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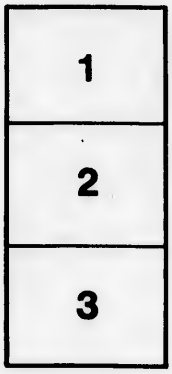

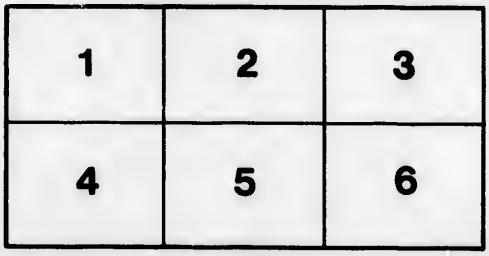

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GEOLOGICAL SURVEY OF CANADA.

DESCRIPTIVE CATALOGUE

OF A COLLECTION OF THE

ECONOMIC MINERALS OF CANADA,

AND OF ITS

CRYSTALLINE ROCKS.

SENT TO THE

LONDON INTERNATIONAL EXHIBITION

FOR

1862.

Montreal
PRINTED BY JOHN LOVELL, ST. NICHOLAS STREET.

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DESCRIPTIVE CATALOGUE

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ECONOMIC MINERALS OF CANADA.

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

In this Catalogue the classification of the Minerals is wholly technical, each substance being arranged under a heading connected with some one of its more prominent applications. There is given with each material the place from which it comes, and the name of the exhibitor, the latter in Italics. Beneath these is placed a list of the objects presented by each exhibitor, and a short description of the contribution, which is always terminated with an indication of the geological formation from which the substance is derived; reference being made to its Canadian designation, and in general to the English group or system in which the formation is included. These designations are also in Italics. The headings under which the Minerals are classed, are as follows:—

1.

METALS AND THEIR ORES.

IRON.

Bog Iron Ore or Limonite.

1. Radnor Forges, Batiscan .....*A. Larue & Co., Three Rivers.*

a. Three pieces of bog ore of different qualities, ready for the furnace.
b. Washed bog ore, ready for the furnace.
c. Slag from the smelting.
d. Limestone used as flux.
e. Sandstone used for furnace hearths.
f. Moulding sand of the neighborhood.
g. " " imported from Waterford, State of New York.
h. Charcoal used in smelting.
i. Five qualities of pig iron, Nos. 1, 2, 3, 4, 5. No. 3 with a polished face.
k. One piece of pig iron, re-cast from Nos. 2, 3, and 4, using anthracite.
l. One railway wheel, with a piece showing chill.
m. One section of wheel, showing chill.
n. Three nail rods.
o. Two sizes of horse-shoe nails.
p. One piece scythe iron.
q. One " " " beaten with hammer.
r. One pair of railway wheels and axle, which have run 150,000 miles.

Deposits of bog iron ore, in greater or less abundance, are spread out in patches on the north side of the St. Lawrence, and between it and the foot of the Laurentide Hills, all the way from Ste. Anne des Plaines to Portneuf; a distance exceeding a hundred miles. In this area, the ore seems to be most concentrated in the neighborhood of the St. Maurice and Batiscan Rivers, and iron has been smelted in the neighborhood of Three Rivers for upwards of a century. The St. Maurice Forges were established in 1737, and continued in operation until 1858. They were supplied with ore (all of it limonite), and with charcoal, from the seigniory of St. Maurice, including the fief St. Etienne; which were leased to the Smelting Company by the Crown. In 1831, according to Bouchette, from 250 to 300 persons were employed at the establishment, which had always been celebrated for the excellence of its iron; but the ore and wood becoming exhausted, and the Radnor Forges having been erected in the seigniory of Cap de la Madelaine, on the Rivière au Lard, a tributary of the Champlain River, in a vicinity where the ore and wood are still abundant, the St. Maurice forges went out of blast. The ore with which the Radnor furnaces are supplied, is derived from the seigniories of Cap de la Madelaine and Champlain, where it occurs close to the surface, in a multitude of patches distributed over the country, with a thickness of from three to twenty-four inches. It is brought to the furnaces, partly by the workmen of the Company, and partly by the various farmers on whose lands the ore occurs. The chief manufacture of the Company consists of cast-iron car wheels, the price of which at the forges is 2½ cents per lb. A rolling-mill has recently been erected at the establishment for the rolling of malleable iron of superior quality, such as scythe iron, the price of which is 3½ cents per lb., and nail-rod iron, the selling price being 5½ cents per lb. Limestone, as a flux for smelting the ore, is obtained from the Trenton group, at the works; and sandstone for furnace hearths at the Grès rapids, on the St. Maurice, where it used formerly to be obtained by the St. Maurice Company. This quartzose sandstone belongs to

the Potsdam formation, part of the lowest group of the Lower Silurian series of rocks. Being in this locality of a freer texture than the same beds in other parts of the province, it has been found capable of resisting a very strong heat without injury. Blocks of from twelve to fourteen inches thick, four feet long and twenty inches wide, do not require renewal oftener than once in two years. The ore is washed at the smelting works, to free it from soil, and it then contains between forty and fifty per cent. of iron. The quantity used annually is between 4000 and 5000 tons, producing about 2000 tons of pig iron, and the number of workmen employed varies from 200 to 400; a great many hands being required at certain periods, to excavate and bring in the ore, and to prepare and transport the charcoal.—*Alluvion.*

2. Vaudreuil, County of Vaudreuil..... *Geological Survey.*

a. Specimens of bog iron ore.

A bed extending over several lots on the Côte St. Charles, in the seigniory of Vaudreuil, at the confluence of the rivers Ottawa and St. Lawrence. The bed is in many places from four to eight feet thick, and there lies beneath it, in some parts, a thin stratum of blue phosphate of iron. This bog iron ore contains about fifty per cent. of iron, but it has never been worked.—*Alluvion.*

3. St. Vallier, County of Bellechasse ..... *Geological Survey.*

a. Specimens of bog iron ore.

An interrupted bed extending over an area of ten or fifteen square miles, near the junction of the two branches of the Rivière du Sud, county of Bellechasse. The patches are from one to ten acres in superficies, and from twelve to twenty inches thick. The specimens are from the property of Capt. Morin, and the ore, which has never been worked, contains about fifty per cent. of iron.—*Alluvion.*

Red Hematite or Oligist Ore.

1. MacNab, lot 6, concessions C and D..... *Geological Survey.*

a. Specimen of red hematite ore.

An unworked bed of thirty feet thick, containing by analysis about fifty-eight per cent. of iron. The bed rests upon crystalline Laurentian limestone, and is limited, at the top, by a magnesian limestone belonging to the Calciferous formation of the Lower Silurian era. It occurs near the Fall of the Dochart, within a quarter of a mile of the shore of Lac des Chats, an expansion of the Ottawa River.—*Laurentian.*

2. Sutton, lot 9, range 11 ..... *Geological Survey.*

a. Specimens of red hematite ore.

A bed of seven feet thick in chlorite slate, on the property of Mr. L. H. Smith. Different portions of the bed yield from twenty to fifty per cent. of iron.—*Quebec group, Lower Silurian.*

3. Sutton, lot 6, range 9 ..... *Geological Survey.*

a. Specimen of red hematite ore.

A bed of seven feet thick, occurring in chlorite slate, and presenting, where exposed, the form of an anticlinal arch, which spans a breadth of thirty feet. The ore is much mixed with chlorite, and has yielded to analysis, about twenty-three per cent. of iron. The bed is on the property of Mr. B. Mudget.—*Quebec group, Lower Silurian.*

4. Brome, lot 3, range 1..... *Geological Survey.*

a. Specimen of hematite ore.

A bed in chlorite slate. The thickness of the bed is five feet, but it presents the crown of a sharp anticlinal fold, which doubles it up, and gives it an apparent breadth of ten feet. The ore may contain about forty per cent. of iron. This bed is on the property of Mr. Reed Sweet, and with a neighboring one of eighteen feet, was formerly quarried for ore, which was conveyed a distance of thirty or forty miles to the town of Troy, on the south side of the province line, in Vermont, and was smelted with the magnetic oxyd, procured from the serpentine in that vicinity.—*Quebec group, Lower Silurian.*

N.B.—Ores similar to those of the last three localities, are exposed in a great number of places in St. Armand, Sutton, and Brome, running in a bearing N. 30° E. The exposures are distributed over a breadth of about a mile, and many of them are repetitions of the same beds, through the effect of undulations. The beds are made up of hematitic iron, mixed with grains of quartz and chlorite; in some the oxyd of iron predominates, constituting a rich iron ore, while in others the earthy minerals are in excess, and the rock passes into the ordinary slates of the country. These iron ores often contain a portion of titanium, as rutile, ilmenite, or sphene; in some, the peroxyd is mixed with magnetic oxyd of iron.

Magnetic Iron Ore.

1. Sutton, lot 9, range 9 ..... *Geological Survey.*

a. Specimen of magnetic iron ore.

A bed of twelve feet thick, consisting of dolomite abounding in small crystals of the magnetic oxyd of iron, which equals in many specimens, about 56 per cent. of the mass; thus giving an iron ore containing about thirty-eight per cent. of metal. The ore is on the east side of a band of dolomite, varying in thickness from twelve to thirty-two yards, on the west side of which there is an irregular bed of red hematite one foot thick. Two other bands of dolomite run parallel with the one mentioned, all in the space of 100 yards, on the property of Mr. Orramel Stutson.—*Quebec group, Lower Silurian.*

2. Marmora Iron Mine, Belmont, lot 8, range 1..... *Geological Survey.*

a. Specimens of magnetic iron ore.

A mine commonly known as the *Big iron ore bed of Marmora.* It appears, however, not to be a single bed, but a succession of them (one measuring 100 feet in thickness), interstratified with thin bands of crystalline limestone and talcose slate, associated with diallage rock, serpentine, and epidosite. The total breadth of the mass is eight chains, and it is interstratified between gneiss and crystalline limestone, with a dip N. W. $< 25° - 50°$. The ore contains between sixty and seventy per cent. of iron. Many years ago a furnace was erected at Marmora to smelt it, and iron of superior quality was manufactured. More recently, different companies have for short periods renewed smelting operations, with very satisfactory results in respect to the quality of the iron produced; but the distance of the place from a shipping port has proved a serious obstacle to success. At present the furnace is not in blast.—*Laurentian.*

3. Newborough, S. Crosby, lots 26 and 27, range 6 ..... *Geological Survey.*

a. Specimen of magnetic iron ore.

