# GEOLOGICAL SURVEY

OF

# CANADA.

## REPORT OF PROGRESS

FOR THE YEAR, 1851-52.

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# GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 14*th* *May*, 1852.

SIR,

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

I have the honor to be,

Sir,

Your most obedient servant,

W. E. LOGAN,

*Provincial Geologist.*

To the Hon. A. N. Morin,

Provincial Secretary,

&c., &c., &c.

TO HIS EXCELLENCY

THE RIGHT HONORABLE

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

*BARON BRUCE OF KINROSS AND OF TORRY,*

ONE OF HER MAJESTY'S MOST HONORABLE PRIVY COUNCIL,

**Governor General of British North America,**

AND

CAPTAIN-GENERAL AND GOVERNOR-IN-CHIEF

IN AND OVER

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

AND VICE-ADMIRAL OF THE SAME.

*Montreal*, 14*th May*, 1852.

MAY IT PLEASE YOUR EXCELLENCY:

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

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

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

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

Metamorphic or Gneissoid group.
Potsdam sandstone.
Calciferous sandrock.
Chazy, Birdseye and Trenton limestones.
Utica slate.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

White sandstone, even-bedded, and splitting into rectangular blocks, fit for building purposes..... 1 6

White sandstone with very regular cleavage and bedding, fit for building, and glass-making; there are ripple-mark and reticulating fucoids on the top..... 1 3

White sandstone with a smooth surface .....0·7

White sandstone with ripple-mark and tracks.....0·5

White sandstone with ripple-mark.....0·2

White sandstone with a smooth surface and tracks.....0·2

— 0 1 5/10

White sandstone; this bed is made up of beautifully regular paralliel layers of two to four inches, closely soldered together, but distinctly marked by very slight differences of color; the joints are remarkably regular and the bed would yield excellent material for glass-making and building, and perhaps for flagging..... 3 0

White sandstone with broad ripple-mark on the top, measuring eight to ten inches from ripple-ridge to ripple-ridge. 4 0

Light grey limestone in patches running into sandstone, and displaying abundance of *Scolithus linearis*..... 0 4

White sandstone ..... 5 4

White sandstone slightly calcareous, with a thin more siliceous bed at the top, varnished over with iron stain and marked by *Scolithus*..... 4 11

White sandstone marked on the top with *Scolithus*..... 1 1

White slightly calcareous sandstone with ripple-mark and *Scolithus* ..... 1 6

White less calcareous sandstone with *Scolithus*..... 0 6

White calcareous sandstone; the calcareous matter increases in patches, and the rock wears unequally..... 2 0

White slightly calcareous sandstone with *Scolithus*, prevailing in a few inches at the top..... 2 2

White slightly calcareous sandstone with a *Scolithus* bed at the top ..... 2 1

White slightly calcareous sandstone; *Scolithus* at the top... 0 6

White sandstone with a *Scolithus* bed at the top holding calcareous patches ..... 2 6

White sandstone with calcareous indications and a *Scolithus* bed at the top..... 2 6

Concealed..... 10 0

Greyish calcareous sandstone, with two bands of limestone pebbles towards the middle; the top and bottom surfaces of the bed are figured with large reticulating fucoids; some of the meshes of the net work are fourteen inches in diameter, and the stems one and a-half to two inches wide; the forms of the meshes are sometimes four, sometimes five

and sometimes six sided; the part included within the mesh is filled with clay or rather a crumbling dark green shale, giving a brownish streak; when the shale is removed, the stems stand out in relief to the height of half an inch; geodes or nodules of reddish dale-spar occur in the bed sparingly disseminated ..... 2 0

55 3

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

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

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

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

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

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

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

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

| | |
|---|---|
| *Stictopora acuta* | Trenton. |
| *Leptena alternistriata* | " |
| ——— *alternata* | " |
| *Pleurotomaria umbilicata* | Birdseye. |
| *Murchisonia perangulata* | " |
| *Modiolopsis obtusa* | " |
| *Favosites alveolaris* | " |
| *Phytopsis cellulosa* | " |
| *Atrypa plena* | Chazy. |

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

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

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

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

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

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

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

### ECONOMIC MATERIALS.

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

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

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

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

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

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

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

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

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

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

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

My visit lasted a week, during one day of which a heavy fall of rain prevented work; but for the remainder of the time a regular account was kept by me of the gold collected and the wages paid. The quantity of gold amounted to $143\frac{16}{24}$ penny-weights, the price of which, stated to me subsequently by dealers in London, to whom a sample was submitted, was £3 10s. 6d. sterling per ounce, or about four shillings and fourpence currency per penny-weight. This would give a total value of

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

Resulting from the season's work on the Rivière du Loup there was about a ton of fine black iron-sand in the keeve or vat, over which the copper bottom was used. The unseparated quantity of gold in this after repeated trials, was ascertained to be 1·77 grains per pound avoirdupois; this would give $165\frac{2}{10}$ penny-weights to the ton, the gross value of which would be about £36. From among a few ounces of fine gold obtained from the sand, there were collected some small grains both of platinum and iridosmine, the value of the former being below, and of the latter double that of gold; almost all of this fine gold was at first of so white a color that it was considered probable the circumstance might be owing to the presence of a very large proportion of silver; some of the larger pieces also obtained from the copper bottom were spotted white from the same supposed cause; but Mr. Hunt, on heating this white gold, found that it quickly turned to a good golden yellow, and that the discoloration was occasioned by a thin coating of mercurial amalgam. As the spots were perceived on some of the larger pieces immediately on their being first obtained by vanning on the shovel, it is supposed they must have been spotted with the mercury while still undisturbed in the drift; and as no mercury had been used on the ground, it leads to the supposition that some ore of mercury may possibly be one of the mineral products of the country, though not a grain of cinnabar, the commonest form of the ores of mercury, has been observed in the gravel. Among the substances obtained in separating the gold, lead shot of various sizes, from partridge to swan shot, has been nearly as abundant as the gold. Not a vanning was made of the concentrated material without obtaining some of it; its presence is no doubt due to the operations of those who have followed the chase, and to judge from the quantity of the shot the place must have been one of favorite resort. Whether the hunters may at any time have brought quicksilver with them and spilt it, is a question that cannot be determined.

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

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

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

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

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

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

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

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

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

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

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

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

1.

| | |
|---|---|
| Hard dark grey sandstone in thin layers of four inches to one foot, separated by thin layers of dark grey and black shales with fine scales of mica | 32. |
| Hard dark grey sandstones and shales, with two hard dark grey beds which weather brownish, and are strongly calcareous | 5. |
| Dark grey brownish weathering limestone of an arenaceous character | 2. |
| Dark grey brownish weathering limestone, and dark grey sandstone layers with dark grey and black arenaceo-micaceous shale | 4. |
| Dark grey sandstone with dark grey arenaceo-micaceous shale | 10. |
| Dark grey fine grained thick-bedded sandstone very slightly calcareous; the band swells occasionally to greater dimensions in the strike, and diminishes occasionally to one foot | 6. |
| Dark grey thin sandstones and shales, a greater proportion of shales than in the previous beds | 27. |
| Grey fine grained calcareous sandstone in beds varying from four inches to one foot, separated by dark grey and sometimes black shales and occasionally by green shales | 94. |
| Striped light and dark grey micaceous shales of an arenaceous character | 6. |
| | 186. |

2.

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

character, with small black phosphatic nodules, sparingly disseminated in them ; the beds are of one inch to one foot, and they are separated in the upper part by red shale, in the lower by green and black shale..... 6.
Green and grey shale with thin bands of limestone..... 2.
Grey conglomerate limestone, with a few small black phosphatic nodules and with some shale above and below the band..... 2.
Grey and reddish-grey shale, with a band of grey limestone... 4.
Grey arenaceous limestone with bands of red and green shale 6.
Grey arenaceous limestone beds separated by red shale..... 7.
Grey arenaceous limestone with small thinly disseminated black phosphatic nodules..... 2.
Grey calcareous sandstone and arenaceous limestone, separated into beds by grey arenaceo-micaceous shale..... 7.
Grey calcareous sandstone and arenaceous limestone, separated into beds by grey and red shale..... 9.
Red shale with bands of grey limestone..... 5.
Grey limestone beds separated by dark grey shale with a band of red shale at the bottom..... 7.
Green and red shale with a few bands of limestone..... 16.
Red shale with patches of conglomerate limestone, sometimes swelling out to a foot and sometimes diminishing to two or three inches; the pebbles of the conglomerate are chiefly limestone with a very few of red jasper, and they are mingled with a great multitude of *black phosphatic nodules*, or pebbles ; some of them are as round as shot and some quite flat, while others are of irregular shapes..... 2.
— 85.

3.

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

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

4.

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

5

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

6.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1—Metals and their ores.

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

3—Mineral paints.

4—Materials applicable to the fine arts.

5—Materials applicable to jewellery.

6—Materials for glass-making.

7—Refractory materials.

8—Grinding and polishing materials.

9—Materials applicable to the purposes of common and decorative construction.

10—Miscellaneous materials.

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

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

## CATALOGUE.

### *Metals and their Ores.*

MAGNETIC IRON ORE.—Large blocks from Marmora, Madoc, Bedford, South Crosby, Hull ; smaller specimens from Portage du Fort, Bolton, Leeds, Sutton, New Carlisle.—*Geological Survey.*

MAGNETIC IRON ORE.—A large block from South Sherbrooke.—*Dr. J. Wilson, Perth.*

SPECULAR IRON ORE.—Specimens from Wallace Mine Location, Lake Huron.—*Geological Survey.*

SPECULAR IRON ORE.—A large block from McNab.—*A. Dickson, Packenham.*

BOG IRON ORE.—A large block from Vaudreuil Seigniory.—*R. Lancaster, Vaudreuil.*

A large block from Rivière du Chêne.—*J. Proulx, St. Eustache.*

A large block from Portneuf Seigniory.—*F. Marcotte, Portneuf.*

Large blocks from St. Vallier Seigniory,—*Capt. Morin, St. Vallier.*

Small specimens from Stanbridge.—*J. W. & H. Desrivières, Stanbridge.*

Small specimens from Camden, Eardley, Simpson, Ireland, Lauzon Seigniory.—*Geological Survey.*

Small specimens from St. Maurice Forges.—*Hon. J. Ferrier, Montreal.*

WROUGHT IRON.—Square and flat bars, axe iron, plough-share plate, with cold-folded and cold-twisted bars manufactured from the bog ore of St. Maurice.—*Hon. J. Ferrier, Montreal.*

CAST IRON.—Pigs cast from the ore of Belmont and Marmora.—*Marmora Iron Company, Marmora.*

TITANIFEROUS IRON.—Large blocks and small specimens from St. Armand, Sutton, Brome, Vaudreuil Beauce.—*Geological Survey.*

ILMENITE, sometimes intermixed with RUTILE.—Large blocks from St. Urbain, Bay St. Paul.—*Geological Survey.*

ZINC ORE (BLENDE.)—Specimens from Prince's Location, Pointe des Mines Lake Superior.—*Geological Survey.*

LEAD ORE (GALENA.)—Specimens from Prince's Location, Thunder Cape, Pointe des Mines Lake Superior, Bedford, Fitzroy, Indian Cove Gaspé.—*Geological Survey.*

COPPER ORE (PYRITES.)—Specimens from Pointe des Mines and Mamainse Lake Superior, Root River, Echo Lake, Bruce Mines, Wallace Mines, Lake Huron, Bastard.—*Geological Survey.*

(Variegated.)—Specimens from Point Porphyry Lake Superior, Bruce Mines Lake Huron, Inverness.—*Geological Survey.*

(Vitreous.)—Specimens from Prince's Location, and Harrison's Location Lake Superior; Bruce Mines Lake Huron.—*Geological Survey.*

(Native.)—Specimens from Harrison's Location, Ewart's Location, Michipicoten Island.—*Geological Survey.*

(Argentiferous Pyrites.)—Upton; (Auro-argentiferous)—Ascott.—*Geological Survey.*

Copper Ore (Yellow.)—Large blocks from Bruce Mines.—*Montreal Mining Company, Montreal.*

Copper (Smelted.)—Tough cake from Bruce Mines, resulting from the pyritous ore.—*Montreal Mining Company, Montreal.*

Copper (Native.)—Specimens from St. Ignace Island Lake Superior.—*Montreal Mining Company.*

Nickel Ore (Sulphuret.)—Specimens from Wallace Mine Lake Huron.—*Geological Survey.*

Silver (Native.)—Specimen of 3½ per cent. ore from Prince's Location, Lake Superior.—*J. F. Badgley, Montreal.*

(Smelted.)—Specimens resulting from the ore of Prince's Location Lake Superior.—*J. F. Badgley, Montreal.*

(Native.)—Specimens from Prince's Location and Harrison's Location, Lake Superior.—*Geological Survey.*

Gold (Native.)—Specimens from washings on the Touffe des Pins, Vaudreuil Beauce.—*Chaudière Mining Company, Quebec.*

(Native)—Specimens from Lake Etchemin, Rivers Chaudière, du Loup, Famine, Poser's Stream, Bras, Guillaume, des Plantes, Metgermet, St. Francis, &c., &c.—*Geological Survey.*

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

Uran Ochre.—Specimens shewing traces from Madoc.—*Geological Survey.*

Chromic Iron.—Large masses from Bolton and Ham.—*Geological Survey.*

Cobalt Bloom.—Specimens shewing traces from Prince's Location Lake Superior.—*Geological Survey.*

Wad or Earthy Manganese.—Small specimens from Bolton, Stanstead, and Tring Townships, and the Seigniories of Aubert Gallion, St. Mary and St. Anne.—*Geological Survey.*

Magnetic Iron Pyrites.—Specimens from Lanotaye and D'Autraye.—*Geological Survey.*

Molybdenite.—Specimens from Terrace Cove, Lake Superior.—*Geological Survey.*

Dolomite.—A large block from Dalhousie.—*Dr. J. Wilson, Perth.*

Specimens from Litchfield, Dunham, Leeds, and Stukely.—*Geological Survey.*

Magnesite.—Large masses from Bolton, and large masses stained with oxide of chromium from Bolton and Sutton.—*Geological Survey.*

*Mineral Paints.*

IRON OCHRE.—Specimens from Seigniory of St. Anne Montmorency.—*E. Caron, St. Anne, Montmorency.*

Specimens from St. Rose.—*L. M. Cyr, St. Eustache.*

Specimens from Pointe du Lac, County St. Maurice.—*D. G. Labarre, Three Rivers.*

Specimens from Petite Rivière Romaine Ibberville.—*G. Dubérger, Murray Bay.*

Specimens from Magdalene Islands and Gaspé.—*R. W. Kelly, Gaspé.*

Specimen from Durham.—*J. Hall, Melbourne.*

Specimens from Beauharnois, Stanstead, Durham.—*Geological Survey.*

BARYTES.—Specimens from Baryta Island Lake Superior, Bedford, MacNab, Seigniory of Vaudreuil Beauce.—*Geological Survey.*

SOAPSTONE, TALCOSE SLATE.—Specimens from Stanstead, Leeds, Potton.—*Geological Survey.*

PHOSPHATE OF IRON.—Specimens from Vaudreuil.—*R. Lancaster, Vaudreuil.*

*Materials applicable to the Arts.*

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

*Materials applicable to Jewellery.*

AGATES.—Cut and polished specimens from Michipicoten, and Simpson's Islands and North shore of Lake Superior.—*Geological Survey.*

JASPER.—Pebbles cut and polished, and a boulder of Jasper Conglomerate Lake Superior.—*Geological Survey.*

RIBBONNED CHERT.—Specimens from Thunder Bay, Lake Superior.—*Geological Survey.*

PERISTERITE, PERTHITE, LABRADORITE.—From Buthurst, Burgess, Drummond.—*Dr. J. Wilson, Perth.*

*Materials for Glass-making.*

WHITE QUARTZOSE SANDSTONES.—Large slabs from the Ottawa Glass Works, Vaudreuil.—*Boden and Lebert, Vaudreuil.*

WHITE QUARTZOSE SANDSTONE.—Small specimens from Ship Channel Lake Huron, Ham, Nepean, Isle Perrot, Rivière du Chêne, Stukely.—*Geological Survey.*

PITCHSTONE.—Small specimen from Michipicoten Island Lake Superior.—*Geological Survey.*

*Refractory Materials.*

SOAPSTONE.—Large thick slabs from Bolton, and small specimens from Seymour, Sutton, Brome, Potton and Bolton.—*Geological Survey.*

PIPESTONE.—Small specimens from Calumet Falls.—*Geological Survey.*

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

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

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

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

*Mineral Manures.*

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

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

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

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

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

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

*Grinding and Polishing Materials.*

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

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

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

*Materials applicable to Common and Decorative Construction.*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

*Miscellaneous Materials.*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Before quitting the subject of the Industrial Exhibition, I

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

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

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

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

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

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

I have the honor to be,

Your Excellency's

Most obedient servant,

W. E. LOGAN

# REPORT

OF

ALEX. MURRAY, ESQ., ASSISTANT PROVINCIAL GEOLOGIST,

ADDRESSED TO

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

Woodstock, 29th January, 1852.

