lustre waxy, shining, sub-translucent; when cut with a knife, the surface is smooth and greenish-blue, resembling an indurated talc; the powder is impalpable and unctuous; hardness not more than 2·5; specific gravity 2·705. When ignited, it loses water and becomes ashy-grey. It is but imperfectly decomposed by hydrochloric acid; the earthy ingredients were determined by fusion of the ignited mineral with carbonate of soda, and the alkalies by decomposing it with a mixture of fluor-spar and sulphuric acid. It gave in two analysis:

	I	II
Silica,	48·50	48·60
Alumina,	27·50	} 33·57
Protoxyd of Iron,	5·67	
Lime,	1·30	1·51
Magnesia,	2·24	2·20
Potash,		5·30
Soda,		1·91
Water,	7·00	7·40
		100·49

No. 2.—Parophite from the same locality, in schistose fragments like the preceding; color pale yellowish-green, translucent upon the edges; hardness 2·5; specific gravity 2·703, —2·714. Its analysis gave:

	I	II
Silica,	48.42	48.14
Alumina,	27.60	
Protoxyd of Iron,.....	4.50	
Lime,	2.80	
Magnesia,.....	1.80	
Potash,	5.02	
Soda,	2.78	
Water,.....	6.88	7.30
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	99.80	

No. 3.—Parophite from the same locality, botryoidal, with appearance of concentric structure, olive green, translucent, fracture conchoidal, hardness 3; specific gravity, 2.784; it passes into a schistose form, which gave 2.681; analysis yielded:

Silica,.....	49.13
Alumina,.....	27.80
Protoxyd of Iron,.....	5.90
Lime,	3.80
Magnesia,.....	1.40
Water,	6.30
Alkalies, not determined,.....	
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	94.33

No. 4.—This is a fine thinly laminated schist, which passes in a little distance, into the parophite No. 1. Its color is dark ash-grey, sometimes marked with red. The laminæ are somewhat curved, the surfaces feebly shining, and slightly unctuous. This schist is completely earthy in its characters; it is opaque even upon the edges, and very soft, yielding with great ease to the nail; its powder is not at all gritty. Analysis of the eleutriated and thoroughly dried substance gave—

Silica,.....	48.10
Alumina,.....	28.70
Protoxyd of Iron,.....	4.80
Lime,.....	2.10
Magnesia,	1.41
Potash,.....	4.49
Soda,	1.53
Water,	8.40
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	99.53

No. 5.—An analysis was made of a red schist of the same formation, from a locality on the Etchemin River two miles

above St. Anselm. It is not distinguishable in its general characters from some of the unaltered beds at St. Nicolas. The earthy ingredients were determined by fusing the ignited mineral with an alkaline carbonate, and the alkalis, by decomposing it directly with hydrofluoric and hydrochloric acids, in a platinum vessel; the solution was not perfect even after the digestion, eleven per cent. remaining undissolved, but the alkalis were determined in the soluble portion, and are given in the following analysis:—

Silica,.....	66.00
Alumina,.....	} 24.60
Peroxyd of Iron, }	
Potash,	3.67
Soda,	2.22
Lime, Magnesia, and Manganese, traces,	
Water,.....	3.00
	— 99.49

The preceding specimens all gave traces of manganese.

The similarity in composition between the different specimens of parophite, and the associated schists into which it passes, shows that the transformation has been effected without the addition or abstraction of any ingredient of the schist, and is simply molecular; the slight excess of water in the latter being probably hygroscopic, the transformation from the earthy schist, to the translucent homogeneous parophite, has consisted in a chemical union of the finely divided mechanical mixture, which makes up the sedimentary rock. Two facts observed in the eleutriation of the specimens analyzed, are illustrations of this difference. The parophite although fragile, was not easily reduced to fine powder, but when by trituration it was suspended in water, a portion of it was found to be so minutely divided as to pass through fine filtering paper, making the filtrate turbid, while the soft easily crushed schist was completely separated from water by filtration; it still retained the character of a sedimentary material, while the parophite resembled other homogeneous minerals, which are generally observed to remain in part, a long time suspended in the process of eleutriation. The water filtered from the pulverized schist, had taken up so much soluble matter as to possess a

strong alkaline reaction, which was much less marked in the case of the parophite.

The large amount of alkalies in the rocks from St. Nicolas and in the more silicious bed of the Etchemin, is worthy of notice ; the small quantity remaining in kaolin and some other clays, seems to have given rise to the idea that sedimentary rocks were generally deficient in alkaline ingredients, but with such materials as these schists, we have no difficulty in understanding the formation of feldspars and other alkaliferous minerals, by metamorphic agencies different from those which have operated at St. Nicolas.

In composition and characters, the mineral resulting from this metamorphosis is somewhat removed from any described species ; a lithomarge from Zorge in the Hartz, analysed by Rammelsberg, approaches closely to it in composition, but differs in specific gravity ; (Dana's Mineralogy ; 3rd edition, page 285). Professor C. U. Shepard has described under the name of dysyntribite, a mineral associated with specular iron from St. Lawrence County, New York, which had hitherto been supposed to be serpentine, and closely resembles it in its color, lustre and general appearance. It has however a greater specific gravity than even parophite, being from 2.76 to 2.81, and a hardness of 3.5 to 4.0. He has given the following analytical results : silica 47.68, alumina 41.50, protoxyd of iron 5.48, water 4.83, and traces of lime and magnesia, = 99.49. This resembles the St. Nicolas mineral, but differs in the greater proportion of alumina, and in the absence of alkalies. Although homogeneous in appearance, the altered schist may yet contain more than one chemical compound, and as any variation in the composition of the sedimentary bed, would affect the composition of the mineral, we cannot in the present state of our knowledge, claim for it the rank of a distinct species, but only assume the name of parophite for a hydrated aluminous alkaline silicate, resembling serpentine in its general appearance.