A bed of 200 feet thick in gneiss. It is situated on Mud Lake, a part of the Rideau Canal, and is the property of Messrs. G. Chaffey and Brothers, who mine the ore, and supply it at Kingston for 2½ dollars the ton, to vessels which carry it as back freight to Cleveland, on Lake Erie; whence it finds its way to the smelting furnaces at Pittsburg on the Ohio, in the State of Pennsylvania. About 4000 tons of the ore were thus exported in 1859.—*Laurentian.*

4. Hull, lot 11, range 7 ..... *Geological Survey.*

a. Specimen of magnetic iron ore.

A bed of about ninety feet in thickness. It is surrounded by gneiss, and appears to present the form of a dome, through the summit of which there protrudes an underlying mass of crystalline limestone. Messrs. Forsyth & Company, smelters, of Pittsburg, commenced mining this ore, in 1854, for the supply of their own furnaces at Pittsburg, exporting the ore by the way of Kingston, on Lake Ontario, to which it was conveyed by the Rideau Canal. Up to 1858 they had exported about 9000 tons of ore, but the opening of the Newborough mine, more favorably situated in regard to the shipping port, induced them to obtain their supply from the latter, and no ore is now exported from Hull. The ore contains between sixty and seventy per cent. of iron. In some parts of the bed it is mingled with a little graphite.—*Laurentian.*

5. Grenville, lot 3, range 3..... *Geological Survey.*

a. Specimen of magnetic iron ore.

A bed of about ten feet thick in gneiss, on the property of Mr. Thomas Loughran.—*Laurentian.*

6. Grandison..... *Geological Survey.*

a. Specimen of magnetic iron ore.

A bed of about twenty feet thick in gneiss, on government land.—*Laurentian.*

7. Madoc, lot 11, range 5..... *G. Seymour, Madoc.*

a. Specimens of magnetic iron ore.

A bed of twenty-five feet thick in gneiss, on the property of Mr. Seymour, the exhibitor, who formerly smelted the ore at his own furnace, making from it iron of a very fine quality. The furnace is not now in blast. The ore is very free from sulphur, and yields to analysis about seventy per cent. of iron. The beds of rock in immediate contact with the ore are soft, black, and very micaceous, and thin seams of a similar character appear occasionally to cut the ore bed diagonally. Masses of actinolite are disseminated in the ore, and yellow uranite has been found investing small cracks. The ore is a natural magnet, displaying strong polarity.—*Laurentian.*

8. South Sherbrooke, lot 14, range 1 ..... *A. Cowan, Kingston.*

a. Specimen of magnetic iron ore.

A bed of about twelve feet thick in gneiss. The ore, which contains between sixty and seventy per cent. of iron, is of very uniform character. The proprietor has recently mined about 300 tons, which are about to be drawn to the Rideau Canal. A small quantity of it has been tried at Mr. Gzowski's iron works, at Toronto, and the ore is found to be well adapted for lining furnaces.—*Laurentian.*

9. Hastings Road, N. side ..... *John Orton, Hastings Road.*

a. Specimen of magnetic iron ore.

A bed in gneiss, the property of the exhibitor.—*Laurentian.*

Ilmenite or Titaniferous Iron Ore with Rutile.

1. St. Urbain, Bay St. Paul..... *Geological Survey.*

a. Specimen of Ilmenite.

A bed of ninety feet thick, which is exposed for 300 feet on the strike, and is traceable for about a mile. The ore has yielded to analysis:—

Oxyd of titanium	48·60
Protoxyd of iron	46·44
Magnesia	3·60
	98·64

In some parts of the bed, rutile is disseminated in the ilmenite, in small red crystalline grains. The ore is interstratified in anorthosite rock.—*Laurentian.*

LEAD.

Galena or Sulphuret of Lead.

1. Gaspé, Indian Cove ..... *C. C. Closter, Gaspé Basin.*

a. Undressed lead ore from the lode.

b. Hand-picked prills.

A vein transversely cutting stratified limestone, which dips about S. W. $< 24°$ and rises northward into a hill about 700 feet in height, constituting Gaspé promontory. The vein has a width of about eighteen inches, and is composed of calcspar, holding disseminated masses of galena. A trial shaft of twenty feet in depth, has been sunk on the vein, and from this and from several small veins running parallel with the main one, about six tons of ore of sixty per cent. have been obtained.—*Lower Helderberg group, Upper Silurian.*

2. Upton, lots 50, 51, range 4..... *James Wright & Co.*

a. Undressed lead ore.

A bed composed of dolomite, with irregularly disseminated patches of galena, varying in thickness from one to four inches, but not easily traceable on the strike. The bed occurs in the upper part of a band of dolomite of from 200 to 300 feet thick, which has been followed a long distance through the country.—*Quebec group, Lower Silurian.*

3. Ramsay Mines, Ramsay, lot 3, range 6..... *Foley & Co., Montreal.*

a. Prills of lead ore as taken from the lode.

b. Hand-picked prill.

c. Sorted lead ore, prepared for the crusher.

d. Pig lead run from the furnace.

e. Slag, from the smelting of eighty per cent. ore.

f. A plan of the mine by Mr. E. Banfield.

A vein cutting nearly horizontal beds of grey, geodiferous, brown-weathering dolomite. The vein is composed of calcspar, and has a breadth varying from two and a half to five feet, in which the galena is disseminated in a width of from eight to twenty-four inches. In some portions the vein is almost dead ground, while in others, judging by the eye, it would yield nearly two tons of eighty per cent. ore per fathom. The bearing of the lode is about N. W., and its underlie to the north-eastward, about a foot in a fathom. A trial

shaft has been sunk on the lode to the depth of thirty-seven feet, and the working of seventy-five fathoms of ground, in 1858, yielded twenty-six tons of ore of eighty per cent. A smelting furnace was erected to reduce the ore, and a ten horse-power engine used to give blast to the furnace and dry the shaft, but a considerable spring of water having been struck, it became necessary to erect a more powerful engine, and one of fifty horse-power has just been completed. The dolomite is underlaid conformably by sandstone, which crops out about a mile from the mine, and is unconformably supported by crystalline limestone and gneiss of Laurentian age. About 105 fathoms south-eastward from the main shaft, a counter-lode joins the main one, at an angle of about 20°; its course being nearly N. N. E. and S. S. W. At the junction of the two lodes a shaft has been sunk in sandstone, to a depth of twenty-one feet, and in the excavation of the pit in which the united lodes have a breadth of ten feet, there have been obtained about seven tons of ore of twenty per cent.—*Calciferous formation, Lower Silurian.*

4. Lansdowne, lot 3, range 8..... *Geological Survey.*

a. Undressed lead ore.

b. Plan of lodes by Mr. E. Banfield.

Ore from a vein cutting crystalline limestone, and running N. 60° W. The vein has a thickness of from six to twelve inches, and is composed of calcspar, in which the galena is disseminated in lumps; which, in a trial shaft of about fifty feet, sunk in 1854, on the land of Mr. Buel, were sufficient to pay the expenses. The largest of these lumps may have been five or six inches in width. A counter-lode diverges from the main one near the shaft, and in this neighborhood, there occur four additional lead-bearing veins, running parallel with the main one, all contained in a breadth of about 1000 feet. They run obliquely across the lots, and thus intersect the lands of several proprietors. On lot four of the same range, Messrs. Foley & Co., of Montreal, have sunk a small shaft on one of the lodes.—*Laurentian.*

5. Bedford, lot 19, range 7 ..... *Geological Survey.*

a. Undressed lead ore.

Ore from one of five nearly parallel lodes, cutting crystalline limestone, in a breadth of about a quarter of a mile, on the property of Mr. Weston Hunt, of Quebec. The gangue of the lode is a mixture of heavy spar and calcspar. About a mile to the eastward of these, are other nearly parallel lodes, also cutting crystalline limestone, on land belonging to the same proprietor. Shallow trial shafts were many years ago sunk on some of these, but what quantity of lead ore was obtained in them, is not known. On lot 13, range 5, of Bedford, Messrs. Foley & Co. of Montreal, have sunk a trial shaft to a depth of fourteen feet, on a lead-bearing lode of six inches, of which the gangue is heavy spar. It cuts crystalline limestone, and reaches gneiss, and in both rocks shows good bunches of ore. This lode is about three miles south-west from those first mentioned, and runs parallel with them.—*Laurentian.*

N.B.—The distance between the Lansdowne and Bedford lodes is about twenty-five miles; they bear for one another, and it appears not at all improbable that the veins in the two localities may be identical, or belong to one group. If a line from the Bedford to the Lansdowne lodes were continued twenty-five miles farther, it would cross the St. Lawrence, and strike Rossie in St. Lawrence County, New York, where a well known group of veins of lead ore intersects Laurentian gneiss. Though just now abandoned, some of these are supposed to be still unexhausted, and two of them are known, at one period, to have yielded a great quantity of ore; one of them as much as $142 worth to a fathom. The Ramsay lode belongs to a series of veins which run parallel with those of Bedford, at a distance of about forty miles to the north-eastward, and, although the two groups cut different rocks, both are probably of one age, which would not be older than that of the *Calciferous formation* of the *Lower Silurian* series.

COPPER.

Sulphurets of Copper.

1. Escott, lot 7, range 2, near Brockville..... *Geological Survey.*

a. Yellow sulphuret of copper, with iron pyrites and magnetic oxyd of iron, from a bed running N. E. and S. W.