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

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

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

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

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

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

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

### *Distribution of the Formations.*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

having a fine grained blackish-green base, with individuals of greenish-white translucent feldspar. Flesh colored feldspathic veins likewise intersect the bedding, and titaniferous iron occurs in patches in some of these dykes, as well as in some of the beds. The run of the gneissoid ridge is nearly N. E. and S. W., and the beds shew a dip to the south.

The Lower Silurian group of rocks, underlying the more level parts of the district, are agreeably to the nomenclature of New York, and in ascending order as follows.

Potsdam sandstone.
Calciferous sandrock.
Chazy limestone.
Birdseye, Black River and Trenton limestones.
Utica slate.

*Potsdam sandstone.*—Towards the western end of the trough which the group forms, this rock, resting unconformably on the previously described Metamorphic series, is traceable by a multitude of exposures running in a meandering course from Brockville to the vicinity of Perth, the bays and promontories of its geographical distribution being occasioned partly by inequalities in the surface of its gneissoid base, and partly by very gentle undulations in itself; on the eastern side it can be followed from the Cascades, by Vaudreuil to Rigaud.

The cliffs below Brockville expose a sequence of seventy-five to eighty feet thick, consisting of the sandstone, with interstratified calcareous bands at the top, and a coarse silicious conglomerate at the base; and about two and a-half miles above the town, an outlying patch of the formation comes in on the river bank, and occupying it for seven miles up, occasionally shews the silicious conglomerate in unconformable contact with the Metamorphic series below. Many of the upper and finer beds of these exposures exhibit fucoids on their surfaces, and a number of small cylindrical holes, recognised as the *Scolithus linearis* of Hall; fragments of shells also occur in some of the interstratified calcareous layers, but they were invariably found to be too obscure to be identified.

At Charleston Lake there is an extensive development of the formation on the north shore, and outliers occur on many of the numerous islands which stud the lake. On one of these

islands already mentioned as a mile south-west of Charleston Village, and commonly called Bluff Island, the following descending section occurs:

| | Ft. | In. |
|---|---|---|
| Sandstone, blood-red at the top and chocolate colored at the bottom, with nodules or concretions of quartz, weathering brown on the upper surface | 4 | 0 |
| Thin bedded white, red, and chocolate colored sandstone | 4 | 0 |
| Red and greyish or white sandstone in alternating stripes | 4 | 3 |
| Dark brown sandstone of a pink or reddish hue, and occasionally striped with decided red | 5 | 7 |
| Red and dark brown sandstone | 5 | 0 |
| Blood-red coarse sandstone with concretionary nodules | 2 | 0 |
| Dark brown, red and yellow banded coarse grained sandstone, dividing into thin layers | 11 | 0 |
| Red and yellow sandstone in alternating stripes, divided into thin layers | 7 | 3 |
| Red and yellow striped and mottled sandstone of a coarse grain, not well exposed | 11 | 0 |
| Coarse red sandstone with quartz pebbles scattered through it | 2 | 6 |
| Coarse dark yellow sandstone striped and mottled with red; the upper part is red, and holds large pebbles of quartz scattered through it | 3 | 6 |
| A conglomerate bed, with a matrix of dark brown or yellowish coarse silicious sandstone, sometimes tinged with pink, and holding pebbles chiefly of quartz, in irregular layers; the largest pebble or rather boulder is one foot in diameter | 8 | 0 |
| Coarse dark brown sandstone or fine conglomerate, with pebbles chiefly of white quartz | 2 | 11 |
| | 71 | 0 |
| Red talco-quartzose rock of the Metamorphic series | | |

The infiltrating iron oxide, which has stained the red talco-quartzose rock at the base of the section, seems to have imparted its color to the overlying mass, and on some parts of the lake, the color of all the lower beds, both sandstones and conglomerates, is deep blood-red, which gives place gradually in the ascending strata, to white with red stripes and spots, and then to white alone. On the eleventh lot of the eleventh concession of Lansdowne, at the head of one of the northern bays of the lake, there is a section of about forty feet thick, consisting of white sandstone, with shaly and slightly calcareous layers at the top, and conglomerate below, which is seen in contact with the Metamorphic rocks, but, (in consequence of

the uneven surface of these,) at a higher level than the highest beds of the previous section, and it is probable that these white beds are additional strata ; the two together would thus give a total thickness of at least 110 feet. Fucoids, *Scolithus linearis* and *Lingula antiqua*, are found associated together in abundance in the upper slaty calcareous part, though sometimes rather obscure.

There is likewise a large display of sandstones and conglomerates in the township of Bastard near Beverly, where the red color prevails near the contact with the crystalline rocks. One exposure occurs on the line dividing the twenty-fourth and twenty-fifth lots, in the tenth concession of the township, near the town line of Lansdowne, where there is a cliff of sandstone of from twenty to thirty feet high. The rock lies in massive beds, occasionally measuring four feet and upwards in thickness ; they are all ferruginous, and passing upwards from a yellow or light brown into a deep red color, they present small seams and patches of specular iron. On the ninth lot of the twelfth concession of Lansdowne also, the same rocks contain streaks and patches of specular iron, a short distance from their junction with the crystalline limestone. North from Beverly, on the twenty-second lot of the ninth concession of Bastard, white sandstone beds, which must be higher than the preceding, contain fucoids, *Scolithus linearis*, and in a full state of preservation and great abundance, *Lingula antiqua*, with another and rarer species much less tapering to the beak. They occur also in a cliff near Newboro', a short distance from the town line between North and South Crosby.

In the townships of Elmsley and Montague, sandstones were observed encircling a dome of Metamorphic rock, which rises on the twenty-eighth lot of the seventh concession of Montague ; and portions of the formation, holding *Scolithus linearis* and fucoids, come to the surface on the crown of an anticlinal form, on the twenty-fourth lot of the fourth concession of West Gloucester ; the anticlinal appears to run parallel with the Ottawa, and again bringing to the surface an exposure of white sandstone, on the thirteenth lot of the eighth concession of East Hawkesbury, makes for the trap mountain of Rigaud and its accompanying Metamorphic rocks. In following the sandstones of

the Potsdam formation from the Cascades to Rigaud, they were found to assume a reddish tinge, on the road in the vicinity of Pointe du Grand Détroit, and to hold frequent small decomposing grains of reddish feldspar; patches of conglomerate occur in some of the beds, the pebbles of which are chiefly of vitreous quartz. In a position supposed to be geologically superior to these, about twenty-five acres above the Pointe du Grand Détroit, fine grained white quartzose sandstones were met with in beds of from six inches to two feet thick. Some surfaces displayed ripple-mark, and on one, trails and footprints of a species of animal exist, similar to the tracks occurring at Beauharnois, in the same description of beds. The largest of the tracks measures eight and a-half inches across, and the trail is visible for four feet, and gradually becomes obliterated at each end. On the same surface, twenty yards farther up the stream, three additional tracks of the same sort were observed, each one traversing the other two; two of these measured four inches across, and the third four and a-half inches; the last is distinct for three feet in length, and the other two, one foot eight inches, and one foot three inches respectively. The groove in the middle between the footprints on each side, so frequently seen at Beauharnois, occurs only in one of the smaller trails.

*Calciferous sandrock.* Resting on the sandstone just described, and frequently capping the cliffs composed of it, are a set of calcareous sandstones and impure arenaceous limestones, which follow its meandering outcrop. The calcareo-arenaceous beds hold geodes and patches of white and smoke-brown calc-spar, sometimes of gypsum, and display convoluted shells of the genera *Raphistoma*, *Maclurea* and *Euomphalus*, and less frequently spiral ones of the genus *Murchisonia*, with fucoids, all of these organic remains being often very obscurely weathered out. Ascending the St. Lawrence, the first intimation of the presence of this formation, connected with the western part of the trough, occurs in the vicinity of the village of Johnstown and on some of the islands opposite. At Battle Windmill, a little over a mile below Prescott, the following descending section was measured :—

| | Ft. | In. |
|---|---|---|
| Pale grey arenaceous impure limestone, weathering bright yellow, and rapidly disintegrating on exposed surfaces; the bed is | | |

| | | |
|---|---|---|
| filled with concentric concretionary balls, the concentric layers of which are frequently interlined with white calc-spar | 1 | 2 |
| Grey less impure limestone | 0 | 5 |
| Grey arenaceous limestone, with many geodes of calc-spar, and cracks lined with the same mineral | 0 | 7 |
| Drab colored calcareous sandstone, with a large quantity of calc-spar in geodes | 1 | 5 |
| Compact pale grey, yellow weathering arenaceous limestone, rapidly disintegrating on the surfaces | 0 | 8 |
| Compact pale grey arenaceous limestone with geodes of calc-spar; a thin division of greenish-brown shale lies between it and the previous bed | 0 | 10 |
| Dark blue arenaceous limestone | 0 | 8 |
| Brownish calcareo-arenaceous shale | 0 | 3 |
| Dark blue arenaceous limestone, with small geodes of calc-spar | 0 | 6 |
| Dark blue arenaceous limestone of a crystalline structure, sometimes tinged with red, and separated into beds by thin layers of a very dark blue shale | 1 | 2 |
| Brownish-grey rather coarse textured limestone, with obscure convoluted shells | 4 | 6 |
| Dark blue arenaceous limestone with occasional large concentric balls | 2 | 0 |
| Arenaceous limestone | 3 | 6 |
| | 17 | 8 |

The dip of the measures here is nearly east, at an angle of two to three degrees; ascending the river, lower beds are alternately concealed and exposed, but there are probably several gentle undulations in the strata, and the following descending section, as measured a short distance above Maitland, is supposed to begin about where the former ends.

| | Ft. | In. |
|---|---|---|
| Dark blue arenaceous limestone with geodes of calc-spar; there are exposed on the surfaces of the beds, fucoids and many convoluted shells | 5 | 0 |
| Dark brownish-grey silicious limestone in irregular layers | 2 | 6 |
| Dark bluish grey arenaceous limestone | 3 | 0 |
| Grey quartzose sandstone, weathering brown | 2 | 0 |
| Dark grey calcareous sandstone | 2 | 6 |
| Concealed | 6 | 0 |
| Bluish-grey slightly arenaceous limestone | 0 | 6 |
| Pale grey or drab colored sandstone in thin beds | 3 | 0 |
| Concealed | 6 | 0 |
| Pale grey arenaceous limestone with great quantities of fucoids on the upper surfaces | 3 | 0 |

| | | |
|---|---|---|
| White sandstone, calcareous on the upper part | 4 | 0 |
| White sandstone, with soft brown-stained vertical streaks probably *Scolithus linearis* | 5 | 0 |
| Concealed | 10 | 0 |
| Brownish-grey calcareous sandstone | 2 | 0 |
| White quartzose sandstone, with some thin interstratified calcareous bands | 5 | 0 |
| | 59 | 6 |

This section, it is evident, is at the base of the formation, where it begins to form a passage to the sandstones beneath, and exposures of this part are very frequent along the whole line of the sandstone outcrop. Towards the interior, however, where the Calciferous sandrock formation approaches the overlying more calcareous series, the investing drift of the country permits fewer opportunities of observation. Exposures were met with at Spencer's Mills on the South Petite Nation, at Grant's Mills lower down, and on the first lot of the seventh concession of Edwardsburgh; in Oxford on the twenty-sixth lot of the tenth concession, and the thirtieth lot of the eighth concession, not far from a denuded mass of quartz rock, belonging to the Potsdam sandstone or the Metamorphic series beneath; again near Kemptville, on the twenty-fourth and thirtieth lots of the third and fourth concessions, and in South Gower on the tenth lot of the ninth concession. In Yonge the rock occurs on the eleventh lot of the eighth and of the ninth concessions, at Loyedu Lake, in the rear of the township, and in Kitley, near the village of Kitley Corner. On the Rideau Canal, it is seen at Smith's Falls, in a cliff of thirty feet, and at Kilmarnock, Merrickville and Nicholson's Rapids. In the south part of the township of Gloucester, it forms a cliff of thirty to forty feet, running from the fourth concession to the town line on the sixth, a distance of ten miles, and the Potsdam sandstone coming out at the base of the cliff, forms an anticlinal arch, which has been already alluded to. In the supposed continuation of this anticlinal in East Hawkesbury, it appears on the thirteenth lot of the seventh concession, where it constitutes a well marked ridge for several miles across Lochiel.

Very few beds belonging to the formation yield good lime; such, however, do occur in some parts, as at Brockville and

Merrickville ; the lime produced from them is dark colored, but is effective in giving strength to the mortar made from it. Stone for building purposes is abundant in the formation ; many of its beds yield a tough, solid and strong material, but it turns yellow under the influence of the weather. Some of the locks on the Rideau Canal afford good examples.