It becomes an interesting question how far such minerals as these described by Professor Shepard and myself, may be distributed in nature, and whether they may not have been confounded with serpentine by geological observers. Such at

least is the case among the crystalline rocks of northern New York, where the dysyntribite forms large masses, but on the other hand, this same formation affords genuine serpentines, such as those which I have described in the Report of last year. I have also examined some similar minerals from the Eastern Townships, which form part of the metamorphic range exposed at St. Nicolas, and which are yet magnesian rocks and true serpentines.

Among these, a serpentine associated with the chromic iron-ore vein in Ham was examined. It occurs massive and compact, fracture splintery, color greenish white, sub-translucent. Hardness 3.5; specific gravity 2.546. Its analysis gave—

Silica,.....	43.4
Alumina and Peroxyd of Iron,.....	3.6
Magnesia, by loss,.....	40.0
Water,.....	13.0
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	100.0

It was but imperfectly decomposed by hydrochloric acid and left after long digestion, 51.6 per cent. of residue. Neither lime, manganese, or chromium could be detected in the examination.

Another almost opaque grayish-green serpentine rock from the twentieth lot of the first concession of Ireland, had a specific gravity of 2.652—2.658, and gave—

Silica,.....	43.70
Magnesia,.....	23.46
Alumina with Peroxyd of Iron,.....	23.00
Water,.....	11.57
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	101.73

Traces of manganese were detected, but no lime or chromium. The high specific gravity, the diminished amount of water, and the presence of so large an amount of alumina and iron indicate a mixture of an anhydrous silicate with the magnesian mineral, which is probably pyroxene; at least it frequently occurs under the form of diallage, in serpentine rocks of the region. Another serpentine rock from the vicinity of Nicolet Lake, of a dark olive-green color with yellowish-green

spots, had a gravity of 2·701, but contained diallage in distinct grains.

CLAYS, SOILS, ORES, &c.

Clays.—In connection with the preceding analyses of ancient sedimentary rocks, it is not without interest to consider the composition of some more recent clay deposits. The following results were obtained from a reddish-fawn colored stratified clay, from the banks of the Rivière à la Graisse, in the Seigniory of Rigaud. It is impalpable, and remains much longer suspended in water than the pulverized schists of St. Nicolas. It lost by gentle ignition 4·5 per cent. of water. By the action of dilute acids it is in part soluble with effervescence ; it gave to hydrochloric acid aided by heat—

Carbonate of Lime,.....	7·10	equal to Lime.....	3·97
Carbonate of Magnesia,.....	3·60	“ “ Magnesia.....	1·92
Alumina and Peroxyd of Iron,....	12·95		

Its complete analysis was effected by fusion with carbonate of soda, and the alkalies were determined by digesting a portion with a mixture of hydrofluoric and sulphuric acids, until the whole was rendered soluble in water. 100 parts gave—

Alumina and Peroxyd of Iron,...	27·30
Lime,	5·32
Magnesia,	2·62
Potash,.....	1·26
Soda,.....	2·06
Phosphoric Acid,	·74

Hence it appears that a portion of the lime and magnesia exist as silicates in the clay. As the carbonic acid was not estimated, it is not certain whether the whole of the bases dissolved by hydrochloric acid exist as carbonates, as some of the silicates may be decomposed by the acid.

A blue clay which is interstratified with the last, yielded to hydrochloric acid, from 100 parts—

Carbonate of Lime.....	4·9	equal to Lime,.....	2·74
Carbonate of Magnesia,.....	5·9	“ “ Magnesia.....	2·86
Alumina and Peroxyd of Iron.....	14·4		

Its complete decomposition gave for 100 parts—

Lime,.....	8.12
Alumina,.....	13.00
* Peroxyd of Iron,.....	13.40

The alkalies and other ingredients were not determined.

Soils.—The results of some examinations of soils may here be presented in continuation of those given in my Report of 1849-50. The different soils of the Province may, I think, be comprehended with few exceptions, in six groups, which are as follows :

1. Marine clays of the St. Lawrence Valley, sometimes calcareous.

2. Clays of the western basin, also calcareous in part, and probably lacustrine.

3. Drift from the crystalline rocks of the north, which in the western portions of the Province, is in some parts intermixed with the detritus of the Silurian formations.

4. Drift and debris derived from the metamorphic rocks of the Eastern Townships.

5. Soils produced by the disintegration of the red slates displayed on the south shore of the St. Lawrence below Quebec.

6. Soils from the disintegration of the Calciferous sandrock, occupying some portions of the Johnstown District.

At a future time when a greater number of results shall have been collected, a specific classification of the soils examined, may be attempted.

Two specimens of the fifth group were examined with reference to their constituents soluble in hydrochloric acid. Both of them were untilled soils lying upon the outcrop of beds of red slate, and composed entirely of the results of its disintegration.

No. 1 was from St. Jean, Port Joli, and was collected at a depth of four inches, in a field covered with a short turf; at six or eight inches, the upturned edges of unbroken slates were found underlying. By sifting the dried soil, which is scarcely coherent, the fragments of slate which it contained were separated from the finer earth, which was of a deep red-brown color and contained no organic matter except a few fibrous roots. The ingredients soluble in boiling dilute hydrochloric acid were

determined according to the process detailed in the Report for 1849-50 ; one hundred parts gave—

Alumina and Peroxyd of Iron, with traces of Manganese,	4.755
Lime, .....	.151
Magnesia, .....	.183
Potash, .....	.249
Soda, .....	.254
Sulphuric Acid,.....	.020
Phosphates.....	(traces)
Soluble Silica,.....	.255

No. 2 is from St. Thomas, and is of a similar origin to the last. It was taken from a depth of six inches in a pasture field, where the red schists are about twelve inches from the surface, but their disintegration has been more complete than in the last, and the soil when dry, is dark red and strongly coherent ; it was crushed and separated from the fragments of undecomposed slate, and gave to hydrochloric acid the following ingredients for one hundred parts :—

Alumina and Peroxyd of Iron, with traces of Manganese.....	5.940
Lime,.....	.235
Magnesia,.....	.504
Potash,.....	.250
Soda,.....	.148
Sulphuric Acid,.....	.015
Phosphates	(traces),
Soluble Silica,.....	.270

The amount of phosphate in the soluble portions of these two soils was very small, and not in either case estimated, although its presence was determined.