This bed is interstratified in gneiss, and consists of magnetic oxyd of iron of about six inches thick, which near a cutting, made for the convenience of the Grand Trunk Railway, was ascertained to be underlaid by copper pyrites. This was mined, and found to be a lenticular mass, extending about twelve feet continuously in the bed, with a thickness of ten inches in the middle. This mass was nearly pure copper pyrites, in which thin leaves of hydrated peroxyd of iron ran in cracks and joints. In some parts calcspar was present in short, thin veins and small specks, and iron pyrites was disseminated in others, increasing in quantity as it approached the north-west side; into which the copper pyrites appeared to run for short distances. Traces of cobalt occur in the iron pyrites. About twenty tons of the copper ore were obtained, but after the mass became exhausted, no excavation through the dead ground was made in search of a farther quantity. It is stated that another mass of copper ore has since been found at the surface, a short distance to the S. W. The details relating to it have not been ascertained, farther than that it is said to be three feet thick, and that a sample, which was an average of nine inches of the breadth, yielded ten per cent. of copper to the analysis of Mr. McFarlane. —*Laurentian.*

2. Bruce Mines, Lake Huron ..... *Montreal Mining Co., Montreal.*

a. Yellow and variegated sulphurets of copper, from the lode.
b. " " " " rough dressed.
c. " " " " jigged.
d. Rough waste from jigging on copper bottom sieves.
e. Plans of the mine, by Mr. C. H. Davie.

At the Bruce mines, a group of lodes traverses the location in a north-westward direction, intersecting a thick mass of interstratified greenstone trap. The strata here present an anticlinal form, the lodes running along the crown of it. All of the lodes contain more or less copper ore, which is disseminated in a gangue of quartz. The main lode, which is worked with another of about the same thickness, is, on an average, from two to four feet wide. In a careful examination made in 1848, about 3000 square fathoms of these lodes were computed to contain about 6½ per cent. of copper. The quantity of ore obtained from the mine, since its opening in 1847, is stated to be about 9000 tons of eighteen per cent. The quantity obtained in 1861 was 472 tons of seventeen per cent. The deepest working is fifty fathoms from the surface. The number of men employed is thirty-four. Smelting furnaces, on the reverberatory principle, were erected at the mine in 1853; the fuel used in these was bituminous coal imported from Cleveland; but after a trial of three years, the Company themselves ceased smelting, and subsequently leased their smelting works to Mr. H. R. Fletcher. At present, the ores are in part sent to the Baltimore market, and in part to the United Kingdom.—*Huronian.*

3. Wellington Mine, Lake Huron,..... *West Canada Mining Co.*

a. Yellow sulphuret of copper, from the lode.
b. Yellow and variegated sulphurets, prills.
c. " " " jigged.
d. " " " buddled.
e. " " " crushed.
f. Rough waste from jigging.
g. Fine waste from tyes.
h. Plans of the mine, by Mr. Plummer.

The lodes of the Wellington Mine are probably a north-westward continuation of those of the B[illegible]oe Mine. They are of the same general character, some of them occasionally reaching a thickness of ten feet. They occur on the ground of the Montreal Mining Company, [illegible] whom they are leased by the West Canada Mining Company at a royalty and continue into the adjoining set, called the Huron Copper Bay location, where they are worked by the same Company. The quantity of ore obtained by this Company, from the Wellington mine, since 1857, is a little over 6000 tons of twenty per cent. In 1861, the quantity was 1175 tons of nineteen per cent., and from the Huron Copper Bay mine, probably about 1300 tons; making the total quantity obtained by the two mining companies in that year about 3000 tons. The deepest working on the West Canada Company's ground is about twenty fathoms. The number of men employed on the Wellington and Copper Bay mines is supposed to be about 260. All of the ore raised by this Company is sent to the United Kingdom.—*Huronian.*

4. Acton Mine, Acton, lot 32, range 3.... *W. H. A. Davies and C. Dunkin, Montreal.*

a. Variegated sulphuret of copper, from the bed.
b. " " jigged.
c. " " rough dressed.
d. " " tye work.
e. Waste from the tyes.
f. A polished slab of the conglomerate ore.
g. Rock of the country at the mine.
h. Plan of the mine, by Messrs. Willson & Robb.

The ore of the Acton mine occurs in masses subordinate to the stratification, at the summit of a band of greyish-white and reddish-grey compact sub-crystalline dolomite, from 200 to 300 feet thick, belonging to the base of the Quebec group. The dolomite is divided into massive beds; it is associated with a good deal of chert, and encloses mammillated fibrous concretionary forms, resembling those of travertine. At the summit, the dolomite often terminates in a breccia or conglomerate, with angular and rounded masses of limestone, intermingled with ragged, irregular masses of chert. In many places the dolomite is marked by the occurrence of the yellow, variegated and vitreous sulphurets of copper, which are in patches, running with the stratification. In the neighborhood of these, many veins and strings of quartz intersect the rock, in various directions, and hold portions of the sulphurets of copper. The copper ores, which often contain native silver, appear to be more abundant in the upper part of the rock. At Acton, the conglomerate is separated from the main body of the dolomite by between eighty and ninety feet of dark grey or black slates, intermixed with diorite; in these the conglomerate lies in large isolated masses, running parallel with the summit of the main body of the dolomite. On the opening of the mine, the sulphurets, where most abundant, appeared to occupy a position immediately near some of the isolated masses of conglomerate, and partially to surround them; in some parts constituting the paste of the conglomerate. As the work proceeded, many slips and dislocations, of no great magnitude, were found to cut the strata. Some of them appear to run with the strike, and others in two of parallel series, oblique to one another. These disturb the regular continuity of the copper-bearing bed, producing apparent undulations in the dip, and causing the diorite and the limestone to protrude into the copper ore, or unexpectedly to interrupt one another. The ores were found to be concentrated in three large masses, occurring in a length of about 120 fathoms. Proceeding south-westwardly, the space occupied by the most northern mass, from a breadth of a few inches, gradually widened out to about ten fathoms, in a length of about forty fathoms; beyond which it appeared to be thrown about fourteen fathoms, obliquely to the westward. The general bearing of the succeeding two masses was still to the south-west. They were about fifteen fathoms apart, and the larger or more

southward one swelled to a breadth of more than fifteen fathoms. The depth to which the ground has been worked on the general slope of the bed, is about ten fathoms; the cupriferous rock at this depth has a breadth of about twelve feet in a shaft on the northern mass, and shews rich ore in the floor and the parts adjacent; but with the exception of what is called Pike's pit, in the most southern part, the floors of the other masses do not at present exhibit that same abundance of ore which characterized the upper part. The working of the mine, however, up to the present time, has been confined to the extraction of the rich ore which was in sight. Little or nothing has been done for discovery, and it cannot be said how near to the present floor of the mine, may be found other masses similar to those that have been excavated. Beyond these masses, in opposite directions on the surface, the ore becomes more scattered in the strata; but there is evidence of its continuance for several hundred feet, in spots and patches, occasionally aggregated into masses of much less importance than the three principal ones. In the first few weeks' work in 1859, about 300 tons of ore, containing nearly thirty per cent. of copper were quarried, in open cuttings, from two of the masses, without making much apparent impression on the quantity in sight. The total quantity sent from the mine up to the end of 1861, is said to be nearly 6000 tons; holding on the average about seventeen per cent. of copper.—*Quebec group, Lower Silurian.*

5. Upton Mine, Upton, lot 51, range 20..... *G. B. Moore & Co., Montreal.*

a. Yellow sulphuret of copper, from a bed.

The band of dolomite, which sinks with a north-westward dip at Acton, rises again at Upton, on the opposite side of a synclinal form, at a distance of about six miles. Here, about twenty feet in the upper portion of the band are marked by the yellow sulphuret of copper; which is disseminated in the rock, as if in a bed, the ore being most abundant in the lower part. The rock is at the same time cut by many reticulating strings and veins of calcspar, which hold ore. An open cutting has been made on the outcrop of the bed; the quantity of ore obtained, is stated by the proprietors to be forty tons, and a sample, represented by them to be an average one, yielded to the analysis of Mr. C. Robb, fourteen per cent. of copper. The quantity of rock which has been excavated is uncertain.—*Quebec group, Lower Silurian.*

6. Bissonette's Mine, Upton, lot 49, range 20..... *Geological Survey.*

a. Yellow sulphuret of copper, from a bed.

From the position where the rock has been wrought in the previous mine, the band of dolomite runs south-westward for nearly a mile, and then appears to be thrown upwards of half a mile to the south-westward, by a dislocation. Bissonette's mine is on the south-west side of the dislocation, and apparently in the same stratigraphical place in the band, as the Upton mine. The bed is about three and a half feet thick, and the ore lies in disseminated masses of various sizes, up to twenty inches long, by from six to nine inches thick. The bed might probably yield from a half to three fourths of a ton of ten per cent. ore to a fathom.—*Quebec group, Lower Silurian.*

7. Wickham Mine, Wickham, lot 15, range 10.....*Pomroy, Adams & Co., Sherbrooke.*

a. Yellow, variegated and vitreous sulphurets of copper, from a bed.

b. Plan of the mine, by Messrs. Willson & Robb.

This ore occurs in masses, disseminated in what appears to be a bed, of uncertain thickness, in the same band of dolomite as that of the Acton mine. An experimental shaft has recently been sunk on it to a depth of about five fathoms, in which good bunches of ore have been met with. About four tons of thirty per cent. ore have been obtained from the excavation.—*Quebec group, Lower Silurian.*

8. Yale's Mine, Durham, lot 21, range 7 .....*Pomroy, Adams & Co., Sherbrooke.*

a. Yellow sulphuret of copper, from a lode.

b. Plan of the mine, by Messrs. Willson & Robb.

At this mine, several veins, carrying more or less copper, intersect a mass of magnesian limestone, which is supposed to belong to the same band as that of the Acton mine. The veins have a general bearing north-eastward, and trial shafts have been sunk on three of them, the thicknesses of which vary from six to thirty inches. The vein-stone is calcspar, with a little quartz, occasionally mixed with portions of the wall rock. On the most north-western vein, the excavation is two fathoms deep, and reaches black shale beneath the limestone. On the middle one, which is eighteen feet to the south-east, the excavation is six fathoms deep, again reaching black shale; and on the third, twenty-four feet farther to the south-eastward, a shaft sunk about four fathoms, is still in magnesian limestone. In this shaft, the vein has an underlie to the south-eastward of about a foot in a fathom, and in a breadth of from six to twelve inches, shows good lumps of ore, mixed with calcspar and wall rock.—*Quebec group, Lower Silurian.*

9. Black River Mine, St. Flavien.....*Shaw, Bignol & Hunt, Quebec.*

a. Yellow sulphuret of copper, from a bed.