*Chazy, Birdseye, Black River and Trenton limestones.*—On Sheik's Island, opposite Mille Roches, in the higher part of the township of Cornwall, there occurs a grey limestone almost entirely composed of multitudes of a species of bivalve shell (*Atrypa plena* of Hall), and there are present with it a few examples of an unfigured species of *Cythere.* The rock rests upon greenish shale, abounding with fucoids, and it constitutes the base of the Chazy limestone formation, which succeeds the formation previously mentioned. On the twenty-fourth lot of the fourth concession of Cornwall, about a mile and a-half or two miles north of Mille Roches, a quarry is opened in massive beds of black limestone highly charged with iron pyrites ; the fossils of the rock are chiefly a large *Orthoceras*, of which the chambers hold indurated bituminous matter, *Streptoplasma crassa*, *Schizocrinus nodosus*, *Leptena alternata*, *L. sericea* and *Orthis testudinaria*, shewing the rock to belong to the Trenton limestone, of which it is probably near the base. In the apparent strike of these beds, on the sixth lot of the fourth concession of the same township, in a quarry where the stone has been extensively worked for the construction of the canal locks, the same description of black massive beds occurs ; and its fossils are *Columnaria alveolata* holding an indurated bituminous matter in the cells, with fragments of *Stictopora acuta*, *Shizocrinus nodosus* and *Isotelus gigas*, as well as the genera *Chætites*, *Leptena*, *Atrypa*, *Murchisonia* and *Cythere ;* orthoceratites also occur, and one of the forms appears to be *Ormoceras tenuifilum ;* some of these species characterise the Birdseye and others the Trenton limestone. Farther on in the strike, on the twenty-second lot of the second concession of Charlottenburgh, black and dark grey beds shew *Leptena sericea*, *L. deltoidea*, *Orthis testudinaria*, *Schizocrinus nodosus*, with *Pleurotomaria*, *Cyrtolites ?* and *Orthoceras.* Turning more northward, and proceeding to the thirtieth lot of the seventh concession of Lan-

caster, on the River Baudette, black beds probably of the Birdseye or Black River limestone, give *Pleurotomaria*, *Murchisonia*, *Lituites*, *Isotelus*, and *Cythere;* and across the stratification to the westward, on the eighth lot of the seventh concession of Charlottenburgh, *Leptena sericea*, *L. alternata*, and *Orthis testudinaria* occur in grey and black Trenton beds. Farther northeast on the River de l'Isle, which at its mouth and for some distance up, runs on the Calciferous sandrock, containing convoluted shells, are large angular blocks of grey limestone filled with *Atrypa plena*. This is on the seventh lot of the eighth concession of Lancaster, and about a mile below Dalhousie Mills, and the blocks probably mark the vicinity of the Chazy formation. Following the river up transversely to the stratification, at and near Alexandria on the eleventh lot of the first, and thirty-fourth and thirty-eighth lots of the second concession of Lochiel, and farther up on the Garry, on the fourth and sixth lots of the second concession of Kenyon, good fossilliferous Trenton limestone is exposed with characteristic remains. From Dalhousie Mills, the base of the Chazy sweeps round to the thirty-third lot of the seventh concession of Lochiel, where it holds *Atrypa plena* and exhibits small black nodules with a large per centage of phosphate of lime. North from this, about two miles, on the thirty-second lot of the seventh concession of Lochiel, the direction being at right angles to the stratification, there is an exposure of Trenton limestone, in which in addition to most of the characteristic species mentioned, a *Lingula* occurs as large as the largest *quadrata* figured, and like it in shape, but without the radiating striæ, and also *Conularia gracilis*; in the space between these two last spots, the Calciferous sandrock occupies the crown of the anticlinal arch which was before mentioned in connexion with that formation. In the ninth concession of Lochiel the strata strike for McDonnel's Mills, on the eighteenth lot of the seventh concession of East Hawkesbury, on the Rivière à la Graisse, where good massive beds of Trenton limestone again occur, within half a mile south of which, the same anticlinal as before, brings up the Potsdam sandstone.

Proceeding in a westerly direction from Cornwall, the Chazy limestone was not anywhere observed, and its position

must be taken as occupying the belt of country that lies between the exposures of the Calciferous sandrock on the one hand, and those of the Birdseye, Black River and Trenton limestones on the other. Black limestones belonging to the last of these formations, crop out on the twenty-sixth lot of the fifth concession of Osnabruck, and shew *Leptena sericea*, *L. alternata*, *L. filitexta*, *Orthis testudinaria*, *Lingula elongata*, *L.* like *quadrata*, but without the radiating striæ, a large bivalve like *Avicula elliptica*, and *Chætites lycoperdon*. Similar beds extend nearly across Winchester on the Petite Nation River, and quarries in them are opened in several places near Armstrong's mills on that stream. On the eleventh lot of the second concession, they hold *Cythere*, and from the twentieth lot of the second concession, black limestones characterised by Trenton fossils occur at intervals to Crysler's Mills in Finch, the whole of which township appears to be underlaid by such strata. At Crysler's Mills on the twelfth lot of the tenth concession of the township, a section shews alternations of grey or bluish and black limestones, dipping N. 50 E. at an inclination of a little over forty feet in a mile. Lumps of iron pyrites occur in the rocks, and the strata are intersected by a set of parallel small veins of calc-spar, running N. W. and S. E. At the High Falls on the seventeenth lot of the sixth concession of Cambridge, the rock is a bluish-grey bituminous and nodular limestone, divided into beds by thin partings of bituminous shale. The dip of the beds below the mill-dam, where the river runs on the face of one of them for 300 yards, is N. 7. E. inclining at an angle of about ninety feet in a mile, and the fossils they contain are *Leptena sericea*, *L. alternata*, *Orthis testudinaria*, *O. lynx*, *O. subquadrata* ? *Streptoplasma crassa*, and the genera *Bellerophon*, *Murchisonia* and *Orthoceras*.

Thin bituminous leaves not only part the beds, but irregularly penetrate the rock, and in this position, probably replacing fucoids, they give the rock its nodular character. To the westward of the High Falls, at Cooke's Mills on the Castor, in the eighth lot of the ninth concession of Russell, which would be in the strike of the strata, there is an escarpment of about five feet, consisting of dark blue limestone alternating with black or

very dark blue shale. Several of the shale beds are very fossiliferous, the shells in most abundance being *Leptena sericea*, *Orthis testudinaria* and *O. pectinella*. On the south bank of the Castor, in the next concession to the west, thick beds of dark blue limestone dip N. 30 W. <20°, and farther west at Louck's Mills, on the eleventh lot of the fourth concession, the dip which on the south side of the stream is S. 43 W. at an inclination varying from sixty to five degrees in the distance of a hundred yards, on the north side is N. 30 W. <17°; and while the north bank is occupied by thick bluish beds of granular limestone, the section on the south is as follows, in descending order :—

| | Ft. | In. |
|---|---|---|
| Black shale supplied with one species of coral in great abundance; the upper part holds large concentric concretionary spherical nodules of a fine-grained black limestone, passing in some parts into a bed of black limestone eight inches thick | 3 | 6 |
| Dark blue or black limestone holding *Cythere* in abundance, some of them of a quarter of an inch long | 1 | 10 |
| A strong bed of black bituminous limestone, somewhat nodular in structure | 3 | 0 |
| Black shale | 0 | 4 |
| Dark blue limestone, with imperfect divisions of black shale | 1 | 6 |
| Dark bluish-grey black weathering limestone, with divisions of calcareous shale holding imperfect fossils | 2 | 4 |
| | 12 | 6 |

The black or dark blue limestones traced thus far, were found where quarries existed, and wherever they had been tried, to yield good material for building, as well as admirable for lime, and the blacker the stone in general the whiter the lime. In many places, by carefully selecting blocks free from calcareous spar, which frequently invests cracks, and fills the organic remains, and avoiding pieces charged with iron pyrites, handsome blocks for the purpose of marble may be procured.

The Trenton limestone and its associated rocks are extensively developed on the banks of the Ottawa near Bytown, where the whole group comes in, and must attain a thickness of pretty nearly 400 feet; but the irregularities occasioned by a succession of dislocations by which the strata are several times partially repeated, disabled me from ascertaining cor-

rectly the exact amount, to determine which will require some additional examination. On the Barrack Hill there was measured an uninterrupted succession of beds, in all making 187 feet of thickness, and on the west side of a fault running S. 78 E., which occurs about 500 yards above the Barrack cliff, throwing down the strata on the south-west side about seventy feet, the beds continue to accumulate (deducting this amount,) at a pretty regular rate for nearly a mile, and a considerable distance beyond the Grande Chaudière Fall. The measures exposed in the Barrack Hill are for the most part more or less bituminous, and very fossiliferous; the upper portions which crown the cliff in the immediate vicinity of Bytown, are of a nodular structure, having the beds usually parted by black bituminous shale. The lower part of the section consists of strong bands highly charged with black chert, and underlaid by beds crowded with stems of encrinites, many of which are of large size, and in a good state of preservation. The rocks above the fault at the Barrack Hill cliff, consist of grey, yellow-weathering bituminous limestone containing numerous fossils, especially corals and spiral univalves; these being usually replaced by dolomite spar, which is less soluble than pure carbonate of lime, weather in relief on the exposed surfaces, and becoming brown from the presence of a small quantity of peroxidised iron, are strongly contrasted in color with the matrix in which they lie.

The Barrack Hill section after a small dislocation, seen a little below the mouth of the canal, parallel to the previously mentioned one, apparently producing a downthrow on the north-east side, is continued in the cliff which forms the bank down to, and for some distance beyond, the mouth of the Rideau River. At the Rideau Falls the strata are in descending order:—

| | Ft. |
|---|---|
| Nodular limestone | 35 |
| Thin bedded limestone, parted by bituminous shales | 16 |
| | 51 |

*Utica slate.*—About half a mile up the Rideau River the black bituminous shales of this formation, holding *Triarthus*[2]

*Beckii* and other fossils characterising it, are found resting on the nodular limestone above mentioned, and with these nodular beds, were traced to the eastward as far as the twelfth lot of the second concession of East Gloucester, keeping a course nearly parallel with the bank of the Ottawa, and dipping very gently in a direction from it. Ascending the Rideau, between four and five miles higher than the half-mile previously mentioned, these black shales, after repeated exposures in the interval, shew a last one a little above Billings' Bridge on the seventeenth lot of the Rideau Front, while the first succeeding limestones appear nearly a mile above, on the twentieth lot; and a couple of miles further up, in the first and second lots of the second concession of West Gloucester, they constitute an escarpment of a hundred feet; at the lower of these calcareous exposures, the dip which is N. N. E. increases from eighteen up to forty-five degrees in inclination in a transverse distance of 200 yards, and the beds are probably in the vicinity of an upthrow dislocation, or a violent twist which will limit the shales on their southern side; the dip at the upper calcareous exposure is N. 45 E. $> 5°$, and the ridge formed by the limestones it discloses, running south-eastward, crosses the Prescott Road between the tenth and fifteenth lots of the fourth concession of West Gloucester. On the flat land in front of the north-eastern slope of the ridge, a well, sunk by Mr. Walkely on the first lot of the third concession of the township, penetrated through fifteen feet of the black shale, and the foot of the ridge in its continuation westward, may be taken as the south limit of this trough of Utica slates. Between the highest and lowest exhibitions of it on the Rideau, the outcrop runs round the western extremity of the trough, but the rim it presents, is broken by the two dislocations which have been mentioned, and the effect of a third one, of which the course is about S. 55 E. throwing the measures down about a hundred feet on the south-west side, is seen on the southern edge of Dow's Swamp at St. Louis Dam, bringing the shale on the south abruptly against the limestone on the north.

How far this trough of black shales extends to the eastward, the season did not give me time to ascertain, but from information derived from various authorities and particularly from Mr.

Slater, C. E., the northern outcrop, running nearly parallel with the Ottawa, and crossing Cumberland, must reach far into Clarence, underlying the flat swampy tract of country, well known to occupy these townships a few miles south of the river.

*Drift.*—The superficial deposits which spread over the area between the Ottawa and St. Lawrence, and generally conceal the older formations, consist of clay, gravel, and sand; the first greatly prevailing on the eastern side, the last, in the western and higher portions of country, especially towards the shores of the St. Lawrence. They were observed on this river as high as Dickenson's Landing, where a brownish or drab colored calcareous clay is overlaid by a coarser clay, holding various pebbles and boulders, derived chiefly from the Calciferous sandrock, mingled with many which have been carried from the crystalline members of the Metamorphic series; and they compose, in a great measure, the banks of the river down to the Cascades. They occupy much of the south bank of the Ottawa, and are exhibited on all the tributary streams in the seigniories of Vaudreuil, Soulanges, and Rigaud, as also on the south Petite Nation and its tributaries. On the Rivière à la Graisse, in Rigaud, (which probably owes its name to the greasy character of the material through which it flows), there are extensive exposures of clay, the lower portions of which are of a blue or greyish color, exceedingly fine in texture, calcareous, but apparently free from limestone pebbles or other coarse materials. The blue clay is surmounted by clay of a brownish color, in which a red band is interstratified of from eighteen to twenty-four inches; both of these likewise are calcareous and fine textured. Sections of clay are exhibited far up the Graisse in Hawkesbury and Lochiel, as also on the Rivières de l'Isle and Baudette, which maintaining a character very similar in all respects to that displayed in Rigaud, suggest the probability that the whole belong to one set of deposits. No fossils were met with in these clays; but clays occur higher on the Ottawa, in the vicinity of Bytown, at the mouth of the Gatineau on the north, and of Green's Creek on the south side, which in addition to marine shells, of the species *Saxicava rugosa*, yield in the

latter named locality two species of fish, the *Mallotus villosus* or common capeling, and *Cyclopterus lumpus* or lump-sucker, both of which are still inhabitants of northern seas; the capeling still frequents the Gulf of St. Lawrence in great numbers, and the lump-sucker, the northern coasts of Scotland and America. Their fossil representatives are always enclosed in nodules of indurated clay of reniform shapes, and they appear to occupy a bed nearly on a level with the water of the Ottawa, about 118 feet above the tide level of Lake St. Peter; the same sort of nodules frequently enclose fragments of wood, leaves of trees, and portions of marine plants; among the last is one of the species of littoral algæ still found near the coasts of arctic seas.

Whether these fossiliferous clays are equivalent to the unfossiliferous clays lower down the river, requires a greater number of facts to determine than are at present in my possession; but though these marine remains were absent from the clays that came under observation, they were by no means so from deposits which overlaid them.

The greatest accumulation of sand that came under my notice was in the townships of Edwardsburgh, Augusta, and the southern part of Oxford, where it occupied the whole of the higher portions of country, frequently being drifted up into dunes of considerable elevation. It is usually of a light yellow color, principally of silicious grains, with a small amount of fine particles of limestone, evidently for the most part the ruins of the Potsdam and Calciferous sandstones. Near Dickenson's Landing, above the Long Sault Rapid, sand of this quality was found resting on the clay.