No. 3 is a soil of the first group, from Ste. Anne de la Poatière, and was taken from the low meadow land some distance from the foot of the hill, below the college. The clays of this place, and of the adjoining parishes, are generally grayish or bluish, often stained with yellow and red, and crumble when exposed to the weather, into a fine, mellow and very fertile soil ; they are often underlaid by a heavy blue clay, and sometimes by beds of gravel and boulders, furnishing a natural drainage. This soil was a clay, almost entirely free from sand, and was from a field which had been long in grass, with oc-

casional alternations of wheat, and had received very little manure ; 100 parts of it gave—

Alumina and Peroxyd of Iron	10·455
Lime	·369
Magnesia,	·503
Potash	·469
Soda,	·385
Phosphoric Acid,	·285
Sulphuric Acid,	·103
Soluble Silica,	·335

No. 4.—This soil is an example of the class designated above as the sixth. Over a large part of the district of Johnstown, the almost horizontal strata of the Calciferous sandrock (passing in some cases into the overlying and underlying formations,) are covered with a layer of earth, generally from a few inches to a foot or two in thickness, which notwithstanding its scanty depth, forms a rich arable soil, covered with a fine growth of hard wood. It is a sandy loam, and appears to have been entirely produced by the disintegration of the underlying rocks, from which atmospheric waters have removed the calcareous cement. The specimen whose analysis is here given, was taken from the twenty-eighth lot of the third concession of Bastard, where a foot of soil was reposing upon the Calciferous sandrock, in a recently cleared and untilled lot. The soil was taken from a depth of six inches, and was a sandy loam containing scarcely any organic matter ; 100 parts of it gave—

Alumina and Peroxyd of Iron.....	6·825
Lime.....	·353
Magnesia.....	·330
Potash.....	·130
Soda,	·129
Phosphoric Acid,.....	·209
Sulphuric Acid,.....	traces
Soluble Silica,.....	·480

No. 5.—This soil was taken from a long-tilled field upon the farm of James Logan, Esq., near the city of Montreal. It is a clay containing some sand in admixture ; 100 parts of it gave 15·5 of silicious sand, mixed with a little magnetic iron, and yielded to hydrochloric acid—

Alumina and Peroxyd of Iron	8·100
Lime.....	·806
Magnesia	·632
Potash	·185
Soda.....	·274
Phosphoric Acid.....	·285
Sulphuric Acid.....	·011
Soluble Silica.....	·225

This soil was submitted to a farther analysis; the entire amount of earthy ingredients and of phosphoric acid was determined by fusion with an alkaline carbonate, while the alkalis were obtained by decomposing a portion with a mixture of fluor-spar and sulphuric acid; 100 parts of it gave—

Alumina	13·15
Peroxyd of Iron	8·50
Lime	1·73
Magnesia	1·14
Potash.....	1·76
Soda.....	2·35
Phosphoric Acid	·54
Water and Organic Matter.....	5·30
Silica, by difference.....	65·53
	————— 100·00

The analysis of many other soils, intended with those of my previous Report, to complete the general description of the soils of the Province, is reserved for another time.

Iron Ores.—Specimens of bog iron ore or limonite, noticed by Mr. Murray in his Report of this year, were examined, and particular reference was had to the determination of the phosphates present. The ore being ignited, and the loss by this process, corresponding to water and any organic matters, ascertained, was dissolved in hydrochloric acid, and the solution mixed with tartaric acid, and ammonia in excess. The iron being thus in solution in an alkaline liquid, was precipitated by sulphuret of ammonium as a sulphuret, which was afterwards converted into peroxyd. Another portion of the ore was dissolved in hydrochloric acid, with the addition of a little chlorate of potash, and the insoluble silicious residue separated. The solution was then boiled with sulphite of soda, to convert the whole of the iron into the state of protosalt, and the excess of sulphurous acid being expelled by ebullition, the

liquid was partly neutralized by carbonate of potash, and acetate of soda added, when a slight flocculent precipitate of phosphate of alumina separated; bromine water was now added drop by drop, to the nearly boiling solution, until the precipitate which was formed by the addition, became reddish in color. The liquid was then boiled, filtered when hot, and the precipitate washed with hot water and dried. It consisted of basic perphosphate of iron and a little phosphate of alumina, and was decomposed by fusing it with carbonate of soda, some silica being added to the mixture. The alkaline solution of the fused mass, previously digested with carbonate of ammonia, was supersaturated with hydrochloric acid, boiled to expel carbonic acid, then rendered alkaline by ammonia, and mixed with a solution of a salt of magnesia, with sal-ammoniac, to precipitate the phosphoric acid, which was estimated in the form of pyrophosphate of magnesia.

The limonite from the twenty-first lot of the second concession of Bastard, formed spongy masses; it was very pure in its appearance, and its powder had a bright yellowish-red color. The alumina and other accidental impurities were not directly determined; no magnesia was present.

Peroxyd of Iron.....	77·80
Water	16·50
Phosphoric Acid	·61
Insoluble, (sand).....	1·76
Alumina and loss	3·33
	<hr style="width: 10%; margin-left: auto; margin-right: 0;"/>
	100·00

Another darker colored and more compact limonite from Côte St. Charles, Vaudreuil, lost by ignition 19·70 per cent. ; on solution it left 5·43 of silicious sand, and gave 1·52 per cent. of phosphoric acid, besides small portions of alumina, and traces of magnesia. The influence of phosphates in such quantity as the last, is regarded as prejudicial to the quality of the iron manufactured from the ores. I have commenced some experiments upon the ores and iron of St. Maurice, which, when completed, will be interesting in this connection.