At St. Flavien, about five leagues above the Chaudière, and two leagues from the St. Lawrence, red shales occur, underlaid by a band of amygdaloidal diorite; this appears to occupy the place of the magnesian limestone, to which the band at Acton belongs. It is between a quarter and half a mile wide, and limestones occur both at the summit and at the base of the band, which in those parts appear to be of a concretionary, or conglomerate and brecciated character; being composed, particularly at the base, of rounded and angular masses of amygdaloidal diorite, varying in diameter from two inches to two feet. Many of these are calcareous, and much of the rock is red. The interstices among the masses are filled with calcspar, which is transversely fibrous towards the walls, and incloses crystallized quartz in the centre. This band is highly cupriferous, and ores of copper occur both in the beds, and in veins or lodes which cut them: the bearing of the veins, however being with the strike. The ore in the beds is copper pyrites, large masses of which, similar to the one exhibited, are associated with the limestones at the top. The veins, in addition to copper pyrites, hold the variegated and vitreous sulphurets. In one spot, native copper occurs in small masses, in the conglomerate at the base of the diorite. The whole band has a striking resemblance to some of the rocks of the Upper Copper-bearing series of Lake Superior.—*Quebec group, Lower Silurian.*

N.B.—A band of diorite very similar to the one above mentioned, and perhaps a continuation of it, occurs at Drummondville on the St. Francis, where the band is half a mile wide. On lot 1, range 1, of Wendover, it holds yellow, variegated and vitreous sulphurets of copper, which run in six or seven thin veins or courses, formed by breaks and slips in the diorite, within a breadth of 350 yards.

The rocks of the Quebec group, which are almost wholly on the south side of the St. Lawrence, are distributed in long narrow parallel synclinal forms, running N.E. and S.W. For the convenience of geological description, these have been divided into: 1st, The Lauzon and Farnham synclinal, which is the one most to the N. W.; 2nd, The Shipton and St. Armand synclinal, continued, to the N. E., in the Shipton and Leeds synclinal. Between these two synclinals runs the Bayer and Stanbridge anticlinal, and beyond them, to the S. E., is the Danville and Sutton anticlinal. From this, there branch, in the neighborhood of the St. Francis, the Sutton Mountain anticlinal, and the Melbourne and Potton anticlinal. The six copper-bearing beds and veins that have been mentioned, 4—9, are all included in the Lauzon and Farnham synclinal.

10. Harvey's Hill Mine, Leeds, lot 18, range 15. *English & Canadian Mining Co., Quebec.*

a. Variegated and vitreous sulphurets of copper, from Hall's lode.
b. " " " " from Campbell's lode in Kent's shaft, at thirty fathoms.
c. Yellow, variegated, and vitreous sulphurets of copper, from lowest bed.
d. " " " " " from highest bed.
e. Variegated and vitreous sulphurets, dressed on copper-bottom sieves.
f. A plan of the mine, by Mr. Herbert Williams.

At Harvey's Hill mine, there occur in a breadth of about 1000 feet, eight courses with a north-eastward bearing, composed chiefly of quartz, with various proportions of bitter-spar, chlorite and calcspar. They all cut the strata, with an underlie, at high angles, to the north-westward, and hold, in greater or less quantities, the yellow, variegated and vitreous sulphurets of copper. These quartz courses, which appear to have lenticular forms; occasionally extend upwards of 100 fathoms horizontally; some of them have shown a width of as much as seven feet in the thickest part, occasionally carrying, for short distances, as much as two tons of twenty per cent. ore to a fathom. The rock of the country is a talcoid mica slate, which from its lustre is called nacreous slate. To prove the quartz courses in a downward direction, an adit level is being driven through these slates, from the north side of the hill, at a level of thirty-seven fathoms below its summit. The length of this adit, when complete, will be 220 fathoms. The same sulphurets of copper which characterize the quartz courses, occur also in beds conformable with the stratification. Of these there are three at Harvey's Hill. The lowest one, resting on a six-feet bed of soapstone, is six inches thick; fifteen feet above this there is another, three inches thick, and twenty fathoms, still higher, one varying in thickness from twenty to thirty inches. In these beds, the ore is distributed through the nacreous slate in patches, generally of a lenticular form; they are usually thin, but sometimes attain one half to three-fourths of an inch in the thickest part, and occasionally present, in section, lines of six inches, or even twelve inches in length. The patches interlock, one overlapping another, with variable distances between; while many single crystals and grains of ore are disseminated through the whole thickness of the beds. The quantity of ore obtained from the mine is uncertain; the number of men employed is about fifty.—*Quebec group, Lower Silurian.*

11. St. Francis Mine, Cleveland, lot 25, range 12.....*Flowers, Mackie & Co.*

a. Yellow sulphuret of copper, from a vein.
b. Plan of the mine, by Messrs. Willson & Robb.

The ore is disseminated in a vein, slightly oblique to the stratification of a quartzo-chloritic rock, frequently studded with nodules of orthoclase feldspar, often surrounding small centres of quartz; the nodules give to the rock the aspect of an amygdaloid trap. The bed has an average thickness of three feet, and the rock is supposed to occupy a higher stratigraphical place than the Acton dolomite. The vein is traced, running N. E., for ninety fathoms. Five or six small excavations, each of a few fathoms in length, have been made in the outcrop, to the depth of two feet, and in these the variegated and vitreous ores are mixed with the yellow sulphuret.—*Quebec group, Lower Silurian.*

12. Jackson's Mine, Cleveland, lot 26, range 13.....*Griffiths & Brothers.*

a. Variegated and vitreous sulphurets of copper, from a bed.

The bed to which this ore is subordinate, is of the same character as that of the St. Francis mine. It dips north-westward, at a high angle, and is about twelve inches thick; a shaft has been sunk in it to a depth of three and a half fathoms. Ten fathoms to the east, and fifteen fathoms to the west of this, other copper-bearing beds occur, composed of an amygdaloidal chloritic rock like that of the St. Francis mine, one of them three feet and the other five feet thick. In these the ore is sparingly disseminated.—*Quebec group, Lower Silurian.*

13. Coldspring Mine, Melbourne, lot 6, range 2 ..... *Flowers, Mackie & Co.*

a. Variegated and vitreous sulphurets of copper, from a bed.

b. Plan of the mine, by Messrs. Willson & Robb.

The bed from which these specimens are derived, is composed of quartz and nacreous slate, in which the ore is disseminated in thin interlocking lenticular patches, and in grains; as in the beds of Harvey's Hill mine. The dip of the strata is north-westward, at an angle of about forty-five degrees. Last summer, a shaft was sunk to cut the bed at seven fathoms, but none of the ore has yet been *stoped*. In a breadth of 120 feet across the strata, on one side of the shaft, and 80 feet on the other, there are several parallel bands of cupriferous strata, marked chiefly by the green carbonate of copper, but showing occasional indications of the variegated and vitreous sulphurets. What the productiveness of the ground may be, has, however, not yet been ascertained.—*Quebec group, Lower Silurian.*

14. Sweet's Mine, Sutton, lot 8, range 10..... *S. Sweet & Co., North Sutton.*

a. Variegated and viteeous sulphurets of copper, from a bed.

b. " " " " "

c. Plan of the mine, by Mr. J. Richardson.

The ore occurs in nacreous slate, in which it is disseminated in thin, lenticular patches and in grains, as in Harvey's Hill mine. The thickness varies from one to about four and a half feet, and the beds dip N. 77° W. $<$ 86°-90°. In this attitude it is visible for 170 yards, and is traceable for a mile, running parallel with a band of dolomite, which is removed from it about half a mile across the strike, to the eastward. Nodules of magnesian limestone are disseminated in the slate, close along the eastern side of the part charged with copper ore. The band of dolomite is supposed to be in the same stratigraphical place as that of Acton, but it occurs on the eastward side of a distinct synclinal form, the axis of which is separated from that to which the Acton band belongs, by about twelve or fifteen miles. A sample of the whole breadth of the bed, where it is four and a half feet, yielded to analysis four and a half per cent. of copper. A pit of ten fathoms deep was, last year, sunk down the incline of the bed, and a small quantity of the ore *stoped* out at the bottom.—*Quebec group, Lower Silurian.*

15. Craig's Range Mine, Chester, lot 8, range 5..... *G. D. Robertson & Co.*

a. Vitreous sulphuret of copper, with green carbonate, from a vein.

The vein, which is composed of quartz, has a thickness of about two feet. It runs with the strike, in chloritic slate, and has been uncovered for a fathom or two along it. It shows enclosed masses of the ore, but the work done is not sufficient to authorise any statement in regard to the quantity.—*Quebec group, Lower Silurian.*

N.B.—The six copper-bearing beds and lodes, 10-15, are all within the Shipton and St. Armand synclinal. Indications of copper occur in a great number of localities in this synclinal, in testing a good many of which, there have been expended considerable sums. These indications run through Stukely, Ely, Melbourne, Cleveland, Shipton, Chester, Halifax, Inverness and Leeds, and cross the Chaudière into the seigniory of St. Mary.

16. Nicolet Branch Mine, Ham, lot 28, range 4..... *Geological Survey.*

a. Yellow and variegated sulphurets of copper, from a bed.

The ore of this mine occurs at the summit of a band of slaty dolomite about 100 feet thick. At the spot the rock dips S. 10° E. $<$ 46°, and runs thence in a general eastwardly direction. For a thickness of about thirty feet, in which nacreous slate is mixed with the dolomite, the ore is disseminated in lenticular patches of various sizes, sometimes measuring several feet in length, with a thickness of an inch or more in the centre. The patches interlock among one another, and appear to be in sufficient abundance to

be profitably wrought. The dolomite crosses the north branch of the Nicolet River, producing a considerable fall in the stream; which is thirty feet wide, and would afford abundant water-power for crushing and dressing the ore.—*Quebec group, Lower Silurian.*

17. Garthby, lot 22, range (north) 1.....*Geological Survey.*

a. Iron and copper pyrites, from a bed.