Besides the stratified deposits of clay and sand, there is a deposit of clay drift, holding pebbles and boulders sometimes angular, but generally rounded, shewing no decided lines of stratification, but irregularly associated with isolated beds of gravel and sand, among which great quantities of marine shells of comparatively recent origin are frequently found. One of the localities where this was particularly observed, was on the Prescott Road, about a mile and a-half from Kemptville, which would be about the eleventh lot of the fifth concession of South Gower. In this spot a vast accumulation of sea shells,

consisting almost entirely of one species, *Tellina grœnlandica*, overlaid a two feet bed of limestone gravel, the latter resting on gravel of a still coarser quality, and of more angular fragments, and irregularly mixed up with sand and clay. The angular fragments of this bed consisted of impure limestone holding calc-spar and fossils of the Calciferous formation, and the rounded pebbles and boulders (which were in a smaller quantity,) of gneiss, some of the boulders being from six to ten inches in diameter. The height of this locality might be about thirty to forty feet over the Rideau Canal, at Kemptville, or about 250 feet over Lake St. Peter. Another locality was about the twentieth lot between the fifth and sixth concessions of Winchester, near Armstrong's Mills. Here the shells, which were much broken, were associated with sand mixed with loam, and appeared to be chiefly *Saxicava rugosa*. The height may be about thirty to forty feet over the Petite Nation, at Armstrong's Mills, and is estimated at about 300 feet above Lake St. Peter. In Kenyon, *Saxicava rugosa* and *Tellina grœnlandica*, were met with on the seventh lot of the second concession in the bed of the Garry River, mixed with fine sand, and no boulders were observed near the spot, the height of which is estimated at 130 to 140 feet over Lake St. Francis, or about 270 feet over Lake St. Peter. *Saxicava rugosa* was met with also on the road between the fifth and sixth concessions of the township, on the nineteenth and the twenty-first lots. They were associated with sand derived from the gneiss, mixed with scales of a greenish shale, probably from the base of the Chazy limestone: large boulders of gneiss, mica-schist and hornblende rock were scattered over the fields, and the height of the locality may be 330 to 340 feet over Lake St. Peter. Two localities occurred in Lochiel, one of them on the fifteenth lot of the first concession, within a mile of Dalhousie Mills, where *Saxicava rugosa* was mixed with sand, and the height was ascertained by admeasurement to be 126 feet over Lake St. Francis, or 264 over Lake St. Peter; the other on the fifth lot of the same concession, where the same *Saxicava* was mingled with sand immediately under the vegetable mould; many boulders or fragments of sandstone and limestone lie on the surface of the surrounding country, and the height of the spot is about 280 to 290 feet over Lake St. Peter.

On Rigaud Mountain there is a set of plains, paved with an accumulation of well rounded boulders, which begin on the north side, about 200 feet over the level of the Rivière à la Graisse at its junction with the Lake of Two Mountains, or 262 feet over Lake St. Peter, and extend over a large area, filling up hollows between elevated summits of trap; these plains rise gradually to the south, until they reach their maximum elevation of about 280 feet over the Graisse, beyond which they slope gently off to the south, and the boulders are found scattered over a large portion of the seigniory of Rigaud. By far the greater portion of the boulders are the ruins of the trap of the mountain, but there is likewise a small proportion of sandstone. On the northern side near the summit, these rolled stones are arranged in parallel ridges, separated from one another by distances varying from twenty to thirty paces, their direction being N. 40 to 57 W., and S. 40 to 57 E. The size of the boulders is seldom less than three inches, or more that eighteen inches in diameter, and the depth of the hollows between the ridges is from four to six feet. Curiosity has induced some persons to remove many of these round stones, for the purpose, it is supposed, of ascertaining the depth of the accumulation, and they have gone down about seven or eight feet, without reaching the solid rock. It is worthy of remark, that while the greater part of the upper portions of the mountain and a large extent of the country south from it, were found thickly strewed over with boulders of its own debris, there were scarcely any of that character seen on the northern flank or on the flats between the mountain and the Ottawa River; on these the erratic blocks, consisted chiefly of large angular masses of sandstone, apparently of the Potsdam formation, and rounded fragments of the Metamorphic group.

### ECONOMIC MATERIALS.

The substances under this head, occurring in the district under description, to which I have to draw your attention, are ores of iron, lead and copper, iron ochre, sulphate of barytes, sandstone and sand for glass-making, shell marl, materials for ornamental and common building purposes, and mineral pitch.

*Magnetic Iron Ore.*—This ore of iron was found very ge-

nerally disseminated in small quantities through the rocks of the Metamorphic series, and so far as my observation went, it thus appeared more particularly to characterise the beds of gneiss rather than those of limestone, though I am aware that in those parts of the province in which large workable masses of it exist in this formation, they frequently are bounded on one and sometimes on both sides, by limestone. No masses of it, however, of a workable character came within the range of any examination, with the exception of a very remarkable one on the twenty-sixth lot of the sixth concession of South Crosby, where on an island in Mud Lake, not far from Newboro' on the Rideau Canal, and near the crystalline limestone of the vicinity, a mass of considerable purity running north-east and south-west, and apparently coinciding with the stratification, has a breadth of about seventy yards. Understanding that you have yourself visited the locality, it is scarcely necessary for me to state, that the great supply of ore that might be here obtained, the proximity of wood in abundance for fuel, and the existence of water power at no great distance, combined with the advantage of a navigable canal, the water of which is in contact with the ore, render the locality well worthy of attention, to such as are disposed to attempt the smelting of iron ore in the Province.

Magnetic iron ore exists on the seventh lot of the second concession of Escott on the property of Mr. W. Way. The rock at the spot is gneiss, the beds of which are composed chiefly of reddish colored feldspar with small grains of translucent white quartz, and an occasional interstratified layer of mica schist. The general strike of the beds is north-east and south-west, and they dip at a high angle to the north-west, but shew various complicated twists, and are traversed by numerous small veins composed of flesh colored feldspar and white quartz. The ore with small specks of copper pyrites, occurs both in the beds and in the veins, and the largest mass is clasped in one of the folds of the strata and runs in its axis. In this position it lies in reticulating strings, and the whole quantity exposed, occupies a length of about fifty yards, by a maximum breadth of six to seven inches. A small mining trial has been made at the spot by a company of gentlemen

from Brockville, but although the ore is of high percentage, and excellent quality, it does not appear to me that the quantity is sufficient to promise a remunerative return.

*Specular Iron Ore.*—The specular oxide of iron, which has been mentioned in connection with the sandstones and conglomerates of the Potsdam formation, requires a further notice in relation to its economic bearing. The cliff of ferruginous sandstone, which occurs on the twenty-fifth lot of the tenth concession of Bastard, displaying a vertical height of about thirty feet, brown in the lower and deep red in the upper part, owes its color to the presence of peroxide of iron, which is mingled with the silicious grains, apparently cementing them together, and sometimes becoming pulverulent, staining the fingers with a red shining powder. In a three feet bed, which occurs within about three feet of the top, the oxide passes into the form of strongly coherent *scaly red iron ore*, in which thin seams and spangles of crystalline specular iron ore occur. The parts so marked run in layers in the bed, and alternate with layers of the sandstone of a yellow and less ferruginous character. The concentration of the ore is greatest towards the middle of the bed, where nodules and patches of pure red hematite, running with the stratification, occur at intervals of a few inches, the thickness they display not exceeding a couple of inches. About forty years since an attempt was made to mine the ore for the supply of a furnace erected at Furnace Falls, but the quantity in the locality worked was not sufficient to give a profitable result. The Potsdam formation is similarly characterised on the twenty-third lot of the same concession of the township, and also on the ninth concession of Lansdowne, and the ferruginous deposit would thus seem to extend over a considerable area ; and although no evidence was observed of the fact, it may be the case that in some part of the distribution, the quantity of ore may increase to a productive amount. In the State of New York, an iron ore of this description, occurring under similar circumstances in the same formation, has been made economically available, and in those parts of the district under consideration, in which a deep red color characterizes the formation, it merits attention.

*Bog Iron Ore.*—This species of ore was observed in the

Seigniory of Vaudreuil, on the sixteenth and seventeenth west lots of Côte St. Charles, the property of Mr. R. Lancaster. This locality has been mentioned by yourself, in the Report of 1845–6, but the thickness of four feet there given to the ore, was doubled in the small brook in which a section of it was exhibited to me, as it there measures fully eight feet. It has been struck in various places around the spot immediately under the soil, over an area of three acres, and it probably extends much farther. An analysis by Mr. Hunt, shewed the presence of some amount of phosphoric acid in the ore, which, when in excess, is considered by manufacturers to render the metal cold-short. The bog ore used at the St. Maurice forges near Three Rivers, is however known to produce an iron of excellent quality. An analytic comparison between the ores of the two localities yet remains to be made.

Bog iron ore is known on the sixteenth east lot of Côte St. Charles, (possibly an extension of the same bed, as before mentioned,) and in the centre of the Seigniory on the west side of Côte St. Louis.

Having been informed of the existence of a bed of the ore in the neighbourhood of Côte St. Guillaume, in Rigaud Seigniory, search was made for it, but the only indications observed were small loose fragments strewed over the ground, on the south side of the road on the twelfth, thirteenth and fourteenth lots.

A bed of bog ore was observed on the twenty-first lot of the seventh concession of Bastard, not far from Beverly. It was found to be about two feet thick in one spot ; on one side it was limited by an escarpment of rock, but its extent in other directions I was unable to ascertain.

*Lead Ore.*—A well defined vein of calc-spar and heavy spar, intersecting coarse disintegrating crystalline limestone of the Metamorphic series of rocks, occurs on the second lot of the eighth concession of Lansdowne. The vein runs nearly due N. W. and S. E., with an average width of about two feet for a quarter of a mile. Galena is disseminated irregularly through the vein in crystals, which are for the most part small, and similar crystals are not uncommon in the limestone on either side. Some years ago, this vein was uncovered, and

a few trial shafts sunk upon it, with the expectation that it might prove a profitable lode of lead ore, but the quantity found appears to have been too small to give any encouragement, and the work was abandoned.

*Copper Ore.*—Having been given to understand that a good vein of copper pyrites had been some years ago discovered at Beverly in Bastard, and that a trial shaft had been sunk upon it, a visit was paid to the locality with a view to its examination. The locality is on the twenty-fourth lot of the tenth concession of Bastard, where the interstratification of a bed of sandstone and conglomerate in the limestone of the Metamorphic series occurs, as already described. The dip of the strata, as before stated, is N. 55 E.<30°, and they are intersected by a vein of calc-spar of between two and three inches wide, with several still smaller veins of a similar kind, close by. A shaft of about twenty feet had been sunk on this, and two others from seven to eight feet; but neither in that part of the vein which was on the exterior surface, nor in that cut in the shaft, were more than small disseminated crystals of copper pyrites, coated with green carbonate, observed. It is said, however, that a string or vein of ore of an inch or two in diameter was followed down the shaft, and this seems at the bottom to have turned aside into a thin vein or sheet of calc-spar, which separated from the main one, and ran in between two of the strata. No indications of this remained in the shafts, in which there did not appear an amount of ore sufficient to justify the expectation of a favorable result. It is probable that the trial had been induced by the previous discovery, on Gananoque Lake near the locality, of some loose masses of very fine and rich copper pyrites, of considerable size. One of these procured at Beverly for the Provincial Collection, weighs several pounds. From what place these loose pieces had been drifted, it is at present impossible to say; they are identical in color, brilliancy and general character with the produce of the shaft; not a particle of the gangue is attached to the specimen procured, but it is very evident from the impressions or moulds left on those parts of the mineral which were in juxtaposition with the gangue, that it was calc-spar and heavy spar; it is not improbable that the source of the loose masses is not far removed from the position

in which they were found, and that they occur in some calcareo-barytic vein cutting the Metamorphic limestone.

*Iron Ochre.*—This mineral paint was met with in Vaudreuil, on the lot belonging to Mr. Lancaster, which holds the eight-feet bed of bog iron ore; the deposit lies on the top of the ore, and is about a foot thick. The color is an ochre-red, and a material might be obtained, by simply washing the deposit, and freeing it from roots of plants and such like impurities, that would quite equal any of the imported paints of this description.

*Phosphate of Iron.*—This mineral which is used as a pigment, is of a blue color, and is sometimes found in the vicinity of bog iron ore; it is so on Mr. Lancaster's lot, where it exists at the edge of the ore deposit, apparently underlying it, in a bed, the thickness of which it was not easy to ascertain, as it was covered by water; it does not, however, appear to be considerable.

*Sulphate of Barytes.*—Of this mineral, which is used for the manufacture of *permanent white* and *Dutch white*, the latter consisting of a certain mixture of it with white lead, has been mentioned under the name of heavy spar, as constituting, in conjunction with calc-spar, a vein holding specks of galena on the twenty-fourth lot of the tenth concession of Bastard. The vein was traceable for a quarter of a mile; no part of it was free from sulphate of barytes, and in one place, where a shaft had been sunk eight to ten feet in search of lead ore, eighteen feet of the lode, in addition to ten feet more, occupied by the shaft, with a breadth of two feet and a quarter, consisted, to the full depth of the shaft, of highly crystalline, almost colorless sulphate of barytes, of which the vein in this part would yield about ten tons to a fathom forward by a fathom vertical. The value of the crude material is said to be eight to ten dollars per ton to the manufacturer, and the manufactured article thirty dollars per ton.

*Stone and Sand for Glass-making.*—Being aware that good pure white sandstone, fit for the purpose of glass-making, existed in the Potsdam formation in Vaudreuil, and other parts of the eastern extremity of the district which has engaged my attention, a similar quality of stone was searched for in the western;

but in this part, as has already been stated, a large portion of the formation is strongly impregnated with iron, and though the beds thus characterised are surmounted by others which are of a general pure white color, these are almost invariably penetrated with what has been called the *Scolithus linearis*, supposed to be the remains of a plant. Where the rock is weathered, these are hollow cylindrical tubes piercing the stone vertically for some distance, and they are always lined with a brown color, which is diffused a little way into the stone. Where the cylinders are not weathered, they are filled with sand rather more calcareous than that around them, and there is still a slight discoloration in the part corresponding to what becomes the interior of the tube. The brown discoloration arises from the presence of iron, and the remains are so abundant that they would probably render the white beds unfit for glass-making.

In the subjacent Metamorphic series, however, some of the beds of quartzite, that have been mentioned in the geological division of the Report, furnish a material that appears to me well worthy of being submitted to an effectual test, with a view of ascertaining its qualities for that purpose; an example of it occurs on Blockhouse Island opposite to Brockville, and on the main land at the west end of the town, where the rock is a white close grained translucent semi-vitreous quartz. It is exceedingly hard, and would be expensive to quarry, and there are a few small yellow specks in it, owing their color probably to oxide of iron, but it would require a chemical analysis, for which there has yet been no opportunity, to determine the quantity. There would be no deficiency in the supply of the material, should it prove suitable.

A fine white silicious sand was met with on Rabbit Island, near the south-east shore of the main body of Charleston Lake, which, while I was on the spot, was supposed from its general aspect to be sufficiently free from impurities to fit it for glass-making; but on closer examination afterwards, small red and black grains were perceived disseminated through it, and to chemical tests it yielded more iron than the best material for glass-making should contain. This sand is probably derived from the disintegration of the white beds of the Potsdam formation, and it occurs in great abundance in the various bays and

inlets of the lake. The red bed of the Potsdam and the magnetic iron of the Metamorphic series, may be the source of the impurities.

*Feldspar.* — Understanding from you, that some economic process has been discovered for the separation of the potash in feldspar, and that rocks of pure feldspar, sufficiently rich in potash, have in consequence assumed a commercial value, I would suggest an analysis of some of those large feldspar masses which have been mentioned as running with the stratification of the gneiss near Brockville; should the percentage be found sufficient, these masses are very conveniently situated for working, and a large supply of the rock might be obtained.