Analyses of supposed Fossil Bones and Coprolites.—In examining last summer, the coarse grained silicious sandstones and conglomerates, which occur at the point of the River

Ouelle, and have been described in a general manner in your report for 1849-50, I detected several hollow cylindrical bodies which I supposed to be some hitherto unknown fossils, and which you from their form, suggested to be possibly bones. A chemical examination shows them to consist in great part of phosphate of lime, and thus gives countenance to the idea that they are the remains of vertebrate animals. The longest fragment found is about an inch and a-half long, and one-fourth of an inch in diameter. It is hollow throughout, and filled with the earthy matter in which it is obliquely imbedded, the disintegration of which by the weather, has exposed the larger extremity of the foreign body, and a portion of its interior. The smaller extremity is cylindrical and thin, but it gradually enlarges from the thickening of the substance, and at the other extremity becomes externally somewhat triangulariform; the cavity remains nearly cylindrical, but its sides are somewhat rough and irregular. Two other fragments, presenting horizontal sections of similar cylinders, were detected, having their other extremities in the rock. The texture of these substances is compact, and the fracture earthy. Their color is dark brown, but exhibits a yellowish-brown translucency in thin layers; the powder is light ash-grey, becoming reddish by ignition; when exposed to heat in a tube, ammoniacal water is evolved, with a strong odor of animal matter, like that of burning horn. A fragment of one of the cylindrical bodies was freed as much as possible from the sandstone which adhered to the interior, pulverized, dried and submitted to analysis. It dissolved in hydrochloric acid with slight effervescence, from the presence of carbonate of lime, derived in part from the adherent rock which is calcareous, and left a considerable residue of quartzose sand. The solution contained phosphate of lime, with a little magnesia and oxyd of iron; 100 parts of the matter gave the following ingredients:

Phosphate of Lime (PO^3 , 3CaO).....	67.53
Carbonate of Lime.....	4.35
Magnesia.....	1.65
Protoxyd of Iron.....	2.95
Insoluble, sand.....	21.10
Volatile matter.....	2.15

The lime beyond that required to form phosphate, is represented as carbonate, and exists as such in part, a portion being derived from the gangue, but in other specimens from the same locality, fluorid of calcium is also detected. It was not sought for in this specimen, but it is probable that a portion of the lime exists in that form, while the magnesia, and the remainder of the lime are combined with carbonic acid.

In a subsequent examination of the locality, you detected in the vicinity of these sandstone beds, a stratum of conglomerate with a calcareous base, containing pebbles of limestone, jasper, and of red and green slates, with a great number of rounded, cylindrical and imitative forms of phosphate of lime, similar in composition to the preceding. Iron pyrites is also found in small globular masses in the aggregate, and seems to be abundant only in the vicinity of the phosphatic masses, the interstices between which are often filled by it. Many of the cylindrical bodies have an axis of a foreign matter, and others have a singular resemblance to fragments of different bones; others again from their form and homogeneous texture resemble coprolites. They are generally very compact, with a fine-grained conchoidal fracture; their color is dark blackish-brown, or bluish-black, and that of the powder ash-grey, becoming reddish-brown by heat. When powdered and mixed with sulphuric acid, effervescence ensues from the escape of carbonic acid gas, and on the application of heat, fumes of hydrofluoric acid are evolved in sufficient quantity to etch very distinctly a glass plate covering the vessel. Heated in a tube, a strong odor of burning horn is evolved. The hardness of these phosphatic masses is about that of calc-spar, and their specific gravity from 3.035 to 3.151. A fragment of a compact apparently homogeneous specimen, yielded by analysis of 100 parts the following ingredients:

Phosphate of Lime.....	40.34
Carbonate of Lime and some Fluorid.....	5.14
Carbonate of Magnesia.....	9.70
Peroxyd of Iron, with a little Alumina and traces of Manganese	12.62
Insoluble silicious residue	25.44
Volatile; water and animal matter.....	2.13

Sections of these substances have been made, and submitted to microscopic examination. The hollow cylindrical mass appears homogeneous and finely granular in its texture, while a fragment from the conglomerate bed, consisted of a finely granular matrix, in which are imbedded angular grains, apparently of quartz. Throughout the mass of the latter specimen are found imbedded small transparent cylinders, which are almost colorless, and appear to be silicious. Some are nearly uniform in diameter, with hemispherical extremities; others are thicker in the middle, and taper to the ends, which are either rounded or conical; they are generally more or less curved, and are from $\frac{1}{100}$ to $\frac{2}{100}$ of an inch in length. Some of them exhibit traces of a longitudinal cylindrical axis, which appears to be a canal filled up with some granular matter. According to my friend Dr. Bacon of Boston, to whom I am indebted for these observations, they resemble the silicious spiculæ which occur in some of the sponges and other zoophytes, but he regards his examination as yet incomplete. The results are conclusive as to the absence of any bony structure in the specimens. At the same time the external form, connected with their peculiar composition, which is identical with that of fossil bones, prompts the inquiry whether any metamorphic agencies could not have so far acted upon the animal remains as to induce an incipient crystallization of the phosphate of lime, thus obliterating the organic structure. Such a change is well known to take place in fossils consisting of carbonate of lime, as the stems of crinoids, which are often highly crystalline in their texture. As an evidence of metamorphic action at the Rivière Ouelle, you have observed that the limestone conglomerate bed, in which the phosphatic bodies are contained, is in contact with a band of red and green slates, a portion of which, where a bend in the strata occurs, is converted into a fine red and green jasper, containing seams and veins of agatized calcedony penetrating it. The transition from the jasper to unaltered schist is well marked, and it appears not improbable that the jasper pebbles in the conglomerate are produced from the metamorphosis of previously imbedded fragments of slate, which seem in some specimens of the conglomerate before me, to prevail to the exclusion of the jasper pebbles. The

limestone rock, contiguous to the portion of the slate bed which is changed into jasper, is altered in its appearance, and the phosphatic bodies which it contains, are harder, more compact and conchoidal in their fracture. The second analysis given above, is of a specimen from the rock thus altered. The large amount of iron present, and the portion of silica which is found in the specimens from the conglomerate bed, to be disseminated in transparent grains throughout the substance, suggests a mineralizing agency which has resulted in the introduction of oxyd of iron and silica. The abundance of iron pyrites found surrounding the phosphatic masses, points to the probable reducing effect of organic matters upon a solution of sulphate of iron, whose oxyd to the amount of more than twelve per cent. has penetrated them,* and the calcedony of the contiguous jasper bed, equally shows silica to have been in solution at the time of the metamorphosis. It is to be remarked that the first described fragment from the sandstone, contains but very little oxyd of iron, and that the prepared section shows it to be homogeneous, so that the silicious material found in the analysis, was adherent to its interior surface.