This appears to be a large mass of iron and copper pyrites, subordinate to the strata, which here consist of calcareous serpentine, and run N.E. and S.W., with a dip about S. E. <50°. The entire thickness of the mass is uncertain, but the breadth in which the sulphurets are more or less mingled with the rock, is probably not less than twenty feet. In some parts sulphuret of iron prevails, almost to the exclusion of that of copper, while in others there is as much as eight per cent. of copper; some parts assume the aspect of what, among Cornish miners, is termed *bell-metal ore*. An opening has been made in the mass, eight feet in length, four feet in height, and four feet wide; in this, the two sulphurets occur unequally mixed with one another, but nearly free from the rock of the country. —*Quebec group, Lower Silurian.*

18. Haskell Hill Mine, Ascot, lot 8, range 8.....*Thos. McCaw, Montreal*

a. Yellow sulphuret of copper, from a bed.

b. Plan of the mine, by Messrs. Willson and Robb.

The bed is five feet thick, and occurs in a calcareous chloritic slate. The mine has been opened on a twist in the stratification, giving three courses of ore in the breadth of eighty feet, but the general plane of the bed dips about S. <65°. A pit has been sunk on the incline of the bed to a depth of five and a half fathoms from the surface, and the ore obtained from the excavation, without any dressing, has been sent to Boston, where it has yielded on an average about eight per cent. of pure copper. The quantity of such ore obtained from the bed by five men in five months, is about 100 tons. The bed is traceable for a considerable distance in opposite directions from the pit, and carries copper as far as it has been tried. The horizon of the strata of this mine is supposed to be higher than the dolomite of Acton, and to be approximatively equivalent to the chloritic slates of the Shipton and St. Armand synclinal. The rock of Haskell Hill composes a belt of ridgy land, running from Owl's Head to Ham Mountain, forming in its progress the Stoke mountains. It spreads out to a width of about seven miles on the St. Francis, and shows indications of copper near Sherbrooke, on the land of Mr. Sheriff Bowen, and in several other places. A vein on lot 17, range 7, of Ascot, within a mile of Sherbrooke, in addition to the yellow sulphuret of copper, has been found to hold traces of gold.—*Quebec group, Lower Silurian.*

N.B.—Besides the fifteen localities of copper-bearing beds and veins belonging to the Quebec group, which have been described above (4–18), nearly 200 additional localities, on separate lots of 200 acres each, in which indications of the metal occur, are known in the same region.

Native Copper.

1. Harrison's Location, St. Ignace Island, Lake Superior....*Geological Survey.*

a. Mass of native copper from a lode.

On the Chenal Ecarté, at the east end of St. Ignace Island, the vein from which the above specimen is derived, cuts a thick mass of amygdaloidal diorite, which lies conformably with the strata, there dipping S. <9°. The vein is about four or five inches wide, and holds masses of native copper, many of them weighing upwards of 100 lbs., accompanied by native silver, in a gangue of calcspar. The underlie of the vein is N. <70°.

About forty-seven feet south from this vein, there is another about twelve inches wide, of which the vein stone is calcspar, with a little quartz, associated with fragments of wall rock. Among these substances are disseminated masses of vitreous copper, accompanied with native silver. The underlie of the vein is N. $< 60°$. These two veins would meet downwards about twenty-five fathoms from the surface, and with a view of testing them, the Montreal Mining Co., to whom the location belongs, in 1846 commenced the sinking of a shaft, about twenty-four feet north of the native-copper vein. It was carried down ten fathoms; a drift from it southward, then intersected the vein at a distance of about twenty feet, thus proving its continuance for a depth of ten fathoms; but the Mining Company, having at that time determined to concentrate all their energy upon the working of the Bruce mine, the experiment was carried no farther. These veins, variously modified, can be traced to the westward for nine miles, along the whole length of St. Ignace Island, carrying native copper and native silver, with the vitreous sulphuret of copper, in greater or less quantity the whole way; and also to the eastward across the northern part of Simpson's Island.—*Quebec group, Lower Silurian.*

2. Michipicoten Island, Lake Superior ..... *Geological Survey.*

a. Nodules of native copper, from a bed.

b. Gangue, or rock of the bed.

c. Plan of the Quebec mine, by Mr. D. S. Cutting.

On the north side of Michipicoten Island, there is a considerable mass of greenstone, several bands of which are of an amygdaloidal character, and some of them are associated with beds of sandstone. Towards the west end of the island, these rocks present a low surface for about 400 or 500 feet, and then rise into a cliff of 200 or 300 feet. In the cliff, the greenstone is marked by crystals of analcime and quartz, occurring in druses. The whole mass lies conformably with the strata, dipping south-eastward. Native copper, associated with a little silver, is disseminated in several parts of the mass, and these more particularly characterise an amygdaloidal bed, two feet thick; which is underlaid by a band of sandstone and has been mined to a small extent by the Quebec Mining Company. In this bed, the copper is distributed in irregular nodular masses of various sizes, from grains no larger than snipe shot, to fantastic forms of five and six inches in diameter; the quantity of metal in the bed being, according to Mr. J. L. Willson, equal to about five per cent. Small nodules of calcspar occur with those of copper. About seven miles to the north-eastward, the bed is cut by a vein, in which copper and silver appear to be associated with ores of nickel, in the forms of a silicate of nickel, containing twenty-five per cent. of the metal, and of a mixture of the arseniurets of nickel and copper, containing between seventeen and thirty-seven per cent. of nickel. These ores were detected by Mr. Sterry Hunt in the refuse thrown aside in a crop trial made on the bed, by Mr. Bonner in 1854; and it is said that a considerable quantity of the silicate of nickel was thrown into the lake, after being stamped and washed, for the purpose of extracting from it the native silver.—*Quebec group, Lower Silurian.*

3. Mamainse, Lake Superior..... *Montreal Mining Co., Montreal.*

a. 450 lbs. of native copper in a single sheet, from a vein.

The promontory of Mamainse consists of various layers of coarse conglomerate, and of greenstone, much of which is of an amygdaloidal character. According to the description of Dr. Dawson, one of the bands of greenstone is intersected by a narrow fissure, running nearly in the strike of the beds, or north and south. Its greatest width is about six inches, and in some places, this is found to be nearly filled with native copper, of which the mass now exhibited is a specimen. An excavation on the vein, twenty-seven feet

deep, without galleries, yielded about three tons of the metal. Other veins intersect the same rock, and one of these, six inches in width, holds good bunches of the variegated sulphuret. In ancient shallow holes, sunk at intervals along the course of some of the veins of metallic copper, in this part, there are occasionally found the remains of Indian hammers, consisting of small boulders, usually of trap, having shallow grooves worked around them, to receive the withes or thongs attaching the handles; giving evidence of rude aboriginal attempts at mining, many centuries since.—*Quebec group, Lower Silurian.*

Smelted Copper.

1. Bruce Mines, Lake Huron.....*R. H. Fletcher.*

a. Two ingots of copper.

This copper is smelted at the Bruce mines, from the ore of the neighborhood, and from the native copper procured from the two feet bed at Michipicoten Island.

NICKEL.

Sulphuret of Nickel.

1. Orford, lot 6, range 12.....*Geological Survey.*

a. Specimens of the sulphuret of nickel, millerite.

Associated with a band of serpentine, which runs along the east side of Brompton Lake, in Orford, there is, on the lot indicated above, a pale green pyroxenic rock, in which occur druses, lined with large twin crystals of white pyroxene, and with cinnamon-colored garnets. Large masses of calcspar, probably filling a vein, are here met with, sometimes nearly pure white and cleavable, at others penetrated and filled with small emerald-green crystals of a chrome garnet. This mineral also forms granular masses, mixed with calcareous spar and pyroxene, and containing small quantities of the sulphuret of nickel, millerite. Some specimens of the rock have yielded to analyses as much as one per cent. of nickel. The ore does not appear to be confined to the portion of rock mixed with calcareous spar, but to penetrate into more homogeneous strata, probably pyroxenic, running with the serpentine; where, however, the quantity of the nickel seems to be less.—*Quebec group, Lower Silurian.*

SILVER.

Native Silver.

1. Prince's Location, Lake Superior.....*Geological Survey.*

a. Silver ore from a lode.

The rock of Prince's location is clay slate, interstratified with greenstone, and overlaid by a great mass of it with a columnar structure; the whole dipping south-eastward at a small angle. These rocks are transversely intersected by a vein, which is twenty feet thick on Spar Island, and from four to five feet on the main land, running N. W. It is composed of calcspar, heavy spar, and amethystine quartz; the latter appearing in druses in the calcspar. With these, are associated the yellow, variegated and vitreous sulphurets of copper in promising quantity, with iron pyrites, blende, galena, and silver; the latter occurring both native and as a sulphuret, in addition to cobalt and arsenic, as well as traces of gold. The location is the property of the British American Mining Company, and in a small trial shaft sunk by them to the depth of between six and seven fathoms, on the main land, where the lode is four feet wide, several hundred pounds of the vein, similar to the specimens exhibited, contained three and a half per cent. of silver.—*Quebec group Lower Silurian.*

GOLD.

Native Gold.

1. Fief St. Charles, Seigniory of Aubert de l'Isle..... *Geological Survey.*

a. Stream gold in nuggets, nine among them weighing from ten dwts. to 126 dwts.

b. Stream gold in dust.

It has long been ascertained that the drift clay and gravel of the south side of the St. Lawrence, in Canada, from Lake Champlain to the Etchemin, and probably to the extremity of the province, in Gaspé, is auriferous; the area being about 15,000 square miles. Gold has been washed from this gravel on the St. Francis in Melbourne, at Sherbrooke, in Westbury, Weedon and Dudswell, and on Lake St. Francis; as well as on the Chaudière and the Etchemin, and their tributaries, from the sources of these rivers nearly to their mouths. Various companies have made trials of this drift in several places, one of the most important having been on the Rivière des Plantes, in the seigniory of Vaudreuil (Beauce); but of this it is not easy to procure authentic details. In 1851, the Canada Gold Mining Company commenced a trial of the drift along the Rivière du Loup, near its junction with the Chaudière, in the seigniory of Aubert de l'Isle; which continued three years. The specimen exhibited is what was obtained by the workings of this Company in 1852, and the following are the results for the years 1851 and 1852:—

	Area. washed.	Gold collected.	Value.	Wages.	Profit.
	Sq. acres.	dwts. grs.	$	$	$
1851.....	½	2107·11	1826·46	1644·33	182·13
1852.....	½	2880·19	2496·69	1888·35	508·34
		4987·30	4323·15	3532·68	690·47

The chief part of the gold was obtained in the bed of the river, but some of it on the bank, and the average thickness of the drift was about two feet. The average daily wages were sixty cents a man. The system adopted for dressing was that used in Cornwall for obtaining tin from alluvial deposits.—*Drift.*

2. Seigniory of Vaudreuil, Beauce ..... *Geological Survey.*

a. Stream gold, a nugget of eighty dwts. with quartz.