*Fresh-water Shell Marl.*—Of this mineral manure, deposits were met with in three localities. One of them is the thirteenth lot of the eighth concession of Yonge, where the marl occurs in a swamp, which, when visited by me, was almost all under water; the deposit, however, was struck with a pole and penetrated to the depth of six or seven feet, and I was informed by Mr. Landon, of Farmersville, that in some parts its depth had been ascertained to be fourteen to fifteen feet, and that the area the marl was known to occupy, was between twenty and twenty-five acres. Another locality is in another lake in Elmsley, where the material is exposed in the bays on the south side, giving a thickness where penetrated with a pole of from three to four feet; the marl extends into the lake, but was not seen above its level. The third locality was on Mr. Delesderniers' farm, near Point Cavagnol, in Vaudreuil Seigniory, and here the marl, of a yellowish color, extends over about twenty acres, with a thickness varying from a foot to eighteen inches. Mr. Delesderniers, acquainted with its value as a manure, uses it largely and beneficially on his farm.

*Marble.*—White limestones of the metamorphic series of of rocks were occasionally seen of a quality capable of taking a polish, but they were invariably too coarsely crystalline to be suited to the more elegant purposes to which marble is devoted. They moreover frequently inclose various minerals, such as serpentine, mica, quartz, pyroxene, tremolite, chondrodite, and graphite, which materially injure the appearance of the

stone, after it has received the smoothest surface which can be given to it. Near Beverly this limestone is quarried and applied to some of the purposes of marble, being cut and polished for tablets, tombstones, and the like. On the north side of Charleston Lake, similar limestones were observed, portions of which might equally be applied to the same purposes.

Limestone which appears to be of a sufficiently fine texture to admit of a good polish, is occasionally found in various parts among the fossiliferous rocks. The quarries opened for building in the black beds of the fourth concession of Cornwall are of this quality, and stones of the same color and as fine a grain were seen in the eleventh lot of the seventh concession of Charlottenburgh, the twenty-ninth and thirty-fourth lots of the seventh concession of Lancaster, the seventeenth lot of the second concession of Winchester, and at Crysler's Mills, on the Petite Nation River in Finch. For ornamental purposes, the material from the black limestone beds would require to be very carefully selected, as it frequently happens that the fossils, especially the orthoceratites and corals, are replaced by calc-spar, which would injure the homogenousness of the surface, and parts of the beds are often highly charged with iron pyrites, which would render the stone useless.

*Building Stone.*—The stone used for building purposes at Brockville and Prescott, is taken from the beds of the Calciferous sandrock formation, which at the former place is extensively quarried on the second lot of the first concession of Elizabethtown, the property of Mr. Perry, and on some of the adjoining lots. The beds here selected as giving the most durable stone, and the handsomest when faced, are those which contain the largest amount of calcareous material, and they are worked in courses that are one foot to fifteen inches thick. At Prescott there is abundance of good material of much the same character, between Battle Windmill, about two miles below the town, and the upper windmill, about two miles above; the stone at present used is quarried at the lower windmill. The beds of the Calciferous sandrock formation have been extensively used in the construction of some of the locks of the Rideau Canal, and these in general afford good examples of the stone. It is a strong tough sufficiently durable

material, grey when first wrought, but soon turning yellowish under the influence of the weather.

The black limestones which run throngh the township of Cornwall, afford an excellent building material. The quarries opened on the fifth and sixth lots of the fourth concession of the township, expose an average thickness of about seven feet in two compact beds of three and a-half to four feet each, and it was from these quarries that the stone was procured for the construction of the locks of the Cornwall Canal, which afford a good example of its quality. Near Mille Roches, on the twenty-fourth lot of the fourth concession of the township, a quarry has recently been opened, which exposes a band of black limestone, averaging upwards of four feet in thickness; the general quality of the stone is very similar to that in the previous quarries, but in some parts of the bed it is deteriorated by the presence of iron pyrites. Another quarry of black limestone is opened on the eleventh lot of the sixth concession of Charlottenburgh, from which a handsome stone is procured from a bed of about fifteen inches thick. It has been used in the construction of the Roman Catholic Church of St. Raphael, in that part of the township; and beds producing a similar quality may be obtained in those parts of Lancaster, Winchester and Finch, which have already been mentioned for black marble. Such beds are quarried on the seventeenth lot of the second concession of the second named of these townships, where the rock has been sunk through for eight feet; the bed that is used for building purposes is two feet thick.

In this last mentioned quarry, a grey bed overlies the black one used, and it is stripped off for the purpose of exposing the black one. The grey bed does not seem to be used for building, but in the strike of the rocks of this part of the township, there are good grey beds for building in Lochiel and Kenyon, on the de l'Isle and Garry, near Alexandria. A quarry has been opened in this part by Colonel Fraser, on the fourth lot of the second concession of Kenyon, which gives a good solid grey stone of about two feet thick, with another not quite so good of one foot. These grey beds appear to belong to the Trenton formation, and probably a high part of it, as the black beds seem to have a considerable thickness beneath them; but

there is another set of grey beds beneath the black; these belong to the Chazy division of the calcareous group; they have yielded good stone at Caughnawaga, at St. Geneviève and other places on the Island of Montreal, and there is every probability, though I was not so fortunate as to meet with them of good quality in place in the district examined, that they will be found in it. The large loose blocks mentioned as met with on the River de l'Isle, upwards of a mile and a-half below Dalhousie Mills, belong to this desirable part of the Chazy formation, and loose blocks of a similar character were found on the fifth lot of the second concession of Cornwall, both localities being near the position in which the Chazy limestone might be expected. The rocks in place on Sheik's Island are probably rather too near the base of the formation to yield the best building stone, which in this part is probably covered by the waters of the St. Lawrence or the drift on the left bank, but how deep it is impossible to say.

*Bituminous Shale.*—Although no analyses have yet been made of any of the bituminous shales which have been met with in the progress of the Survey, and it is therefore uncertain whether the amount of bitumen that would result from any of them could be turned to profitable account, I yet consider it proper that they should not be passed by without mention among the economic materials, as attempts have within a few years been made in England on a practical scale, to distill bituminous products from rocks of such a character. The shales of the Utica slate formation, are usually very bituminous, and in some parts of the province, as on the Great Manitoulin Island, so much so as to give small springs of petroleum; and though no indications of such springs were observed in the black shales of the neighborhood of Bytown, these shales were always of a deep black color, and constantly yielded a strong bituminous odor; such was the character of the fifteen feet of shale sunk through in the well on Mr. Walkley's farm, already mentioned as occurring on the first lot of the third concession of West Gloucester, with the exception of a foot or eighteen inches at the top, which weathered of a rusty brown, and seemed more gritty than the part below. A precisely simi-

lar character obtains in a section of from ten to seventeen feet on the seventeenth lot Rideau front, where an excavation has been made for the foundation of a mill building, on a small brook which falls into the Rideau above Billings' Bridge. The shales that crop out on the bank of the Rideau between Billings' Bridge and the Falls at the mouth, are likewise jet black and bituminous, but in some specimens of these submitted to Mr. Hunt, the deep black color appears to indicate the presence more particularly of carbonaceous matter, than any very large amount of bitumen.

*Mineral Caoutchouc.*—The black shales of the Hamilton group, in the Western Peninsula, are in general probably more bituminous than those of the Utica slate. Several places in their distribution are characterised by bituminous springs, and a visit was made in the early part of the season to a bed of nearly pure bitumen, of which the existence has been noticed in previous Reports, including that of last year, in which the range of the Hamilton group in the Western Peninsula is given. This bed of bitumen, which in some parts has the consistency of mineral caoutchouc, occurs on the sixteenth lot of the second concession of Enniskillen in the county of Kent, but its extent does not appear to be so great as we were at first led to understand. It does not seem to exceed half an acre, extending five chains in a north-east direction, with a breadth of rather less than half a chain. By different trial holes which have been sunk through the deposit, it would appear to have a thickness of two feet over about twenty feet square, towards the south-west end, from which it gradually thins towards the edge in all directions, varying in some parts along a low ridge which it forms, from a foot to four inches. The bitumen is underlaid by a very white clay, which I was informed had been bored through in one part for thirty feet. The upper portion of the clay was observed to be more or less penetrated with petroleum, and small black globules of the same were seen scattered through the mass for a depth of four or five feet. Bituminous oil was observed to rise to the surface of the water on the Black Creek, a branch of Bear Creek, in two places on the seventeenth lot of the third concession of Enniskillen, and I

was informed that it had been observed at other parts further down the stream, but to what amount the material might be daily collected at any of the places, I am quite unable to say; a freshet prevailed in the river at the time of my visit, the current of which swept away the oil as fast as it rose.

I have the honor to be,

Sir,

Your most obedient servant,

A. MURRAY.

# REPORT

OF

T. S. HUNT, ESQ., CHEMIST AND MINERALOGIST TO THE PROVINCIAL GEOLOGICAL SURVEY,

ADDRESSED TO

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

LABORATORY OF THE PROVINCIAL SURVEY,
MONTREAL, 1st *May*, 1852.

SIR,—During the summer of last year, I was for a great portion of the time engaged with Mr. Murray in his explorations between the St. Lawrence and Ottawa Rivers. I however found time to make some examinations upon the Richelieu, in the vicinity of Quebec at St. Nicolas, in the county of Kamouraska, and in some other localities. The results of these observations, and of the examinations of soils, rocks, and mineral waters collected on these excursions, I propose to present as far as yet completed, in this Report, in connection with some other results of my labors in the laboratory during the past winter.

In the first place I beg leave to call your attention to the peculiar nature of the metamorphosed shales of the Hudson River Group, which with their associated sandstones, are exposed upon the south shore of the St. Lawrence, near the village of St. Nicolas. You had drawn my attention to the fact, that an intrusion of trappean rock in this vicinity had produced an alteration in the texture of the shales, and in some instances converted them into a substance resembling serpentine. As the results of our researches in the Eastern Townships had demonstrated that the serpentines of that metamorphic region, really belong to the series of Lower Silurian rocks, called the Hudson River Group, and as the exposure of shales and

sandstones at St. Nicholas is but a prolongation of these same rocks, it was to be hoped that a careful chemical examination of the altered shales in the vicinity of the intrusive rock, and a comparison between them and the unchanged shales near them, would throw some light upon the difficult questions of the nature of these changes, and the origin of serpentines.

Reserving to yourself the more particular geological description of these rocks, I will only mention, that between beds of greenish sandstone of from one to three feet in thickness, are interstratified greenish or bluish and reddish shales, generally in thin layers. Their colors seem dependent upon local causes, and connected probably with the different states of oxydation of the iron which they contain. The green color is sometimes observed in small oblong rounded patches in the red slates, and where in a mass of the latter, a thin layer of from half an inch to an inch of calcareous material occurs, it is bordered on each side by a layer of green slate, sometimes no more than a quarter of an inch in thickness. In a section near Point Levi, the green color was seen following down a rift or joint in the red slates, across the stratification, and spreading irregularly on either side. Such modes of occurrence suggest a local deoxydation of the red slates, by imbedded or infiltrating organic matters.

In the immediate vicinity of the intruded rock, it is observed that thin layers of schist are converted into a soft greenish translucent matter resembling serpentine, which sometimes is an inch in thickness. The adjoining sandstones seem to have undergone a similar change, or at least, to be covered with a film of the greenish translucent mineral, and often exhibit a concretionary or mammillated structure upon their surfaces. In one instance, the thickening of a stratum of shale, forms a mass of several inches in diameter, which is earthy and opaque within, but upon the surface contiguous to the overlying rock, assumes the translucent serpentine-like character already alluded to, and in a continuation of the layer, where it becomes thinner, the transformation is complete. In the interstratified sandstones, which sometimes assume a conglomerate character, cavities are seen filled with a similar mineral, and fragments of bright red and much indurated shale, were found

at the foot of the hill, having fallen from the cliff above, which contained in their fissures the same soft green mineral.

The careful analysis of this substance has shown that it is entirely distinct from serpentine, and not a magnesian mineral; it is essentially a hydrous silicate of alumina, protoxyd of iron and potash, with small portions of soda, lime and magnesia. It is also distinguished from serpentine by a lesser hardness and a greater specific gravity, the hardness of serpentine being from 3· to 4·, while that of the new substance is 2·5, rarely 3·; the specific gravity of serpentine is always below 2·6, and generally 2·5, while the mineral from St. Nicolas has a specific gravity of 2·7. To distinguish it, I shall provisionally adopt the name of *parophite*, to express its similarity to ophite or serpentine. Some results of the analysis of it, and of the accompanying schists are subjoined.

No. 1.—Parophite in schistose fragments; texture granular and exceedingly fragile, especially when moistened; color pale greenish-white, streak white; lustre waxy, shining, subtranslucent; when cut with a knife, the surface is smooth and greenish-blue, resembling an indurated talc; the powder is impalpable and unctuous; hardness not more than 2·5; specific gravity 2·705. When ignited, it loses water and becomes ashy-grey. It is but imperfectly decomposed by hydrochloric acid; the earthy ingredients were determined by fusion of the ignited mineral with carbonate of soda, and the alkalies by decomposing it with a mixture of fluor-spar and sulphuric acid. It gave in two analysis:

| | I | II |
|---|---|---|
| Silica, | 48·50 | 48·60 |
| Alumina, | 27·50 } | 33·57 |
| Protoxyd of Iron, | 5·67 } | |
| Lime, | 1·30 | 1·51 |
| Magnesia, | 2·24 | 2·20 |
| Potash, | | 5·30 |
| Soda, | | 1·91 |
| Water, | 7·00 | 7·40 |
| | | 100·49 |

No. 2.—Parophite from the same locality, in schistose fragments like the preceding; color pale yellowish-green, translucent upon the edges; hardness 2·5; specific gravity 2·703, —2·714. Its analysis gave:

| | I | II |
|---|---|---|
| Silica, | 48·42 | 48·14 |
| Alumina, | 27·60 | |
| Protoxyd of Iron, | 4·50 | |
| Lime, | 2·80 | |
| Magnesia, | 1·80 | |
| Potash, | 5·02 | |
| Soda, | 2·78 | |
| Water, | 6·88 | 7·30 |
| | 99 80 | |

No. 3.—Parophite from the same locality, botryoidal, with appearance of concentric structure, olive green, translucent, fracture conchoidal, hardness 3; specific gravity, 2·784; it passes into a schistose form, which gave 2.681; analysis yielded:

| | |
|---|---|
| Silica, | 49·13 |
| Alumina, | 27·80 |
| Protoxyd of Iron, | 5·90 |
| Lime, | 3·80 |
| Magnesia, | 1·40 |
| Water, | 6·30 |
| Alkalies, not determined, | |
| | 94·33 |

No. 4.—This is a fine thinly laminated schist, which passes in a little distance, into the parophite No. 1. Its color is dark ash-grey, sometimes marked with red. The laminæ are somewhat curved, the surfaces feebly shining, and slightly unctuous. This schist is completely earthy in its characters; it is opaque even upon the edges, and very soft, yielding with great ease to the nail; its powder is not at all gritty. Analysis of the eleutriated and thoroughly dried substance gave—

| | |
|---|---|
| Silica, | 48·10 |
| Alumina, | 28·70 |
| Protoxyd of Iron, | 4·80 |
| Lime, | 2·10 |
| Magnesia, | 1·41 |
| Potash, | 4·49 |
| Soda, | 1·53 |
| Water, | 8·40 |
| | 99·53 |

No. 5.—An analysis was made of a red schist of the same formation, from a locality on the Etchemin River two miles

above St. Anselm. It is not distinguishable in its general characters from some of the unaltered beds at St. Nicolas. The earthy ingredients were determined by fusing the ignited mineral with an alkaline carbonate, and the alkalies, by decomposing it directly with hydrofluoric and hydrochloric acids, in a platinum vessel; the solution was not perfect even after the digestion, eleven per cent. remaining undissolved, but the alkalies were determined in the soluble portion, and are given in the following analysis :—

| | | |
|---|---|---|
| Silica, | 66·00 | |
| Alumina, } Peroxyd of Iron, } | 24·60 | |
| Potash, | 3·67 | |
| Soda, | 2·22 | |
| Lime, Magnesia, and Manganese, traces, | | |
| Water, | 3·00 | |
| | | 99·49 |

The preceding specimens all gave traces of manganese.