I have since detected the presence of similar bodies in the sandstones from the Lac des Allumettes. These beds you have shown to belong to the Calciferous sandrock formation; they are coarse silicious sandstones containing *Lingula* and *Pleurotomaria* or *Holopea*, besides rounded cylindrical and imitative masses of a chocolate-brown colored substance, which consists in part of phosphate of lime. These are sometimes an inch in diameter and two inches in length, and one of them when broken, was found to contain a portion of one of the valves of a lingula lying transversely. This fossil which is abundant in the rock, is always found filled with the brown phosphatic material, and sometimes the exterior is covered by a layer of it; casts of the interior of pleurotomaria also occur in this material. It is granular in its texture, less hard and compact

* The formation of iron pyrites, which is a bisulphuret, by the desoxydation of a solution of the neutral sulphate, is accompanied with the separation of an equal amount of iron in the form of an oxyd; two equivalents of sulphate of iron, $2\text{FeO},\text{SO}^3 - \text{S}^2 \text{Fe}^2 \text{O}^3 - \text{FeS}^2 + \text{FeO} + \text{O}^7$. An acid solution of sulphate could not exist in the presence of carbonate of lime.

than that from Rivière Ouelle, and somewhat porous; the color is chocolate-brown. The specific gravity of a fragment was found to be 2.875. When heated in a tube, strongly ammoniacal water is evolved, with the peculiar odor of burned horn already observed in the specimens from Rivière Ouelle. It is partly soluble with slight effervescence in hydrochloric acid, and leaves a white silicious residue. The solution contains phosphate of lime with some magnesia and iron; 100 parts of it gave—

Phosphate of Lime, (bone earth),.....	36.38
Carbonate of Lime, with some Fluorid,.....	5.00
Magnesia and Peroxyd of iron, by difference,.....	7.02
Insoluble, Silica,.....	49.90
Volatile matter,.....	1.70
	———— 100.00

Another specimen contained but 38 per cent. of insoluble substance; this silicious matter is distinguished by the eye, in the form of small rounded translucent grains disseminated through the mass.

At Grenville there are beds of sandstone intermixed with green shales, and pertaining to the same formation as those at Lac des Allumettes, in which similar fragments of phosphatic material are abundantly disseminated. They are smaller and more compact than those of the former locality, and often have the appearance of flattened and worn fragments of dark slate. They have not been quantitatively analysed, but were found to give off an animal odor when heated, and to consist principally of phosphate of lime, and an insoluble silicious residue. Similar bodies were met with in the Chazy limestone in Hawkesbury; they are rounded forms, one-quarter to one-half an inch in diameter. The exterior is tinged blackish-brown, and the color has penetrated to the depth of about a line; the interior is yellowish-brown, and the fracture is earthy; when heated, they give abundant evidence of animal matter, by the peculiar odor of burning horn, accompanied by ammoniacal vapors, which yield white fumes with acetic acid; these leave like the others, a silicious residue on solution, but less abundant than those from the Lac des Allumettes. The analysis of one from Hawkesbury gave me for 100 parts—

Phosphate of Lime, (bone earth).....	44.70
Carbonate of Lime,.....	6.60
Carbonate of Magnesia,.....	4.76
Peroxyd of Iron and a trace of Alumina,.....	8.60
Insoluble silicious residue,	27.90
Volatile matter,.....	5.00
	<hr/>
	97.56

In support of the suggestion that these are bones or coprolites into which silicious matter has been introduced, it may be stated that at the Lac des Allumettes there is also evidence of the solution of the silica, not in the formation of calcedony, but in the silicification of fossils. The shells occurring in the calcareous beds of this as well as the overlying formation, at the Lac des Allumettes, in the immediate vicinity of this locality of phosphatic remains, are replaced either wholly or in part, by silica. On exposing them to the action of a dilute acid, which dissolves the matrix, the process of silicification is seen to have commenced at several points, and from these centres, to have spread until the whole shell is frequently replaced. The trilobites it may be remarked, have not hitherto been found to be replaced by silica. Although the presence of these peculiar animalized phosphatic masses, in different parts of the Lower Silurian rocks, points to the existence of vertebrate animals at that geological epoch, as the only hypothesis which in the present state of our knowledge, can account for the origin of such substances, it will be felt that a suggestion, so novel and so much at variance with hitherto established facts and recognized ideas in geology, is not to be received without great hesitation, nor until further investigations shall have thrown more light upon the subject than is afforded by the preceding observations and experiments.

MINERAL WATERS.

The results of the examination of a number of Mineral Waters from different sources are here presented; although some of them are, perhaps, of no great interest in a medicinal point of view, they are not without value in carrying out the general plan of examinations mentioned in the Report of last year.

Gloucester.

The water of a spring on the land of Mr. Borthwick, in the township of Gloucester, near Bytown, was sent me through the politeness of the Town Major McDonald. It is strongly saline, and resembles the waters of Plantagenet and Lanoraie; 1000 parts of it yield 11·200 parts of solid matter. The water deposits by boiling an abundant precipitate of carbonates of lime and magnesia, with traces of strontia and iron, and the concentrated liquid contains besides the alkaline chlorids, those of calcium and magnesium in considerable amount, besides a small quantity of a salt of strontia, and of iodids and bromids.

Alfred.

The water of a saline spring said to occur on the ninth lot of the tenth concession of the township of Alfred, upon the land of M. Honoré Rochon, was furnished me by Dr. A. Seguin of Rigaud. It is strongly saline and somewhat bitter to the taste, containing a large amount of earthy chlorids, and belongs to the same class of mineral waters as the last. 1000 parts of it contain 14·5 parts of solid matter; its qualitative examination showed the same ingredients as that of Gloucester, with the exception of salts of baryta and strontia, which were not looked for.

