# GEOLOGICAL SURVEY

OF

# CANADA.

## REPORT OF PROGRESS

FOR THE YEAR 1846–7.

Montreal:
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1847.

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PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.

Toronto:
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1850.

# 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 Geloogist.*

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.

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MONTREAL, 1*st 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 Frênes, the Little Lake and Nairne's 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°. 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° 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. *Calciferous Sand rock.*—Resting conformably on the previous formation, there is met with a calcareous sandstone, or arena-

ceous 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°, but at the small point mentioned, the dip gradually changes by a fold in the strata to E. mag. <58°. 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° 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°, moderating to <30° 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 |
| | 178 |

| | | |
|---|---|---|
| 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 | | 280 |

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 Palœontology, are as follows :— *Chœtites 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 Frênes, 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 theGouffre 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°; 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 heen 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 36½ 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 fluorid 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 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 fossilferous 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 titanum; 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 deposites, 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 calcspar, and occasional colorless translucent quartz; the latter four minerals are in a highly crystalline condition and the epidote frequently surrounds the nodules of calcspar. The *rognons* 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 calcspar, 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 northeast; 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 anticinals, 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 Beaurivage River, four bands of this conglomerate which are probably repetitions of one bed. That at the Forks of the Beaurivage, 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 |
| Total thickness | 30 |

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°, 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°,

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 Beaurivage 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°; that of the succeeding portion of the section is 135°, mag. <45° | 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° 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 riband-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 arenaceo-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°, 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. $<65°$, 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 |
| | 880 |

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°), 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 slighly 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° 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 possiblecalcareous. 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 *Pointe aux Trembles*..... 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°. 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. <22½° ..... 96

—132

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°.

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, Batté wichcàgameg, (*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 viens 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 Rice'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 inches; 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 domaine, 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 desseminated 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 Riviére 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.

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Laboratory of the Geological Survey,
Montreal, 1*st 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 Fergusson, 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 Berzelius.

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 alkalies, 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, in part as carbonates. | .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 | .276 |
| 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 |
| | 100.0 |

100 parts of it yielded:

| | |
|---|---|
| Alumina | 12.420 |
| Oxyd of Iron | 7.320 |
| Lime | .697 |
| Magnesia | 1.490 |
| Potash | .591 |
| Soda | .231 |
| Phosphoric Acid | .390 |
| Sulphuric Acid | .022 |
| Soluble Silica | .105 |

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 | 6.245 |
| Lime | .980 |
| Magnesia | 1.080 |
| Potash | .753 |
| Soda | .355 |
| Phosphoric Acid | .474 |
| Sulphuric Acid | .024 |
| Soluble Silica | .210 |

*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 } Soda } | .380 |
| 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 seive 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, Magnesia } in part as silicates | Lime | 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 |
| | | 100,308 |

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 |
| | 100.0 |

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 | |
| | | 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, Magnesia... in part as carbonates | 2.625 |
| | 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 |

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 | .303 |
| 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 | |
| | | 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 |

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 Sociey, 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 subsoil, 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, alkalics 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<br>Alumina<br>Manganese, a trace } ..... | 13.50 |
| 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 $4\frac{1}{2}$ 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 Resourses 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 it 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 calcium 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 calcium; 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.

# CATALOGUE

OF SOME OF THE

# ECONOMIC MINERALS AND DEPOSITS

OF CANADA,

WITH THEIR LOCALITIES.

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.

## *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 pyrates*,) 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 Seigniory, 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, Russieau ——, 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 copperas 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 neigbouring 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, Sapphires } ...Burgess Range 9, lot 2, (in minute grains.)

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; Montreal, 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 strewed 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 serpentine 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; Marston; Strafford; Weedon; Vaudreuil Beauce Seignory, near the band of serpentine. (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 thePotsdam 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 Hones—Madoc, range 5, lot 4; Marmora, range 6, lot 22; Lake Mazinaw, 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 Tripoli, *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 28, 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 Vielle.

## *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; Barnston, 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 Ditton; 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 Louisa; Winslow, 3 miles long, about 5 miles south-east of Lake Aylmer; Strafford, 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. Chapreon; 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.

*Variegated, 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 Cranbourne ; 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, NAPTHA, &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.

DIGEST OF THE

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