The similarity in composition between the different specimens of parophite, and the associated schists into which it passes, shows that the transformation has been effected without the addition or abstraction of any ingredient of the schist, and is simply molecular ; the slight excess of water in the latter being probably hygroscopic, the transformation from the earthy schist, to the translucent homogeneous parophite, has consisted in a chemical union of the finely divided mechanical mixture, which makes up the sedimentary rock. Two facts observed in the eleutriation of the specimens analyzed, are illustrations of this difference. The parophite although fragile, was not easily reduced to fine powder, but when by trituration it was suspended in water, a portion of it was was found to be so minutely divided as to pass through fine filtering paper, making the filtrate turbid, while the soft easily crushed schist was completely separated from water by filtration ; it still retained the character of a sedimentary material, while the parophite resembled other homogeneous minerals, which are generally observed to remain in part, a long time suspended in the process of eleutriation. The water filtered from the pulverized schist, had taken up so much soluble matter as to possess a

strong alkaline reaction, which was much less marked in the case of the parophite.

The large amount of alkalies in the rocks from St. Nicolas and in the more silicious bed of the Etchemin, is worthy of notice ; the small quantity remaining in kaolin and some other clays, seems to have given rise to the idea that sedimentary rocks were generally deficient in alkaline ingredients, but with such materials as these schists, we have no difficulty in understanding the formation of felspars and other alkaliferous minerals, by metamorphic agencies different from those which have operated at St. Nicolas.

In composition and characters, the mineral resulting from this metamorphosis is somewhat removed from any described species ; a lithomarge from Zorge in the Hartz, analysed by Rammelsberg, approaches closely to it in composition, but differs in specific gravity ; (Dana's Mineralogy ; 3rd edition, page 285). Professor C. U. Shepard has described under the name of dysyntribite, a mineral associated with specular iron from St. Lawrence County, New York, which had hitherto been supposed to be serpentine, and closely resembles it in its color, lustre and general appearance. It has however a greater specific gravity than even parophite, being from 2·76 to 2·81, and a hardness of 3·5 to 4·0. He has given the following analytical results : silica 47·68, alumina 41·50, protoxyd of iron 5·48, water 4·83, and traces of lime and magnesia, = 99·49. This resembles the St. Nicolas mineral, but differs in the greater proportion of alumina, and in the absence of alkalies. Although homogeneous in appearance, the altered schist may yet contain more than one chemical compound, and as any variation in the composition of the sedimentary bed, would affect the composition of the mineral, we cannot in the present state of our knowledge, claim for it the rank of a distinct species, but only assume the name of parophite for a hydrated aluminous alkaline silicate, resembling serpentine in its general appearance.

It becomes an interesting question how far such minerals as these described by Professor Shepard and myself, may be distributed in nature, and whether they may not have been confounded with serpentine by geological observers. Such at

least is the case among the crystalline rocks of northern New York, where the dysyntribite forms large masses, but on the other hand, this same formation affords genuine serpentines, such as those which I have described in the Report of last year. I have also examined some similar minerals from the Eastern Townships, which form part of the metamorphic range exposed at St. Nicolas, and which are yet magnesian rocks and true serpentines.

Among these, a serpentine associated with the chromic iron-ore vein in Ham was examined. It occurs massive and compact, fracture splintery, color greenish white, sub-translucent. Hardness 3·5; specific gravity 2·546. Its analysis gave—

| | |
|---|---|
| Silica, | 43·4 |
| Alumina and Peroxyd of Iron, | 3·6 |
| Magnesia, by loss, | 40·0 |
| Water, | 13·0 |
| | 100·0 |

It was but imperfectly decomposed by hydrochloric acid and left after long digestion, 51·6 per cent. of residue. Neither lime, manganese, or chromium could be detected in the examination.

Another almost opaque grayish-green serpentine rock from the twentieth lot of the first concession of Ireland, had a specific gravity of 2·652—2·658, and gave—

| | |
|---|---|
| Silica, | 43·70 |
| Magnesia, | 23·46 |
| Alumina with Peroxyd of Iron, | 23·00 |
| Water, | 11·57 |
| | 101·73 |

Traces of manganese were detected, but no lime or chromium. The high specific gravity, the diminished amount of water, and the presence of so large an amount of alumina and iron indicate a mixture of an anhydrous silicate with the magnesian mineral, which is probably pyroxene; at least it frequently occurs under the form of diallage, in serpentine rocks of the region. Another serpentine rock from the vicinity of Nicolet Lake, of a dark olive-green color with yellowish-green

spots, had a gravity of 2·701, but contained diallage in distinct grains.

### CLAYS, SOILS, ORES, &c.

*Clays.*—In connection with the preceding analyses of ancient sedimentary rocks, it is not without interest to consider the composition of some more recent clay deposits. The following results were obtained from a reddish-fawn colored stratified clay, from the banks of the Rivière à la Graisse, in the Seigniory of Rigaud. It is impalpable, and remains much longer suspended in water than the pulverized schists of St. Nicolas. It lost by gentle ignition 4·5 per cent. of water. By the action of dilute acids it is in part soluble with effervescence ; it gave to hydrochloric acid aided by heat—

| | | | |
|---|---|---|---|
| Carbonate of Lime,.....7·10 | equal to Lime.....3·97 |
| Carbonate of Magnesia,.....3·60 | " " Magnesia.....1·92 |
| Alumina and Peroxyd of Iron,....12·95 | |

Its complete analysis was effected by fusion with carbonate of soda, and the alkalies were determined by digesting a portion with a mixture of hydrofluoric and sulphuric acids, until the whole was rendered soluble in water. 100 parts gave—

| | |
|---|---|
| Alumina and Peroxyd of Iron,... | 27·30 |
| Lime,..... | 5·32 |
| Magnesia,..... | 2·62 |
| Potash,..... | 1·26 |
| Soda,..... | 2·06 |
| Phosphoric Acid,..... | ·74 |

Hence it appears that a portion of the lime and magnesia exist as silicates in the clay. As the carbonic acid was not estimated, it is not certain whether the whole of the bases dissolved by hydrochloric acid exist as carbonates, as some of the silicates may be decomposed by the acid.

A blue clay which is interstratified with the last, yielded to hydrochloric acid, from 100 parts—

| | | | |
|---|---|---|---|
| Carbonate of Lime.....4·9 | equal to Lime,.....2·74 |
| Carbonate of Magnesia,.....5·9 | " " Magnesia..2·86 |
| Alumina and Peroxyd of Iron.....14·4 | |

Its complete decomposition gave for 100 parts—

| | |
|---|---|
| Lime,..... | 8·12 |
| Alumina,..... | 13·00 |
| Peroxyd of Iron,..... | 13·40 |

The alkalies and other ingredients were not determined.

*Soils.*—The results of some examinations of soils may here be presented in continuation of those given in my Report of 1849-50. The different soils of the Province may, I think, be comprehended with few exceptions, in six groups, which are as follows:

1. Marine clays of the St. Lawrence Valley, sometimes calcareous.

2. Clays of the western basin, also calcareous in part, and probably lacustrine.

3. Drift from the crystalline rocks of the north, which in the western portions of the Province, is in some parts intermixed with the detritus of the Silurian formations.

4. Drift and debris derived from the metamorphic rocks of the Eastern Townships.

5. Soils produced by the disintegration of the red slates displayed on the south shore of the St. Lawrence below Quebec.

6. Soils from the disintegration of the Calciferous sandrock, occupying some portions of the Johnstown District.

At a future time when a greater number of results shall have been collected, a specific classification of the soils examined, may be attempted.

Two specimens of the fifth group were examined with reference to their constituents soluble in hydrochloric acid. Both of them were untilled soils lying upon the outcrop of beds of red slate, and composed entirely of the results of its disintegration.

No. 1 was from St. Jean, Port Joli, and was collected at a depth of four inches, in a field covered with a short turf; at six or eight inches, the upturned edges of unbroken slates were found underlying. By sifting the dried soil, which is scarcely coherent, the fragments of slate which it contained were separated from the finer earth, which was of a deep red-brown color and contained no organic matter except a few fibrous roots. The ingredients soluble in boiling dilute hydrochloric acid were

determined according to the process detailed in the Report for 1849-50; one hundred parts gave—

| | |
|---|---|
| Alumina and Peroxyd of Iron, with traces of Manganese, | 4.755 |
| Lime, | ·151 |
| Magnesia, | ·183 |
| Potash, | ·249 |
| Soda, | ·254 |
| Sulphuric Acid, | ·020 |
| Phosphates | (traces) |
| Soluble Silica, | ·255 |

No. 2 is from St. Thomas, and is of a similar origin to the last. It was taken from a depth of six inches in a pasture field, where the red schists are about twelve inches from the surface, but their disintegration has been more complete than in the last, and the soil when dry, is dark red and strongly coherent; it was crushed and separated from the fragments of undecomposed slate, and gave to hydrochloric acid the following ingredients for one hundred parts:—

| | |
|---|---|
| Alumina and Peroxyd of Iron, with traces of Manganese | 5·940 |
| Lime, | ·235 |
| Magnesia, | ·504 |
| Potash, | ·250 |
| Soda, | ·148 |
| Sulphuric Acid, | ·015 |
| Phosphates | (traces), |
| Soluble Silica, | .270 |

The amount of phosphate in the soluble portions of these two soils was very small, and not in either case estimated, although its presence was determined.

No. 3 is a soil of the first group, from Ste. Anne de la Pocatière, and was taken from the low meadow land some distance from the foot of the hill, below the college. The clays of this place, and of the adjoining parishes, are generally grayish or bluish, often stained with yellow and red, and crumble when exposed to the weather, into a fine, mellow and very fertile soil; they are often underlaid by a heavy blue clay, and sometimes by beds of gravel and boulders, furnishing a natural drainage. This soil was a clay, almost entirely free from sand, and was from a field which had been long in grass, with oc-

casional alternations of wheat, and had received very little manure; 100 parts of it gave—

| | |
|---|---|
| Alumina and Peroxyd of Iron | 10·455 |
| Lime | ·369 |
| Magnesia, | ·503 |
| Potash | ·469 |
| Soda, | ·385 |
| Phosphoric Acid, | ·285 |
| Sulphuric Acid, | ·103 |
| Soluble Silica, | ·335 |

No. 4.—This soil is an example of the class designated above as the sixth. Over a large part of the district of Johnstown, the almost horizontal strata of the Calciferous sandrock (passing in some cases into the overlying and underlying formations,) are covered with a layer of earth, generally from a few inches to a foot or two in thickness, which notwithstanding its scanty depth, forms a rich arable soil, covered with a fine growth of hard wood. It is a sandy loam, and appears to have been entirely produced by the disintegration of the underlying rocks, from which atmospheric waters have removed the calcareous cement. The specimen whose analysis is here given, was taken from the twenty-eighth lot of the third concession of Bastard, where a foot of soil was reposing upon the Calciferous sandrock, in a recently cleared and untilled lot. The soil was taken from a depth of six inches, and was a sandy loam containing scarcely any organic matter; 100 parts of it gave—

| | |
|---|---|
| Alumina and Peroxyd of Iron | 6·825 |
| Lime | ·353 |
| Magnesia | ·330 |
| Potash | ·130 |
| Soda, | ·129 |
| Phosphoric Acid, | ·209 |
| Sulphuric Acid, | traces |
| Soluble Silica, | ·480 |

No. 5.—This soil was taken from a long-tilled field upon the farm of James Logan, Esq., near the city of Montreal. It is a clay containing some sand in admixture; 100 parts of it gave 13·5 of silicious sand, mixed with a little magnetic iron, and yielded to hydrochloric acid—

| | |
|---|---|
| Alumina and Peroxyd of Iron | 8·100 |
| Lime | ·806 |
| Magnesia | ·632 |
| Potash | ·185 |
| Soda | ·274 |
| Phosphoric Acid | ·285 |
| Sulphuric Acid | ·011 |
| Soluble Silica | ·225 |

This soil was submitted to a farther analysis; the entire amount of earthy ingredients and of phosphoric acid was determined by fusion with an alkaline carbonate, while the alkalies were obtained by decomposing a portion with a mixture of fluor-spar and sulphuric acid; 100 parts of it gave—

| | | |
|---|---|---|
| Alumina | 13·15 | |
| Peroxyd of Iron | 8·50 | |
| Lime | 1·73 | |
| Magnesia | 1·14 | |
| Potash | 1·76 | |
| Soda | 2·35 | |
| Phosphoric Acid | ·54 | |
| Water and Organic Matter | 5·30 | |
| Silica, by difference | 65·53 | |
| | ——— | 100·00 |

The analysis of many other soils, intended with those of my previous Report, to complete the general description of the soils of the Province, is reserved for another time.

*Iron Ores.*—Specimens of bog iron ore or limonite, noticed by Mr. Murray in his Report of this year, were examined, and particular reference was had to the determination of the phosphates present. The ore being ignited, and the loss by this process, corresponding to water and any organic matters, ascertained, was dissolved in hydrochloric acid, and the solution mixed with tartaric acid, and ammonia in excess. The iron being thus in solution in an alkaline liquid, was precipitated by sulphuret of ammonium as a sulphuret, which was afterwards converted into peroxyd. Another portion of the ore was dissolved in hydrochloric acid, with the addition of a little chlorate of potash, and the insoluble silicious residue separated. The solution was then boiled with sulphite of soda, to convert the whole of the iron into the state of protosalt, and the excess of sulphurous acid being expelled by ebullition, the

liquid was partly neutralized by carbonate of potash, and acetate of soda added, when a slight flocculent precipitate of phosphate of alumina separated; bromine water was now added drop by drop, to the nearly boiling solution, until the precipitate which was formed by the addition, became reddish in color. The liquid was then boiled, filtered when hot, and the precipitate washed with hot water and dried. It consisted of basic perphosphate of iron and a little phosphate of alumina, and was decomposed by fusing it with carbonate of soda, some silica being added to the mixture. The alkaline solution of the fused mass, previously digested with carbonate of ammonia, was supersaturated with hydrochloric acid, boiled to expel carbonic acid, then rendered alkaline by ammonia, and mixed with a solution of a salt of magnesia, with sal-ammoniac, to precipitate the phosphoric acid, which was estimated in the form of pyrophosphate of magnesia.

The limonite from the twenty-first lot of the second concession of Bastard, formed spongy masses; it was very pure in its appearance, and its powder had a bright yellowish-red color. The alumina and other accidental impurities were not directly determined; no magnesia was present.

| | | |
|---|---|---|
| Peroxyd of Iron | 77·80 | |
| Water | 16·50 | |
| Phosphoric Acid | ·61 | |
| Insoluble, (sand) | 1·76 | |
| Alumina and loss | 3·33 | |
| | | 100·00 |

Another darker colored and more compact limonite from Côte St. Charles, Vaudreuil, lost by ignition 19·70 per cent.; on solution it left 5·43 of silicious sand, and gave 1·52 per cent. of phosphoric acid, besides small portions of alumina, and traces of magnesia. The influence of phosphates in such quantity as the last, is regarded as prejudicial to the quality of the iron manufactured from the ores. I have commenced some experiments upon the ores and iron of St. Maurice, which, when completed, will be interesting in this connection.