In this specimen the proportion of the gold is sixty-four per cent. It was obtained from the drift of the Rivière des Plantes, a tributary of the Chaudière. Many of the small masses of gold which have been obtained from the drift of the Chaudière valley, being of a character somewhat similar, there cannot be much doubt that the drift gold of the region has been derived from quartz veins, situated probably somewhere not far distant. No quartz so rich in gold as the specimen, has as yet been met with in place in Canada, but the precious metal has been observed in small grains in a quartz vein of between two and three feet thick, which cuts bluish-black slate, and crosses the Chaudière at the St. Francis rapids, about half a mile from their foot, and about three quarters of a mile above St. Francis (Beauce) church.—*Drift.*

3. Rapids of the Chaudière, parish of St. François (Beauce):... *Geological Survey.*

a. Auriferous blende, galena, arsenical, magnetic and cubic iron pyrites, with quartz and bitter spar; from a vein.

This vein, as just mentioned, is between two and three feet thick, and consists principally of quartz, in which native gold has been observed; although none is visible to the eye in

the specimens exhibited. The quartz is associated with bitter spar; and in the gangue are disseminated small quantities of galena, blende, arsenical sulphuret of iron, often well crystallized; besides cubic and magnetic iron pyrites. In an analysis made by Mr. Sterry Hunt, in 1854, a portion of the galena separated by washing, but still containing a small mixture of the blende and pyrites, gave by assay of 500 grains, sixty-nine per cent. of lead, and thirty-two ounces of silver to the ton of ore. Another sample of 500 grains, more carefully dressed, gave thirty-seven ounces of silver to the ton. The silver contained a small quantity of gold. Another portion of 500 grains, of the sample which gave sixty-nine per cent. of lead, afforded by cupellation, a quantity of silver equal to not less than 256 ounces of silver to the ton. This amount of silver was probably owing to the accidental presence of a fragment of some rich silver ore. 1000 grains of the pyrites, mixed with a little blende, galena, and arsenical pyrites, gave by cupellation 0.15 grains of an alloy of gold and silver. 700 grains of the impure blende gave 0.19 grains of a yellow alloy of the same metals.—*Quebec group, Lower Silurian.*

4. Leeds, lot 15, range 14 ..... *Geological Survey.*

a. Grains of gold in bitter-spar.

On the property of Mr. Nuthrown, of which the mining rights have been purchased by the English & Canadian Mining Company, there occurs a vein cutting a bed of steatite. The vein is composed of a gangue of coarsely crystalline bitter spar, mixed with talc, copper-glance, and specular iron. There is disseminated, principally in the bitter spar, a small quantity of gold in grains, varying in size from mere points to the magnitude of pin heads. Sometimes the metal appears in laminæ in the bitter spar, having a diameter of about one eighth or one fourth of an inch. The vein, which is two feet thick, has been mined to a small extent for copper ore.—*Quebec group, Lower Silurian.*

PLATINUM AND IRIDOSMINE.

Native Platinum.

1. Fief St. Charles, Seigniory of Aubert de l'Isle..... *Geological Survey.*

a. Grains of platinum and of indosmine separated from gold dust.

Among the drift gold of the Chaudière there are met with, in very small quantities, grains of platinum, and of iridosmine; the latter being an alloy of the rare metals iridium and osmium, which is very hard, and is used for pointing gold pens. Some of the gold met with on the Chaudière has been found thinly coated with a mercurial amalgam; but no trace of cinnabar, the commonest form of the ores of mercury, has been observed in the drift. Among the substances met with by the Canada Gold Mining Company, in separating the gold from the drift, lead shot of various sizes, from partridge to swan shot, were nearly as abundant as the gold.—*Drift.*

2.

MINERALS APPLICABLE TO CHEMICAL MANUFACTURES.

Chromic Iron.

1. Mount Albert, Shickshock range, Gaspé..... *Geological Survey.*

   a. Specimens of chromic iron from the surface.

   Loose masses, traced for half a mile, running with the strike of the serpentine, of which the mountain is composed; the largest masses weighing about twenty pounds.—*Quebec group, Lower Silurian.*

2. Ham, lot 4, range 2 ..... *Geological Survey.*

   a. Specimen of chromic iron from a bed.

   A bed of about fourteen inches thick in serpentine. The bed has been partially worked by the proprietor, Mr. Leckie, of Acton Vale; who obtained about ten tons of ore, with forty-five per cent. of oxyd of chromium, from seven square fathoms in the plane of the bed. The ore forms a lenticular mass in the serpentine.—*Quebec group, Lower Silurian.*

3. Bolton, lot 23, range 6 ..... *Geological Survey.*

   a. Specimen of chromic iron from a bed.

   A bed of from twelve to twenty-four inches thick in serpentine, on the property of Mr. L. A. Perkins. The bed dips to the eastward, at an angle of about 80°, and the ore occurs in it in masses of from fifty to 1000 pounds in weight.—*Quebec group, Lower Silurian.*

4. Melbourne, lot 22, range 6 ..... *Benj. Walton, Montreal.*

   a. Specimen of chromic iron from a bed.

   A bed of uncertain thickness in serpentine, in which the ore runs in lenticular masses of from six to nine inches thick.—*Quebec group, Lower Silurian.*

Molybdenite or sulphuret of molybdenum.

1. Quetachoo River, Manicouagan Bay, N. shore Gulf of St. Lawrence..... *Geological Survey.*

   a. Specimens of molybdenite from a bed.

   A bed of six inches thick in gneiss, in which the sulphuret of molybdenum occurs in nodules of from one to three inches in diameter, and also in flakes from one-eighth to one-fourth of an inch thick, and twelve inches in diameter.—*Laurentian.*

Cobaltiferous iron pyrites.

1. Elizabethtown, near Brockville .....*A. S. Brown, Brockville.*

a. Specimens of pyrites from a bed.

A great irregular mass in gneiss, probably lenticular, running with the stratification. It has been excavated to a breadth of twenty feet, but its length and full thickness have not been ascertained. Assays of the ore have yielded one half of one per cent. of cobalt. This, according to the newest methods of extraction of McFarlane, Roscher and Dahll, would yield a profitable result. The ore is on the property of Mr. Billings.—*Laurentian.*

Dolomite.

1. Brome, lot 16, range 11.....*Geological Survey.*

a. Specimens of dolomite from a bed.

In the Eastern Townships a vast quantity of dolomite occurs. Stratigraphically, it is at the base of the Quebec group, where magnesian rocks of different descriptions are associated with the sulphurets of copper and other metals. The dolomite occurs in bands, which are from 100 to 300 feet thick. These run parallel to one another, on the opposite sides of synclinal and anticlinal forms, by which the bands are repeated in many places. The exposure in Brome, from which the specimen exhibited is taken, is on the east side of the Shipton and St. Armand anticlinal, and has been traced for many miles, running N. E. and S. W.—*Quebec group, Lower Silurian.*

Magnesite or carbonate of magnesia.

1. Sutton, lot 12, range 7 .....*Geological Survey.*

a. Specimens of magnesite from a bed.

2. Bolton, lot 17, range 9.....*Geological Survey.*

a. Specimen of magnesite from a bed.

One of the rocks associated with or replacing the dolomites of the Quebec group, is magnesite. It is of more rare occurrence than the dolomite. In Sutton, it occurs on the east side of the Shipton and St. Armand anticlinal, where it is often slaty, from a mixture of feldspar, with a mica colored green by chromium. The purest specimens contain eighty per cent. of carbonate of magnesia, with a portion of carbonate of iron. In Bolton, it occurs on the east side of the Melbourne and Potton anticlinal, where it forms an enormous bed, resembling a crystalline limestone. It contains, like the last, small portion of chromium and nickel, and consists of:

Carbonate of magnesia,.....	60
Carbonate of iron.....	9
Grains of quartz.....	31
	100

Though the use of this mineral as an economic source of pure magnesia and magnesian salts on a large scale, may be worthy of consideration, its most important application is probably for the fabrication of a cement to resist the action of sea-water.—*Quebec group, Lower Silurian.*

Petroleum or rock oil.

1. Enniskillen, lot 16, range 2..... *Canadian Oil Company, Hamilton.*

   a. Gum or mineral tar from the surface.

   b. Crude petroleum from a well.

   c. Refined or burning oil.

   d. Lubricating or machinery oil.

Natural springs of rock oil have long been known in several localities in Western Canada. Two of these are in the township of Enniskillen, in the southern part of which are two patches of an acre or more, covered with a layer of several inches of viscid mineral tar or asphaltum, which has resulted from the drying up of the petroleum of these springs. Wells sunk in their vicinity, to a depth of from forty to sixty feet, through the superficial clays, encounter a stratum of gravel, resting on the surface of the rock beneath, and often filled with oil; giving origin to what are called surface wells. On boring into the underlying soft fossiliferous shales and limestone, fissures are met with at various depths, from which rise abundant supplies of oil, often accompanied with inflammable gas, and with water, which is sometimes saline. These fissures, which also supply the surface wells, are apparently connected with the oil-bearing strata of the Corniferous limestone: which is from 200 to 300 feet below the surface, in Enniskillen. Within an area of about four square miles in the first three ranges of this township, there were supposed to be, in August, 1861, about seventy wells, yielding more or less oil. Of these, forty were surface wells, that is, wells sunk from forty to sixty feet, through the drift clay and gravel, to the rock beneath. Some of these latter, which had yielded but little oil, gave abundant supplies by boring into the rock. The oil-bearing fissures or veins, in adjacent wells, were met with at depths varying from thirty-six to 100 and even 150 feet from the surface of the rock. One of the most abundant occurred at sixty feet. In some few cases, the oil from the borings rises above the surface of the ground, constituting what are called flowing wells.