Rivière Ouelle.

At the Rivière Ouelle I visited an interesting saline spring which is worthy of notice. It is found on the third concession of the Seigniory, on the south side of the River, and upon the land of Mr. Charles Rocheford. At about two arpents from the river is a plain of perhaps half an arpent in extent, in which are four basins of water; the largest is four or five feet in diameter, and three or four feet deep, and the smallest is probably half this size; three of them are near to each other. They are constantly filled, and the small streams which flow from them form a little rivulet. The bottom of the basins and the surface of the land are of clay; the soil is for the most part bare, with a scattered growth of reeds, and a plant which I had before recognized as common to the salt marshes of this part of the country, and which I take to be the *Salicornia herbacea* Linn. The earth over the whole of this area is saturated with

the saline water, and after two or three days of warm dry weather, a copious white saline efflorescence covers the whole surface, to a depth of three or four lines. The water in the different basins is colorless and transparent, and has a disagreeably bitter saline taste, in regard to which no difference can be observed among the different basins. The temperature of the water in the larger basin was 50° F., but it was the twenty-first of July, and the water was exposed to the direct rays of the sun, so that the temperature was probably above the truth.

1000 parts of the water from the largest basin contain 13·36 parts of solid matter. By boiling, the water deposits comparatively a small amount of perfectly white earthy carbonates; and then contains besides common salt, a great amount of chlorids of magnesium and calcium, besides a considerable portion of sulphates. When evaporated to crystallization, the mother liquid gave a strong reaction of bromine, and feeble but distinct traces of iodine. The presence of the latter ingredient in appreciable quantity, shows the source of the salts not to be the adjoining sea-water, in addition to which it may be stated that the adjacent creek, several feet below the level of the basins, is never salt to the taste, even at high tide, when the water flows back as far this place.

Ste. Anne de la Pocatière.

In the second concession of this Seigniory, and upon the land of Nicolas Rouleau is a sulphurous alkaline mineral spring. The supply is abundant; it issues from the base of a hill of sandstone, and deposits a white film along its channel. The temperature of the water was 44·5° F. It is but feebly sulphurous and sweetish to the taste, and leaves by evaporation ·36 parts of residue for 1000 of water. By boiling it became turbid and deposited earthy carbonates; when concentrated, it was strongly alkaline to the taste, and gave with chlorid of barium a copious precipitate, which dissolved in a few drops of hydrochloric acid, leaving a trace of sulphate. It contains besides the carbonate and sulphate of soda thus indicated, a portion of common salt; neither bromids or iodids could be detected in the water. In the same concession, about a mile N. E. from the last, and

a mile south from the college, there is another spring near the road, and on the bank of a little stream. The supply is but small, and the temperature of the water in a tank surrounding the spring, was 48° F. but this was probably heated by the sun above the normal temperature. The water is transparent and saline to the taste; by boiling it deposited a small amount of carbonates, and when concentrated, crystals of sulphate of lime separated; it was now very bitter to the taste, and contained besides chlorids, abundance of sulphates of lime and magnesia. The liquid was evaporated with an excess of carbonate of potash and the residue extracted with alcohol, but no trace of iodine could be detected, although a reaction of bromine was obtained; 1000 parts of the water gave 5.06 of solid residue.

Ste. Martine.

A portion of a mineral water, from Ste. Martine in Beauharnois, was brought to me by Mr. A. Primeau, of that parish. The recent water is said to be sulphurous; it had a feebly saline sweetish taste and gave 1.98 parts of solid residue for 1000. It contains a considerable portion of earthy carbonates with a little iron, and is when concentrated, strongly alkaline and saline, containing besides carbonate of soda and common salt, a small portion of sulphates, and distinct traces of bromids and iodids.

Chambly.

In the month of October last, I visited three mineral springs in the parish of Chambly. The first of these occurs in the second concession from the Montréal River, at the Grand Coteau, and is upon the land of Antoine Getté. Here a well has been made eight or ten feet deep, in which the water rises to the surface and issues in a small stream. A few bubbles of gas, probably carburetted hydrogen, escape from time to time. The temperature of the water, was found to be 53° F. at the surface, and the same at the bottom of the well, that of the air being 72° F. The water is feebly sweetish and saline to the taste, and gives by evaporation 2.09 parts of solid residue in 1000. It deposits on boiling a small amount of earthy salts, and the liquid, at first colorless, becomes deep yellowish-brown. This

character, which I have generally remarked in alkaline mineral waters, probably depends upon a little organic matter present, which is modified by the alkaline carbonate. When evaporated to one twentieth, the alkaline taste is so strong as to disguise almost entirely the saline flavor, and the liquid gives with a salt of baryta a copious precipitate, which dissolves entirely in hydrochloric acid, with effervescence. The alcoholic extract of the saline residue gives feeble but distinct reactions of iodine and bromine salts. 500 grammes of the water were evaporated to a small bulk, a little carbonate of ammonia was added, and the whole evaporated and dried in a sand-bath. The soluble portion mixed with a solution of chlorid of barium gave a precipitate of $\cdot 918$ grammes of carbonate of baryta, equal to $1\cdot 916$ grammes in 1000, and corresponding to $1\cdot 0295$ parts of carbonate of soda. The chlorine in 1000 parts was $\cdot 5271$, equal to $\cdot 8689$ parts of chlorid of sodium, and a determination of the alkali in this form, gave $2\cdot 264$ grammes. If we disregard the mixture of potassium salt, and calculate the whole as chlorid of sodium, there remains $1\cdot 295$ grammes of the salt, corresponding to $1\cdot 1744$ parts of carbonate of soda; but these results are only approximations, and the small amount of the water at my disposal at that time, did not permit me to carry my experiments further. The insoluble residue after the evaporation of the water with carbonate of ammonia, was dissolved in hydrochloric acid; the silica was separated by evaporation, and weighed $\cdot 061$, corresponding to $\cdot 122$ in 1000 parts. The solution gave $\cdot 054$ of carbonate of lime, and $\cdot 0908$ of carbonate of magnesia for 1000. In another determination, the precipitate from 500 grammes of the water which had been evaporated to one-tenth, gave only $\cdot 018$ grammes of silica, a fact coinciding with that remarked in my Report for last year, upon the examination of another alkaline water, that the silica remains in great part in solution, until a late stage in the evaporation, but is completely separated with the earthy salts, when the evaporation is carried to dryness. Since the above experiments, I have met with some observations of Bischof which throw great light upon the subject. He has found that carbonates of lime and magnesia are gradually decomposed, in the presence of boiling water, by silica either in its soluble or