*Analyses of supposed Fossil Bones and Coprolites.*—In examining last summer, the coarse grained silicions sandstones and conglomerates, which occur at the point of the River

Ouelle, and have been described in a general manner in your report for 1849-50, I detected several hollow cylindrical bodies which I supposed to be some hitherto unknown fossils, and which you from their form, suggested to be possibly bones. A chemical examination shows them to consist in great part of phosphate of lime, and thus gives countenance to the idea that they are the remains of vertebrate animals. The longest fragment found is about an inch and a-half long, and one-fourth of an inch in diameter. It is hollow throughout, and filled with the earthy matter in which it is obliquely imbedded, the disintegration of which by the weather, has exposed the larger extremity of the foreign body, and a portion of its interior. The smaller extremity is cylindrical and thin, but it gradually enlarges from the thickening of the substance, and at the other extremity becomes externally somewhat triangulariform; the cavity remains nearly cylindrical, but its sides are somewhat rough and irregular. Two other fragments, presenting horizontal sections of similar cylinders, were detected, having their other extremities in the rock. The texture of these substances is compact, and the fracture earthy. Their color is dark brown, but exhibits a yellowish-brown translucency in thin layers; the powder is light ash-grey, becoming reddish by ignition; when exposed to heat in a tube, ammoniacal water is evolved, with a strong odor of animal matter, like that of burning horn. A fragment of one of the cylindrical bodies was freed as much as possible from the sandstone which adhered to the interior, pulverized, dried and submitted to analysis. It dissolved in hydrochloric acid with slight effervesence, from the presence of carbonate of lime, derived in part from the adherent rock which is calcareous, and left a considerable residue of quartzose sand. The solution contained phosphate of lime, with a little magnesia and oxyd of iron; 100 parts of the matter gave the following ingredients:

| | |
|---|---|
| Phosphate of Lime ($PO^5$, 3CaO,) | 67·53 |
| Carbonate of Lime | 4·35 |
| Magnesia | 1·65 |
| Protoxyd of Iron | 2·95 |
| Insoluble, sand | 21·10 |
| Volatile matter | 2·15 |
| | 99·73 |

The lime beyond that required to form phosphate, is represented as carbonate, and exists as such in part, a portion being derived from the gangue, but in other specimens from the same locality, fluorid of calcium is also detected. It was not sought for in this specimen, but it is probable that a portion of the lime exists in that form, while the magnesia, and the remainder of the lime are combined with carbonic acid.

In a subsequent examination of the locality, you detected in the vicinity of these sandstone beds, a stratum of conglomerate with a calcareous base, containing pebbles of limestone, jasper, and of red and green slates, with a great number of rounded, cylindrical and imitative forms of phosphate of lime, similar in composition to the preceding. Iron pyrites is also found in small globular masses in the aggregate, and seems to be abundant only in the vicinity of the phosphatic masses, the interstices between which are often filled by it. Many of the cylindrical bodies have an axis of a foreign matter, and others have a singular resemblance to fragments of different bones ; others again from their form and homogeneous texture resemble coprolites. They are generally very compact, with a fine-grained conchoidal fracture ; their color is dark blackish-brown, or bluish-black, and that of the powder ash-grey, becoming reddish-brown by heat. When powdered and mixed with sulphuric acid, effervescence ensues from the escape of carbonic acid gas, and on the application of heat, fumes of hydrofluoric acid are evolved in sufficient quantity to etch very distinctly a glass plate covering the vessel. Heated in a tube, a strong odor of burning horn is evolved. The hardness of these phosphatic masses is about that of calc-spar, and their specific gravity from 3·035 to 3·151. A fragment of a compact apparently homogeneous specimen, yielded by analysis of 100 parts the following ingredients :

| | |
|---|---|
| Phosphate of Lime | 40·34 |
| Carbonate of Lime and some Fluorid | 5·14 |
| Carbonate of Magnesia | 9·70 |
| Peroxyd of Iron, with a little Alumina and traces of Manganese | 12·62 |
| Insoluble silicious residue | 25·44 |
| Volatile ; water and animal matter | 2·13 |
| | 95·37 |

Sections of these substances have been made, and submitted to microscopic examination. The hollow cylindrical mass appears homogeneous and finely granular in its texture, while a fragment from the conglomerate bed, consisted of a finely granular matrix, in which are imbedded angular grains, apparently of quartz. Throughout the mass of the latter specimen are found imbedded small transparent cylinders, which are almost colorless, and appear to be silicious. Some are nearly uniform in diameter, with hemispherical extremities; others are thicker in the middle, and taper to the ends, which are either rounded or conical; they are generally more or less curved, and are from $\frac{1}{100}$ to $\frac{2}{100}$ of an inch in length. Some of them exhibit traces of a longitudinal cylindrical axis, which appears to be a canal filled up with some granular matter. According to my friend Dr. Bacon of Boston, to whom I am indebted for these observations, they resemble the silicious spiculæ which occur in some of the sponges and other zoophytes, but he regards his examination as yet incomplete. The results are conclusive as to the absence of any bony structure in the specimens. At the same time the external form, connected with their peculiar composition, which is identical with that of fossil bones, prompts the inquiry whether any metamorphic agencies could not have so far acted upon the animal remains as to induce an incipient crystallization of the phosphate of lime, thus obliterating the organic structure. Such a change is well known to take place in fossils consisting of carbonate of lime, as the stems of crinoids, which are often highly crystalline in their texture. As an evidence of metamorphic action at the Rivière Ouelle, you have observed that the limestone conglomerate bed, in which the phosphatic bodies are contained, is in contact with a band of red and green slates, a portion of which, where a bend in the strata occurs, is converted into a fine red and green jasper, containing seams and veins of agatized calcedony penetrating it. The transition from the jasper to unaltered schist is well marked, and it appears not improbable that the jasper pebbles in the conglomerate are produced from the metamorphosis of previously imbedded fragments of slate, which seem in some specimens of the conglomerate before me, to prevail to the exclusion of the jasper pebbles. The

limestone rock, contiguous to the portion of the slate bed which is changed into jasper, is altered in its appearance, and the phosphatic bodies which it contains, are harder, more compact and conchoidal in their fracture. The second analysis given above, is of a specimen from the rock thus altered. The large amount of iron present, and the portion of silica which is found in the specimens from the conglomerate bed, to be disseminated in transparent grains throughout the substance, suggests a mineralizing agency which has resulted in the introduction of oxyd of iron and silica. The abundance of iron pyrites found surrounding the phosphatic masses, points to the probable reducing effect of organic matters upon a solution of sulphate of iron, whose oxyd to the amount of more than twelve per cent. has penetrated them,* and the calcedony of the contiguous jasper bed, equally shows silica to have been in solution at the time of the metamorphosis. It is to be remarked that the first described fragment from the sandstone, contains but very little oxyd of iron, and that the prepared section shows it to be homogeneous, so that the silicious material found in the analysis, was adherent to its interior surface.

I have since detected the presence of similar bodies in the sandstones from the Lac des Allumettes. These beds you have shown to belong to the Calciferous sandrock formation; they are coarse silicious sandstones containing *Lingula* and *Pleurotomaria* or *Holopea*, besides rounded cylindrical and imitative masses of a chocolate-brown colored substance, which consists in part of phosphate of lime. These are sometimes an inch in diameter and two inches in length, and one of them when broken, was found to contain a portion of one of the valves of a lingula lying transversely. This fossil which is abundant in the rock, is always found filled with the brown phosphatic material, and sometimes the exterior is covered by a layer of it; casts of the interior of pleurotomaria also occur in this material. It is granular in its texture, less hard and compact

* The formation of iron pyrites, which is a bisulpluret, by the desoxydation of a solution of the neutral sulphate, is accompanied with the separation of an equal amount of iron in the form of an oxyd; two equivalents of sulphate of iron, $2FeO,SO^3 = S^2\,Fe^2\,O^8 = FeS^2 + Fe\,O + O^7$. An acid solution of sulphate could not exist in the presence of carbonate of lime.

than that from Rivière Ouelle, and somewhat porous; the color is chocolate-brown. The specific gravity of a fragment was found to be 2·875. When heated in a tube, strongly ammoniacal water is evolved, with the peculiar odor of burned horn already observed in the specimens from Rivière Ouelle. It is partly soluble with slight effervescence in hydrochloric acid, and leaves a white silicious residue. The solution contains phosphate of lime with some magnesia and iron; 100 parts of it gave—

| | |
|---|---|
| Phosphate of Lime, (bone earth,) | 36·38 |
| Carbonate of Lime, with some Fluorid, | 5·00 |
| Magnesia and Peroxyd of iron, by difference, | 7·02 |
| Insoluble, Silica, | 49·90 |
| Volatile matter, | 1·70 |
| | 100·00 |

Another specimen contained but 38 per cent. of insoluble substance; this silicious matter is distinguished by the eye, in the form of small rounded translucent grains disseminated through the mass.

At Grenville there are beds of sandstone intermixed with green shales, and pertaining to the same formation as those at Lac des Allumettes, in which similar fragments of phosphatic material are abundantly disseminated. They are smaller and more compact than those of the former locality, and often have the appearance of flattened and worn fragments of dark slate. They have not been quantitatively analysed, but were found to give off an animal odor when heated, and to consist principally of phosphate of lime, and an insoluble silicious residue. Similar bodies were met with in the Chazy limestone in Hawkesbury; they are rounded forms, one-quarter to one-half an inch in diameter. The exterior is tinged blackish-brown, and the color has penetrated to the depth of about a line; the interior is yellowish-brown, and the fracture is earthy; when heated, they give abundant evidence of animal matter, by the peculiar odor of burning horn, accompanied by ammoniacal vapors, which yield white fumes with acetic acid; these leave like the others, a silicious residue on solution, but less abundant than those from the Lac des Allumettes. The analysis of one from Hawkesbury gave me for 100 parts—

| | |
|---|---|
| Phosphate of Lime, (bone earth) | 44·70 |
| Carbonate of Lime, | 6·60 |
| Carbonate of Magnesia, | 4·76 |
| Peroxyd of Iron and a trace of Alumina, | 8·60 |
| Insoluble silicious residue, | 27·90 |
| Volatile matter, | 5·00 |
| | 97·56 |

In support of the suggestion that these are bones or coprolites into which silicious matter has been introduced, it may be stated that at the Lac des Allumettes there is also evidence of the solution of the silica, not in the formation of calcedony, but in the silicification of fossils. The shells occurring in the calcareous beds of this as well as the overlying formation, at the Lac des Allumettes, in the immediate vicinity of this locality of phosphatic remains, are replaced either wholly or in part, by silica. On exposing them to the action of a dilute acid, which dissolves the matrix, the process of silicification is seen to have commenced at several points, and from these centres, to have spread until the whole shell is frequently replaced. The trilobites it may be remarked, have not hitherto been found to be replaced by silica. Although the presence of these peculiar animalized phosphatic masses, in different parts of the Lower Silurian rocks, points to the existence of vertebrate animals at that geological epoch, as the only hypothesis which in the present state of our knowledge, can account for the origin of such substances, it will be felt that a suggestion, so novel and so much at variance with hitherto established facts and recognized ideas in geology, is not to be received without great hesitation, nor until further investigations shall have thrown more light upon the subject than is afforded by the preceding observations and experiments.

### MINERAL WATERS.

The results of the examination of a number of Mineral Waters from different sources are here presented; although some of them are, perhaps, of no great interest in a medicinal point of view, they are not without value in carrying out the general plan of examinations mentioned in the Report of last year.

*Gloucester.*

The water of a spring on the land of Mr. Borthwick, in the township of Gloucester, near Bytown, was sent me through the politeness of the Town Major McDonald. It is strongly saline, and resembles the waters of Plantagenet and Lanoraie; 1000 parts of it yield 11·200 parts of solid matter. The water deposites by boiling an abundant precipitate of carbonates of lime and magnesia, with traces of strontia and iron, and the concentrated liquid contains besides the alkaline chlorids, those of calcium and magnesium in considerable amount, besides a small quantity of a salt of strontia, and of iodids and bromids.

*Alfred.*

The water of a saline spring said to occur on the ninth lot of the tenth concession of the township of Alfred, upon the land of M. Honoré Rochon, was furnished me by Dr. A. Seguin of Rigaud. It is strongly saline and somewhat bitter to the taste, containing a large amount of earthy chlorids, and belongs to the same class of mineral waters as the last. 1000 parts of it contain 14·5 parts of solid matter; its qualitative examination showed the same ingredients as that of Gloucester, with the exception of salts of baryta and strontia, which were not looked for.

*Rivière Ouelle.*

At the Rivière Ouelle I visited an interesting saline spring which is worthy of notice. It is found on the third concession of the Seigniory, on the south side of the River, and upon the land of Mr. Charles Rocheford. At about two arpents from the river is a plain of perhaps half an arpent in extent, in which are four basins of water; the largest is four or five feet in diameter, and three or four feet deep, and the smallest is probably half this size; three of them are near to each other. They are constantly filled, and the small streams which flow from them form a little rivulet. The bottom of the basins and the surface of the land are of clay; the soil is for the most part bare, with a scattered growth of reeds, and a plant which I had before recognized as common to the salt marshes of this part of the country, and which I take to be the *Salicornia herbacea* Linn. The earth over the whole of this area is saturated with

the saline water, and after two or three days of warm dry weather, a copious white saline efflorescence covers the whole surface, to a depth of three or four lines. The water in the different basins is colorless and transparent, and has a disagreeably bitter saline taste, in regard to which no difference can be observed among the different basins. The temperature of the water in the larger basin was 50° F., but it was the twenty-first of July, and the water was exposed to the direct rays of the sun, so that the temperature was probably above the truth.

1000 parts of the water from the largest basin contain 13·36 parts of solid matter. By boiling, the water deposits comparatively a small amount of perfectly white earthy carbonates; and then contains besides common salt, a great amount of chlorids of magnesium and calcium, besides a considerable portion of sulphates. When evaporated to crystallization, the mother liquid gave a strong reaction of bromine, and feeble but distinct traces of iodine. The presence of the latter ingredient in appreciable quantity, shows the source of the salts not to be the adjoining sea-water, in addition to which it may be stated that the adjacent creek, several feet below the level of the basins, is never salt to the taste, even at high tide, when the water flows back as far this place.