It is not easy to know the amount of oil which these wells are capable of supplying; since from the great difficulty in getting it to market, arising from the want of good roads, few of the wells are regularly and continuously pumped. Some of those which were bored in July and in August last, are stated upon good authority, to have yielded from 400 to 500 barrels of oil, in a week or two after having been opened; but the reservoirs provided, being filled with oil, the pumping of the wells was suspended. Two bored wells, belonging to Mr. Williams, which were the only ones continuously wrought in August last, are said to have yielded together, during some months, from twenty to twenty-five barrels (of forty gallons each,) daily. About six miles to the northward, on lots thirteen and fourteen, of ranges ten and eleven of the same township, sixteen wells had been sunk last August; of which twelve were surface wells, and had yielded large quantities of oil. Several of these had been wrought for nearly twelve months, and were supposed in that time to have yielded 1000 barrels. Other wells had recently been bored to a depth of nearly 200 feet, but yielded less oil than the surface wells. The wells of this region seem, thus far, to be less important than those in the southern part of the township. The oil from the deep or rock wells, is somewhat lighter and more fluid than that from the superficial wells, which is very dark colored and somewhat viscid.

Great expectations have recently been excited by a flowing well, known as Shaw's, which was sunk to a depth of about 200 feet, and when first opened, a few weeks since, was supposed to yield, for a short time, 2000 barrels of oil in twenty-four hours; which flowed into a stream near by and was lost. This well is however said to have been since closed, so that the discharge is under control. Another recent well, near by, known as Bradley's, nearly as abundant. The experience in Pennsylvania has however shown that the supply from these flowing wells soon diminishes, and eventually fails. Adjacent borings sometimes appear to be connected with the same oil-yielding fissure, and to affect each other's supply; in some cases air passes down one shaft when the other is pumped. — *Corniferous formation, Devonian.*

2. Tilsonburgh..... *Watkins and Inglis, Hamilton.*

a. Crude petroleum from a well.

Near the village of Tilsonburgh, in the township of Dereham, natural oil springs occur, and two wells have been bored in the Devonian limestone, which is here covered by about forty feet of clay and sand. One of these had been sunk thirty-six feet in the limestone, and had furnished, when seen in August, a few barrels of oil.

In the townships of Zone, Mosa, and Orford, on the banks of the Thames, oil springs abound for a distance of about four miles. These, like the other natural springs mentioned above, furnish but small quantities of oil; several wells have however been sunk in the clay, and the rock beneath has been drilled. One of these, at a depth of seventy feet in the clay, had yielded about forty barrels of oil.—*Corniferous formation, Devonian.*

3. Bertie, lot 13, range 1 ..... *Geological Survey.*

a. Specimen of limestone yielding petroleum.

In a quarry on the lot indicated, two oil-bearing beds, one of two and another of six inches, are seen; they are made up in great part of corals of the genera *Heliophyllum* and *Favosites*, in the pores of which the oil is lodged like honey in a comb. Other coral beds in the same series, however, are quite free from oil. The limestone beds above and below these are compact, and not at all impregnated with oil, which, even in the coral beds, is seen, when these are freshly broken, to be confined to the fossils, and not to be uniformly disseminated in the layer. When the rock is quarried, the oil flows out, and may be collected on the water in the bottom of the quarry. The facts observed with regard to the petroleum springs in Canada and the United States, would seem to show that they are always on the lines of anticlinals, along which the oil from its superior levity accumulates, and afterwards, by the pressure of water, is raised to the surface through the natural fissures which generally occur upon anticlinals. The oil-bearing limestone underlies an area of 7000 square miles in Western Canada. This limestone is of marine origin, and contains no organic remains but those of marine animals; so that we are led to conclude that these hydrocarbons have been derived from a peculiar decomposition of their tissues. These, as is well known, differ but little from those of the plants, which in many more recent formations have given rise to bitumens. We may suppose that many soft gelatinous animals, and perhaps even marine plants, whose traces have disappeared, may have contributed to form the petroleum of these coral beds.—*Corniferous formation, Devonian.*

Bituminous shale.

1. Collingwood, lot 23, range 3..... *Geological Survey.*

a. Shale from the bed.

b. Burning oil distilled from the shale.

c. Lubricating oil from "

The shale of Collingwood, on lot 23, range 3, yields, when distilled, from three to four per cent. of tarry oil, which by the usual process of rectification affords oils fitted for illumination and lubrication. Works were erected by Messrs. Pollard & Macdonell, in October, 1859, consisting of twenty-four retorts, and capable of yielding about 250 gallons of oil daily, by the distillation of from twenty to thirty tons of shale. The available bed of shale is seven feet in thickness, and the material was delivered, broken for the retorts, at twenty cents the ton. The cost of the crude oil was said to be fourteen cents the gallon, and for a while the works were carried on successfully, a ready market being found for the oils; but the works were repeatedly destroyed by fire, and the oils from this source coming in competition with petroleum from the oil wells of Enniskillen, the enterprise is for the present abandoned.—*Utica formation, Lower Silurian.*

Phosphate of lime (Apatite).

1. North Elmsley, lot 25, range 8.....*A. S. Brown, Brockville.*

a. Specimen of phosphate of lime from a bed.

This deposit has been traced across lots 24, 25, and 26, range 8 of North Elmsley, for a distance of about a mile, in a direction nearly S. W. It apparently forms an irregular bed in the Laurentian limestone. On lot 25, where it has been somewhat quarried, the breadth of the bed seems to be about ten feet, of which three feet are nearly pure crystalline apatite, with only a small admixture of black mica. The remainder is mingled with the limestone, the phosphate, however, in many parts largely predominating.—*Laurentian.*

2. South Burgess, lot 9, range 5..... *A. Cowan, Kingston.*

a. Specimen of phosphate of lime from a bed.

The deposit of phosphate of lime seen in North Elmsley, appears to be continued southwestwardly through Burgess. Indications of it occur on lot 2, range 7, and the quantity on lots 7, 8, 9, 10, range 5, still farther on, appears to be important.—*Laurentian.*

3.

REFRACTORY MINERALS.

Soapstone (steatite, compact talc).

1. Bolton, lot 24, range 4..... *Geological Survey.*

a. Cut specimens of soapstone.

2. Sutton, lot 12, range 7..... *Geological Survey.*

a. Cut specimens of soapstone.

Among the magnesian rocks at the base of the Quebec group, in that part of its distribution where it is in a metamorphic state, soapstone or steatite occurs in great abundance. Beds of it, varying in thickness from one to sixteen feet, can be traced for long distances, usually not far removed from serpentine, dolomite, or magnesite; or apparently replacing one or other of these rocks. In general the soapstone is remarkably pure, but occasionally there are disseminated in it crystals of bitter spar or of actinolite. The specimens exhibited from Sutton and Bolton are from equivalent bands of twenty and thirty feet respectively, on the opposite sides of Sutton Mountain. In the latter locality the soapstone is interstratified with potstone and dolomite, and in some parts of the band, the three rocks are seen to interlock among one another in lenticular masses. These two bands of soapstone appear to be on the opposite sides of a general synclinal form; yet Sutton Mountain between them, has an anticlinal structure, with a height stated to be four thousand feet.

This mountain occupies a breadth of ten miles at the province line, but gradually narrows, and completely dies down in a distance of thirty miles north-eastward. Its structure may be explained by stating that Sutton valley on the west, Sutton Mountain in the middle, and Potton valley on the east, run upon three anticlinal axes, which converge to the north-eastward, like the sticks of a fan; and while the rocks on the two outside anticlinals have been worn into valleys, those on the middle anticlinal have resisted denudation. Sutton Mountain is continued into Vermont, in Jay Mountain; which appears to stand on one of the main axes of the Green Mountain range.—*Quebec group, Lower Silurian.*

Potstone (compact chlorite).

1. Bolton, lot 26, range 2..... *Geological Survey.*

   a. Cut specimens of potstone.

A considerable portion of the rocks of the Quebec group, in their metamorphic condition, consists of chloritic slates; which appear to occupy a somewhat higher stratigraphical place than the more magnesian strata just mentioned, and usually to fill up the middle, and more elevated parts of the synclinal forms of the Quebec series, through the country. There occur also bands of pure compact chlorite or potstone interstratified with the more magnesian strata. Some of these are of considerable thickness, and the one in Bolton, from which the specimens are taken, has a width of about twenty feet.—*Quebec group, Lower Silurian.*

Mica rock.

1. Shipton, lot 18, range 5..... *Geological Survey.*

   a. Uncut specimens of mica rock.

In nearly the same stratigraphical place as the potstone, there occurs, in some localities, a compact, hydrous mica, which so much resembles potstone as to have been mistaken for it; and very probably it possesses the same refractory properties. Where the specimens were obtained, a breadth of five feet is exposed; the full thickness of the band, however, is supposed to be much greater.—*Quebec group, Lower Silurian.*

Mica.

1. Grenville, lot 9, range 6 ..... *Geological Survey.*

   a. Cut and dressed plates of mica.

2. Augmentation of Grenville ..... *Geological Survey.*

   a. Specimen of mica in crystals.

3. North Burgess, lot 17, range 9..... *A. Cowan, Kingston.*

   a. Cut and dressed plates of mica.

4. South Burgess, lot 1, range 4 ..... *A. Cowan, Kingston.*

   a. Uncut specimens of mica.

Magnesian mica or phlogopite occurs abundantly, in small scales, in the crystalline limestones of the Laurentian system, but sometimes also in crystals sufficiently large to be economically available. These are generally met with near bands of quartzite, or of pyroxenic gneiss, limiting the limestones, or near to some interstratified mass of a similar character, and they are usually associated with other minerals. Among these, in addition to quartz, pyroxene and feldspar, there occasionally occur tabular spar, apatite, sphene, iron pyrites, idocrase, garnet, tourmaline, zircon, and sometimes corundum. In Grenville, where the mineral is imbedded in massive pyroxene rock, close alongside of a band of crystalline limestone, crystals of mica have been obtained, giving sheets measuring twenty-four by fourteen inches. In North Burgess, where it has been mined by Mr. Cowan, on lot 17, range 9, the mica is imbedded in a soft pyroxenic rock, running apparently N. E. and S. W., and limited by a band of quartzite on the southward side. The mica here appears to run for seventy-five yards in pretty regular bands, and some of the sheets, after being dressed, are as much as twenty inches square; some have been obtained measuring twenty by thirty inches.—*Laurentian.*

Plumbago or black lead.