insoluble forms, a silicate of lime or magnesia being formed, and carbonic acid evolved. It is probable that a soluble alkaline silicate would, under these conditions, produce a like decomposition of the earthy carbonates, and thus the silica in these alkaline waters, whether as alkaline silicate, or in the state in which it exists dissolved in many saline waters not alkaline, may when boiled with earthy carbonates, convert them into silicates, and thus be entirely separated from the waters. The precipitation at a late stage of the evaporation of a portion of silica in combination with the earthy bases, indicating a solubility of the earthy silicates under certain conditions, has been remarked in a previous Report, and will require further examination and additional researches upon these alkaline waters. This of Chambly is remarkable, from the fact that more than one-half of its solid contents is carbonate of soda. Taking the first determination of the alkaline carbonate, we have for the mineral ingredients of 1000 parts of the water—

Chlorid of Sodium,	·8689
Iodid and Bromid of Sodium,	traces
Carbonate of Soda.....	1·0295
“ of Lime.....	·0540
“ of Magnesia,.....	·0908
Silicia,	·1220
	————— 2·1652

Another spring rises about ten feet distant from the last, and yields small bubbles of gas; it is however not inclosed, and being a favorite resort for cattle, was so muddy and impure, as to be unfit for analysis. A qualitative examination of a portion, showed it to be like the last, strongly alkaline, and to contain chlorids with traces of bromine and iodine salts.

In another portion of the parish, about a league north of the village of Chambly, there are two mineral springs, upon what is known as Le Rang des Quarantes (arpents) upon the Ruisseau Macé, which falls into the Montréal River. These springs are upon the land of Mr. Cherrier, and are about forty arpents from the river. One of them is a copious spring, which fills a basin from which the water flows in a considerable current; its temperature was found to be 53° F., that of the air being 78°, and it evolves a large amount of inflammable

gas. The water, which is slightly turbid from the suspended clay, is pleasantly saline to the taste, and gives 5·74 parts of solid residue for 1000. It yields by boiling, a copious precipitate of earthy carbonates, while the concentrated water is strongly alkaline to the taste and contains carbonate of soda, besides chlorid of sodium with bromids and iodids in marked quantity. The solution of the earthy salts in hydrochloric acid, is abundantly precipitated by solution of gypsum, indicating carbonate of baryta and probably of strontia. About an arpent from the last, is another spring, which like the last yields bubbles of gas; the water has a feeble sweetish saline taste, and is at the same time slightly ferruginous; it appears to be like the others alkaline, but was not further examined. Its temperature was 50° F.; but these determinations require to be verified by accurate observations at other seasons of the year, when the springs are less heated by the sun. The waters appear to be slightly thermal, at least their temperature is higher than the mean of Montreal, which is 49·5° F.

Kingston.

There is a mineral well at Morton's Distillery at Kingston, from which I collected a portion of water, and have since subjected it to qualitative analysis. It is somewhat sulphurous, and exceedingly bitter as well as saline to the taste; 1000 parts give 10·16 parts of solid residue. By boiling, the water lets fall a considerable amount of earthy carbonates, mixed with a trace of iron. When concentrated to one-half, crystals of sulphate of lime separate, and the liquid contains, besides alkaline and earthy chlorids, a large amount of sulphates; salts of magnesia are abundant. When evaporated with carbonate of potash, the residue treated with alcohol, gives feeble but distinct reactions of bromine and iodine.

ANALYSES OF MINERALS.

Sphene.—The cleavable variety of sphene from the plumbago vein at Grenville, was observed by Shepard and Brooke to be peculiar in its cleavage forms, and was proposed as a subspecies by the former, under the name of Lederite. The ordinary varieties of sphene cleave readily in the form of an obli-

que rhombic prism of $113^{\circ} 30'$; while the cleavage prism of the Lederite gave the angle $125^{\circ} 30'$. The mineral of Grenville is massive, but crystals from Phillipstown and Hammond, New York, were found to exhibit a similar cleavage, and were also supposed to differ in their external forms from ordinary sphene. Mr. Dana has since shown that the discordance in form is merely apparent, and that the two are identical in crystallization, the peculiar cleavage of the Lederite constituting the only recognized distinction.* The observations of M. Baudrimont upon the cleavages of calcspar, have however shown that the parallel rhombohedral cleavages of this mineral are not always equally perfect, and that it is much more common to find one or two of them distinguished from the rest. He has further remarked, that in certain varieties, diagonal cleavages not observed in others, are found, and also cleavages parallel to different secondary planes.† Apparent anomalies in cleavages such as are presented in the Lederite, may then easily be conceived to be only instances of an unusually perfect development of some cleavage, which in the ordinary crystals of sphene is very obscure, or not at all observable.

The Grenville mineral was first brought into notice by Dr. A. F. Holmes of this city. It occurs in a vein of plumbago which was formerly wrought by the Hon. R. U. Harwood, and is associated with white tabular spar, felspar, green pyroxene, yellow idocrase, and more rarely zircon and cinnamon-stone garnet. The sphene forms masses often several inches in diameter, and perfect cleavage-forms measuring from one to two inches may be obtained. It is also found at another locality described in my Report for 1847-48, about half a mile north from this, in a vein with the same minerals, where it forms drusy-surfaced crystals, often of considerable size. The hardness of this sphene is 5.5; specific gravity of pure cleavable fragments, 3.490—3.499, from the second locality, 3.510; color light clove-brown or chocolate-brown; translucent. The mineral was finely divided by eleutriation, and dried in a water-bath. It was decomposed by heating with sulphuric acid, and after removing the soluble portions by water, repea-

* See Shepard's Mineralogy, Ed. 1844, p. 144, and the American Journal of Science for October, 1840, p. 357, and January, 1845, p. 180.