### *Ste. Anne de la Pocatière.*

In the second concession of this Seigniory, and upon the land of Nicolas Rouleau is a sulphurous alkaline mineral spring. The supply is abundant; it issues from the base of a hill of sandstone, and deposits a white film along its channel. The temperature of the water was 44·5° F. It is but feebly sulphurous and sweetish to the taste, and leaves by evaporation ·36 parts of residue for 1000 of water. By boiling it became turbid and deposited earthy carbonates; when concentrated, it was strongly alkaline to the taste, and gave with chlorid of barium a copious precipitate, which dissolved in a few drops of hydrochloric acid, leaving a trace of sulphate. It contains besides the carbonate and sulphate of soda thus indicated, a portion of common salt; neither bromids or iodids could be detected in the water. In the same concession, about a mile N. E. from the last, and

a mile south from the college, there is another spring near the road, and on the bank of a little stream. The supply is but small, and the temperature of the water in a tank surrounding the spring, was 48° F. but this was probably heated by the sun above the normal temperature. The water is transparent and saline to the taste ; by boiling it deposited a small amount of carbonates, and when concentrated, crystals of sulphate of lime separated; it was now very bitter to the taste, and contained besides chlorids, abundance of sulphates of lime and magnesia. The liquid was evaporated with an excess of carbonate of potash and the residue extracted with alcohol, but no trace of iodine could be detected, although a reaction of bromine was obtained; 1000 parts of the water gave 5·06 of solid residue.

*Ste. Martine.*

A portion of a mineral water, from Ste. Martine in Beauharnois, was brought to me by Mr. A. Primeau, of that parish. The recent water is said to be sulphurous ; it had a feebly saline sweetish taste and gave 1·98 parts of solid residue for 1000. It contains a considerable portion of earthy carbonates with a little iron, and is when concentrated, strongly alkaline and saline, containing besides carbonate of soda and common salt, a small portion of sulphates, and distinct traces of bromids and iodids.

*Chambly.*

In the month of October last, I visited three mineral springs in the parish of Chambly. The first of these occurs in the second concession from the Montréal River, at the Grand Coteau, and is upon the land of Antoine Getté. Here a well has been made eight or ten feet deep, in which the water rises to the surface and issues in a small stream. A few bubbles of gas, probably carburetted hydrogen, escape from time to time. The temperature of the water, was found to be 53° F. at the surface, and the same at the bottom of the well, that of the air being 72° F. The water is feebly sweetish and saline to the taste, and gives by evaporation 2·09 parts of solid residue in 1000. It deposits on boiling a small amount of earthy salts, and the liquid, at first colorless, becomes deep yellowish-brown. This

character, which I have generally remarked in alkaline mineral waters, probably depends upon a little organic matter present, which is modified by the alkaline carbonate. When evaporated to one twentieth, the alkaline taste is so strong as to disguise almost entirely the saline flavor, and the liquid gives with a salt of baryta a copious precipitate, which dissolves entirely in hydrochloric acid, with effervescence. The alcoholic extract of the saline residue gives feeble but distinct reactions of iodine and bromine salts. 500 grammes of the water were evaporated to a small bulk, a little carbonate of ammonia was added, and the whole evaporated and dried in a sand-bath. The soluble portion mixed with a solution of chlorid of barium gave a precipitate of ·918 grammes of carbonate of baryta, equal to 1·916 grammes in 1000, and corresponding to 1·0295 parts of carbonate of soda. The chlorine in 1000 parts was ·5271, equal to ·8689 parts of chlorid of sodium, and a determination of the alkali in this form, gave 2·264 grammes. If we disregard the mixture of potassium salt, and calculate the whole as chlorid of sodium, there remains 1·295 grammes of the salt, corresponding to 1·1744 parts of carbonate of soda; but these results are only approximations, and the small amount of the water at my disposal at that time, did not permit me to carry my experiments further. The insoluble residue after the evaporation of the water with carbonate of ammonia, was dissolved in hydrochloric acid; the silica was separated by evaporation, and weighed ·061, corresponding to ·122 in 1000 parts. The solution gave ·054 of carbonate of lime, and ·0908 of carbonate of magnesia for 1000. In another determination, the precipitate from 500 grammes of the water which had been evaporated to one-tenth, gave only ·018 grammes of silica, a fact coinciding with that remarked in my Report for last year, upon the examination of another alkaline water, that the silica remains in great part in solution, until a late stage in the evaporation, but is completely separated with the earthy salts, when the evaporation is carried to dryness. Since the above experiments, I have met with some observations of Bischof which throw great light upon the subject. He has found that carbonates of lime and magnesia are gradually decomposed, in the presence of boiling water, by silica either in its soluble or

insoluble forms, a silicate of lime or magnesia being formed, and carbonic acid evolved. It is probable that a soluble alkaline silicate would, under these conditions, produce a like decomposition of the earthy carbonates, and thus the silica in these alkaline waters, whether as alkaline silicate, or in the state in which it exists dissolved in many saline waters not alkaline, may when boiled with earthy carbonates, convert them into silicates, and thus be entirely separated from the waters. The precipitation at a late stage of the evaporation of a portion of silica in combination with the earthy bases, indicating a solubility of the earthy silicates under certain conditions, has been remarked in a previous Report, and will require further examination and additional researches upon these alkaline waters. This of Chambly is remarkable, from the fact that more than one-half of its solid contents is carbonate of soda. Taking the first determination of the alkaline carbonate, we have for the mineral ingredients of 1000 parts of the water—

| | | |
|---|---|---|
| Chlorid of Sodium, | ·8689 | |
| Iodid and Bromid of Sodium, | traces | |
| Carbonate of Soda | 1·0295 | |
| " of Lime | ·0540 | |
| " of Magnesia, | ·0908 | |
| Silicia, | ·1220 | |
| | | 2·1652 |

Another spring rises about ten feet distant from the last, and yields small bubbles of gas; it is however not inclosed, and being a favorite resort for cattle, was so muddy and impure, as to be unfit for analysis. A qualitative examination of a portion, showed it to be like the last, strongly alkaline, and to contain chlorids with traces of bromine and iodine salts.

In another portion of the parish, about a league north of the village of Chambly, there are two mineral springs, upon what is known as Le Rang des Quarantes (arpents) upon the Ruisseau Macé, which falls into the Montréal River. These springs are upon the land of Mr. Cherrier, and are about forty arpents from the river. One of them is a copious spring, which fills a basin from which the water flows in a considerable current; its temperature was found to be 53° F., that of the air being 78°, and it is evolves a large amount of inflammable

gas. The water, which is slightly turbid from the suspended clay, is pleasantly saline to the taste, and gives 5·74 parts of solid residue for 1000. It yields by boiling, a copious precipitate of earthy carbonates, while the concentrated water is strongly alkaline to the taste and contains carbonate of soda, besides chlorid of sodium with bromids and iodids in marked quantity. The solution of the earthy salts in hydrochloric acid, is abundantly precipitated by solution of gypsum, indicating carbonate of baryta and probably of strontia. About an arpent from the last, is another spring, which like the last yields bubbles of gas; the water has a feeble sweetish saline taste, and is at the same time slightly ferruginous; it appears to be like the others alkaline, but was not further examined. Its temperature was 50° F.; but these determinations require to be verified by accurate observations at other seasons of the year, when the springs are less heated by the sun. The waters appear to be slightly thermal, at least their temperature is higher than the mean of Montreal, which is 49·5° F.

### *Kingston.*

There is a mineral well at Morton's Distillery at Kingston, from which I collected a portion of water, and have since subjected it to qualitative analysis. It is somewhat sulphurous, and exceedingly bitter as well as saline to the taste; 1000 parts give 10·16 parts of solid residue. By boiling, the water lets fall a considerable amount of earthy carbonates, mixed with a trace of iron. When concentrated to one-half, crystals of sulphate of lime separate, and the liquid contains, besides alkaline and earthy chlorids, a large amount of sulphates; salts of magnesia are abundant. When evaporated with carbonate of potash, the residue treated with alcohol, gives feeble but distinct reactions of bromine and iodine.

### ANALYSES OF MINERALS.

*Sphene.*—The cleavable variety of sphene from the plumbago vein at Grenville, was observed by Shepard and Brooke to be peculiar in its cleavage forms, and was proposed as a subspecies by the former, under the name of Lederite. The ordinary varieties of sphene cleave readily in the form of an obli-

que rhombic prism of 113° 30′; while the cleavage prism of the Lederite gave the angle 125° 30′. The mineral of Grenville is massive, but crystals from Phillipstown and Hammond, New York, were found to exhibit a similar cleavage, and were also supposed to differ in their external forms from ordinary sphene. Mr. Dana has since shown that the discordance in form is merely apparent, and that the two are identical in crystallization, the peculiar cleavage of the Lederite constituting the only recognized distinction.* The observations of M. Baudrimont upon the cleavages of calcspar, have however shown that the parallel rhombohedral cleavages of this mineral are not always equally perfect, and that it is much more common to find one or two of them distinguished from the rest. He has further remarked, that in certain varieties, diagonal cleavages not observed in others, are found, and also cleavages parallel to different secondary planes.† Apparent anomalies in cleavages such as are presented in the Lederite, may then easily be conceived to be only instances of an unusually perfect development of some cleavage, which in the ordinary crystals of sphene is very obscure, or not at all observable.

The Grenville mineral was first brought into notice by Dr. A. F. Holmes of this city. It occurs in a vein of plumbago which was formerly wrought by the Hon. R. U. Harwood, and is associated with white tabular spar, felspar, green pyroxene, yellow idocrase, and more rarely zircon and cinnamon-stone garnet. The sphene forms masses often several inches in diameter, and perfect cleavage-forms measuring from one to two inches may be obtained. It is also found at another locality described in my Report for 1847–48, about half a mile north from this, in a vein with the same minerals, where it forms drusy-surfaced crystals, often of considerable size. The hardness of this sphene is 5·5; specific gravity of pure cleavable fragments, 3·490—3·499, from the second locality, 3·510; color light clove-brown or chocolate-brown; translucent. The mineral was finely divided by eleutriation, and dried in a water-bath. It was decomposed by heating with sulphuric acid, and after removing the soluble portions by water, repea-

* See Shepard's Mineralogy, Ed. 1844, p. 144, and the American Journal of Science for October, 1840, p. 357, and January, 1845, p. 180.

† Comptes Rendus de l'Academie, Nov. 8, 1847, p. 668.

ting the operation with the acid three or four times, in the manner recommended by H. Rose. The remaining silica was analysed by dissolving it in a boiling dilute solution of soda, and the oxyd of titanium precipitated from the acid solution by ammonia, was also redissolved, to remove from it a little adherent lime. A trace of iron associated with the oxyd of titanium was not separated; 100 parts of mineral gave :—

| | |
|---|---|
| Oxyd of Titanium $TiO^2$, with a trace of Iron... | 40·00 |
| Silica, | 31·83 |
| Lime, | 28·31 |
| Loss by ignition, | ·40 |
| | 100·54 |

The composition is therefore identical with that of ordinary sphene; the formula assigned to the species requires oxyd of titanium, 40·60,—silica, 31·03,—lime, 28·37. Subsequent experiments were made with the titanic oxyd, to ascertain whether it was any way distinguishable from that of rutile or ilmenite, but with negative results.

In a previous Report the existence of sphene in several of the intrusive trap rocks of this district has been mentioned. It has been observed at Montreal, Yamaska, Monnoir and Brome Mountains. The crystals which are generally imbedded in felspar and are very numerous, are always honey-yellow or amber-yellow, transparent, brilliant and exceedingly minute; they are often highly modified, and from their smallness are very difficult to measure. Tkey are evidently monoclinic, and in the hands of my friend Mr. W. P. Blake, of New York, gave for the angle of the prism, as a mean of several measurements, 136° 16′, which is that of a common form of sphene. To render more complete the evidence of its character, I endeavoured to submit it to analysis, and by care was able to detach from a specimen of trap from Yamaska mountain, ·2 grammes, which gave by a single trial 2·76 as the specific gravity. By ignition, the pulverized mineral lost only ·001 gramme; heated with sulphuric acid, it left a residue of silica which was at once dissolved by hydrofluoric acid with the exception of a little undecomposed mineral; the silica equalled 31·5 per cent. The sulphuric solution gave about 40 per cent. of titanic acid, and contained besides this, nothing but lime in solution. The

mineral was therefore identical in its composition with ordinary sphene.

*Rutile.*—In examining at the locality, the extensive masses of ilmenite which you have described as occuring at Bay St. Paul, and of which I have given the analysis in a previous Report, some portions of it were found to be coarsely crystalline, and to contain abundantly disseminated hard translucent grains of a yellowish-red colour and conchoidal fracture. A qualitative examination showed them to consist of oxyd of titanium, so that they will probably belong either to the species rutile or brookite; a determination of their gravity will be necessary in order to decide as to their specific nature.

The mineral which occurs at the Bay St. Paul, in veins of calcareous spar, and was alluded to in a previous Report as a green apatite containing much fluorid, is fluor-spar. The specimens much resemble apatite in their appearance, and gave with molybdate of ammonia the reaction of a phosphate; but Berzelius has shown that fluor sometimes contains small portions of phosphate of lime, and such upon further examination, proved to be the nature of this mineral.

*Allanite.*—I have observed this rare mineral in small quantities in a felspathic rock, which is found upon the mountain road from St. Joachim to Bay St. Paul, about two leagues before reaching the latter place. It here occurs massive in thin seams, and somewhat resembles the Swedish variety orthite. The specimens were brownish-black, opaque and apparently decomposing. A qualitative analysis showed it to be a silicate of lime, alumina and oxyd of cerium.

*Platinum.*—This metal was detected last summer, in the gold washings of the Rivière duLoup, where it is found sparingly mixed with the gold, in minute scales and grains. These were soluble in aqua-regia, and the solution gave with sal-ammoniac the characteristic double salt. Associated with it there was another metal which resisted completely the action of the acid. It formed small plates of a tin-white, generally hexagonal, and so hard as to resist steel; these characters show it to be *iridosmine*, the native alloy of the rare metals iridium and osmium, which is found with the gold of South America, and is from its extreme hardness, employed to form the points of

gold pens. Specimens of both of these metals, said to be from the Rivière des Plantes, have been placed in my hands by Mr. Cunningham.

*Gold.*—The specific gravity of several worn fragments of the gold from the Rivière du Loup, was found to be as follows:—15·761—16·490—16·654—17·60—17·77. The third specimen (I) after being hammered out to a thin plate and twice annealed, had a specific gravity of 17·024, and the fifth (II) after the same process 17·848. These two were analysed by solution in aqua-regia and determining the amount of chlorid of silver. The gold was calculated from the loss, the solutions containing besides only traces of iron and copper. A third specimen of gold in fine scales (III) had a specific gravity of 16·57. The results of the three analyses are as follows:—

| | I. | II. | III. |
|---|---|---|---|
| Gold, | 86·40 | 87·77 | 89·24 |
| Silver, | 13·60 | 12·23 | 10·76 |
| | 100·00 | 100·00 | 100·00 |

In these specimens there does not appear any proportion between the specific gravity and the amount of alloy. The condensation on hammering seems to be by no means alike in the two specimens. Perhaps the previous fusion of the gold, would render more evident the relation between its purity and specific gravity. A fragment of 7·5 grammes weight, which appeared to be free from cavities or foreign impurities, had a specific gravity of 15·761, and by a prolonged fusion with nitre and carbonate of soda, lost 1·76 per cent. of its weight, and acquired a specific gravity of 17·43. The pure gold from the previous essays, precipitated from its solution by oxalic acid and fused with nitre, had a specific gravity of 18·685.

I have the honor to be,

Sir,

Your most obedient servant,

T. S. HUNT.

## ERRATA

Page 15,—5th line from top, for *Stromatopora* read, *Stictopora*.
" 78,—10th line from top, for 250 feet, read, 350 feet.