† Comptes Rendus de l'Academie, Nov. 8, 1847, p. 668.

ting the operation with the acid three or four times, in the manner recommended by H. Rose. The remaining silica was analysed by dissolving it in a boiling dilute solution of soda, and the oxyd of titanium precipitated from the acid solution by ammonia, was also redissolved, to remove from it a little adherent lime. A trace of iron associated with the oxyd of titanium was not separated; 100 parts of mineral gave:—

Oxyd of Titanium TiO_2 , with a trace of Iron...	40·00
Silica,	31·83
Lime,	28·31
Loss by ignition,	·40

— 100·54

The composition is therefore identical with that of ordinary sphene; the formula assigned to the species requires oxyd of titanium, 40·60,—silica, 31·03,—lime, 28·37. Subsequent experiments were made with the titanitic oxyd, to ascertain whether it was any way distinguishable from that of rutile or ilmenite, but with negative results.

In a previous Report the existence of sphene in several of the intrusive trap rocks of this district has been mentioned. It has been observed at Montreal, Yamaska, Monnoir and Brome Mountains. The crystals which are generally imbedded in felspar and are very numerous, are always honey-yellow or amber-yellow, transparent, brilliant and exceedingly minute; they are often highly modified, and from their smallness are very difficult to measure. They are evidently monoclinic, and in the hands of my friend Mr. W. P. Blake, of New York, gave for the angle of the prism, as a mean of several measurements, $136^{\circ} 16'$, which is that of a common form of sphene. To render more complete the evidence of its character, I endeavoured to submit it to analysis, and by care was able to detach from a specimen of trap from Yamaska mountain, .2 grammes, which gave by a single trial 2·76 as the specific gravity. By ignition, the pulverized mineral lost only .001 gramme; heated with sulphuric acid, it left a residue of silica which was at once dissolved by hydrofluoric acid with the exception of a little undecomposed mineral; the silica equalled 31·5 per cent. The sulphuric solution gave about 40 per cent. of titanitic acid, and contained besides this, nothing but lime in solution. The

mineral was therefore identical in its composition with ordinary sphene.

Rutile.—In examining at the locality, the extensive masses of ilmenite which you have described as occurring at Bay St. Paul, and of which I have given the analysis in a previous Report, some portions of it were found to be coarsely crystalline, and to contain abundantly disseminated hard translucent grains of a yellowish-red colour and conchoidal fracture. A qualitative examination showed them to consist of oxyd of titanium, so that they will probably belong either to the species rutile or brookite; a determination of their gravity will be necessary in order to decide as to their specific nature.

The mineral which occurs at the Bay St. Paul, in veins of calcareous spar, and was alluded to in a previous Report as a green apatite containing much fluorid, is fluor-spar. The specimens much resemble apatite in their appearance, and gave with molybdate of ammonia the reaction of a phosphate; but Berzelius has shown that fluor sometimes contains small portions of phosphate of lime, and such upon further examination, proved to be the nature of this mineral.

Allanite.—I have observed this rare mineral in small quantities in a felspathic rock, which is found upon the mountain road from St. Joachim to Bay St. Paul, about two leagues before reaching the latter place. It here occurs massive in thin seams, and somewhat resembles the Swedish variety orthite. The specimens were brownish-black, opaque and apparently decomposing. A qualitative analysis showed it to be a silicate of lime, alumina and oxyd of cerium.

Platinum.—This metal was detected last summer, in the gold washings of the Rivière duLoup, where it is found sparingly mixed with the gold, in minute scales and grains. These were soluble in aqua-regia, and the solution gave with sal-ammoniac the characteristic double salt. Associated with it there was another metal which resisted completely the action of the acid. It formed small plates of a tin-white, generally hexagonal, and so hard as to resist steel; these characters show it to be *iridosmine*, the native alloy of the rare metals iridium and osmium, which is found with the gold of South America, and is from its extreme hardness, employed to form the points of

gold pens. Specimens of both of these metals, said to be from the Rivière des Plantes, have been placed in my hands by Mr. Cunningham.

Gold.—The specific gravity of several worn fragments of the gold from the Rivière du Loup, was found to be as follows:—15·761—16·490—16·654—17·60—17·77. The third specimen (I) after being hammered out to a thin plate and twice annealed, had a specific gravity of 17·024, and the fifth (II) after the same process 17·848. These two were analysed by solution in aqua-regia and determining the amount of chlorid of silver. The gold was calculated from the loss, the solutions containing besides only traces of iron and copper. A third specimen of gold in fine scales (III) had a specific gravity of 16·57. The results of the three analyses are as follows:—

	I.	II.	III.
Gold,.....	86·40.....	87·77.....	89·24
Silver,	13·60.....	12·23.....	10·76
	<hr style="width: 50%; margin: 0 auto;"/> 100·00	<hr style="width: 50%; margin: 0 auto;"/> 100·00	<hr style="width: 50%; margin: 0 auto;"/> 100·00

In these specimens there does not appear any proportion between the specific gravity and the amount of alloy. The condensation on hammering seems to be by no means alike in the two specimens. Perhaps the previous fusion of the gold, would render more evident the relation between its purity and specific gravity. A fragment of 7·5 grammes weight, which appeared to be free from cavities or foreign impurities, had a specific gravity of 15·761, and by a prolonged fusion with nitre and carbonate of soda, lost 1·76 per cent. of its weight, and acquired a specific gravity of 17·43. The pure gold from the previous essays, precipitated from its solution by oxalic acid and fused with nitre, had a specific gravity of 18·685.

I have the honor to be,

Sir,

Your most obedient servant,

T. S. HUNT.

ERRATA

Page 15,—5th line from top, for *Stromatopora* read, *Stictopora*.

“ 78,—10th line from top, for 250 feet, read, 350 feet.