1. Pointe du Chêne Graphite Mine, County of Argenteuil... *Russell & Co., Kingston.*

   a. Specimen of plumbago from a bed.

2. Augmentation of Grenville, lot 3, range 6 ..... *Geological Survey.*

   a. Specimen of plumbago from a bed.

3. Lochaber..... *A. Cowan, Kingston.*

   a. Specimen of plumbago from a bed.

The crystalline limestones of the Laurentian system are very generally marked by the occurrence of graphite or plumbago, in small scales, which are often so thickly disseminated in particular bands of the rock, as to give them a black or dark grey color, distinctly marking its stratified character. It occurs also in beds, in sufficient purity and quantity to be economically available. The workable beds which have been observed, are chiefly in various townships on the north side of the Ottawa They occur in many localities, at considerable distances from one another, but several of the exposures are probably repetitions of the same bed, or, at any rate, of beds approximately equivalent, in repetitions of the same band of limestone. The whole Laurentian series is so corrugated, that the outcrop of one of these bands of limestone, in the counties of Argenteuil and Two Mountains, followed through all its windings, in an area of fifty miles northward by twenty miles eastward, measures upwards of 200 miles. A bed of pure graphite occurs in the Augmentation of Grenville, and has been traced at intervals, for a distance of about three miles, running a little east of north. One of the exposures, occurring on lot 3, range 2, has been mined, to a small extent, by Messrs. Russell & Co. At the opening of the excavation, it showed a thickness of about ten inches, but the pure graphite was found to form a lenticular mass, which appeared to be separated from other masses of the same character by intervals, in which the graphite became intermixed with the limestone. It is probable that a number of these, running through the rock at the same horizon, may represent the general character of the workable beds. On lot 3, range 6, the bed becomes three feet thick, but here the quality is impaired by the presence of foreign earthy matters, which, however, can scarcely be detected by the eye.—*Laurentian.*

Asbestus.

1. St. Joseph seigniory ..... *Geological Survey.*

a. Specimen of asbestus from a vein.

Asbestus, generally a fibrous serpentine or chrysotile, occurs in veins cutting the serpentine of the Eastern Townships.—*Quebec group, Lower Silurian.*

Friable Sandstone.

1. Pittsburgh, lot 20, range 1. ..... *A. Cowan, Kingston.*

a. Specimen of sandstone as sent to foundries.

This crumbling sandstone occurs in a bed upwards of twenty feet thick, and is in much demand for iron foundries, being used to protect the sides and bottoms of the furnaces. It is supplied to the founders of Montreal at $3, and to those of Toronto at $2.60 per ton, after being carried about 170 miles, in opposite directions, to these places. About 1500 tons are consumed in the foundries of these two cities.—*Potsdam formation, Lower Silurian.*

Fire-Clay.

1. Dundas ..... *Geological Survey.*

a. Specimen of fire-clay.

This clay is derived from an argillaceous band twenty feet in thickness, near the base of the Clinton formation. The rain washes the clay from the bank, and deposits it in the bottom of pools at its foot. When the water dries up in these, the clay is dug from them, and is used in the iron foundries at Dundas and at Hamilton. From the neighborhood of Dundas, the Clinton formation strikes south-westward, and after folding over an anticlinal axis, which runs southward of west from the extremity of Lake Ontario, it returns on the south side of Lake Ontario, towards the Niagara River. The same clay band is thus again met with in the escarpment near the village of Ancaster. The clay has only lately come into use, and not much is yet known regarding its merits, but it is said to answer a good purpose, and in Mr. Gartshore's foundry, at Dundas, has entirely superseded the fire-clay formerly imported from the United States.—*Clinton formation, Middle Silurian.*

2. St. Foy, near Quebec. ..... *Michael Finley, Quebec.*

a. Specimen of clay.

b. Piece of pottery made from the clay.

This clay, which is represented by the contributor to be of a refractory nature, forms a considerable deposit at Belmont, the property of Mr. J. W. Dunscomb.—*Drift.*

4.

MINERALS APPLICABLE TO COMMON AND DECORATIVE CONSTRUCTION.

BUILDING STONES.

Limestones.

1. Arnprior, MacNab, lot 4, range C..... *Geological Survey.*

   a. A foot cube of limestone, dressed.

   This building stone is derived from one of the bands of crystalline limestone of the Laurentian series. It occurs on the property of Mr. McLaren, close upon the margin of the Lac des Chats, one of the expansions of the Ottawa; where a great supply of the rock might be obtained. It has been used by the Board of Works in the construction of a bridge over the river Madawaska, the mouth of which is near to this limestone.—*Laurentian.*

2. Phillipsburg, St. Armand ..... *C. R. Cheeseman, Phillipsburg.*

   a. A foot cube of limestone, dressed.

   The exposure of limestone from which this stone is derived, occurs within a mile of Phillipsburg, Missisquoi Bay, on the land of the exhibitor, near the line of a proposed railway. The rock is compact and crystalline, dresses easily, and appears to have considerable strength. A few obscure fossils are met with in the rock, belonging to the genera *Pleurotomaria* and *Holopea*. Higher in the series, the organic remains are more distinct, and shew the formation to be equivalent to the Calciferous.—*Quebec group, Lower Silurian.*

3. Caughnawaga..... *Geological Survey.*

   a. A foot cube of limestone, dressed.

4. St. Dominique ..... *Geological Survey.*

   a. A foot cube of limestone, dressed.

5. East Hawkesbury..... *Geological Survey.*

   a. A foot cube of limestone, dressed.

   The specimens of building stone from Caughnawaga, St. Dominique, and East Hawkesbury, 3–5, are all from one geological formation, the Chazy; which in the area indicated by the distribution of the places named, is composed of massive beds, yielding blocks of stone fitted for the purposes of canal locks and railroad bridges. The quarries of Caughnawaga have supplied a large amount of material for the upper locks of the Lachine Canal, and those of the Beauharnois Canal. That of Hawkesbury, as well as a quarry on the same formation on Isle Bizard, has furnished blocks for the Carillon Canal. The same formation, near Montreal, and on Isle Jesus, near Terrebonne, has been resorted to for similar blocks for the lower locks of the Lachine Canal. In all the places named, the beds abound

in the remains of encrinites and cystidians, and the peculiar crystallization of these, give to the rock a crystalline texture, which constitutes one of its valuable characters. There is occasionally some admixture of magnesia in the stone, and after long exposure to the atmosphere it assumes a yellowish tinge. The St. Dominique stone is more compact than that of Caughnawaga, and has been used for the purposes of the St. Lawrence and Atlantic Railway.—*Chazy formation, Lower Silurian.*

6. Pointe Claire..... *Geological Survey.*

a. A foot cube of limestone, dressed.

7. Cornwall..... *Geological Survey.*

a. A foot cube of limestone, dressed.

The stone of Pointe Claire and Cornwall, 6—7, belongs to the formation next above the Chazy. It is black, compact, and thick bedded. At Mille Roches, near Cornwall, it has supplied stone for the construction of the locks of the Cornwall Canal, and at Pointe Claire, has furnished the stone used in building the piers of the western half of Victoria Bridge, while that used for the other half was brought from what is said to be the same formation, at Isle la Motte in Lake Champlain. On the north side of the Pointe Claire quarry, there is a vertical exposure of thirty feet of massive strata, varying in thickness from one to three feet, the blocks obtained from which, for the bridge, ranged from four to seven tons.—*Birdseye and Black River formation, Lower Silurian.*

8. Montreal..... *Geological Survey.*

a. A foot cube of limestone, dressed.

9. Chevrotière..... *Geological Survey.*

a. A foot cube of limestone, dressed.

The Trenton formation, which is the next in succession above the Birdseye and Black River, yields excellent building stone at Montreal, at Chevrotière, nearly forty miles above Quebec, and at many intermediate places. The best stone at Montreal is derived from a ten feet band of grey bituminous granular limestone, in beds of from three to eighteen inches thick at the bottom, passing at the top, into a black nodular bituminous limestone; which is interstratified with black bituminous shale, in irregular layers of from one to three inches. This grey limestone, which is near the base of the formation, is a mass of comminuted organic remains, which consist largely of the ruins of crinoids and cystideans. The crystallization of these fossils gives a crystalline character to the rock. A considerable number of quarries are worked upon this band of grey limestone, there being four principal ones near Montreal, and the best houses of the city are built of the stone. The quantity of stone annually quarried in the immediate vicinity of Montreal is computed to be:—

313,200 cubic feet of cut stone,.....	28,600 tons.
5,252 toises of rubble,.....	63,024 "
	91,624 "

The prices of good stone in Montreal are:—

Ashlar stone, undressed,.....	$0.13½ per square foot.
Ashlar stone, dressed,.....	0.30 " "
Mouldings, from $0.16⅔ to $3.00, or for a fair moulding,	$1.50 per linear foot.
Fluted columns 18 inches diameter,.....for the stone,	$1.00 per rising foot.
" " " .....for cutting,	$2.50 " "
Heavy rough stone, from 6 to 30 cubic feet, from.....	$0.30 to 0.50 per cubic foot.
Very heavy rough stone, say 60 cubic feet,.....	$1.00 " "

The strata in the neighborhood of the city are much traversed by trap dykes, which probably have a connection with an intrusive mass extending over 700 acres, and constituting Mount Royal, from which the city and island take their name. Some of the quarries display a number of these trap dykes, which run in several directions and intersect one another. In some instances, the limestone, having been removed from among them, the dykes are left standing up several feet above the bottom of the quarries, representing in a marked manner the various details of the cracks they once filled.

In the seigniory of La Chevrotière, a very excellent limestone for building is obtained between three and four miles back from the St. Lawrence. It usually goes, however, under the name of the Deschambault stone, in consequence of its being put on board of boats at this place. The stone is of a yellower or warmer grey than the Montreal stone; it is more even in its tint, and becomes somewhat less discolored by weathering. It is more granular and more easily cut, being softer and tougher, but it does not take so fine nor so sharp an edge, nor does it *pick* so well. Three beds of pretty uniform character are worked; the top and bottom ones are eighteen inches thick each, and the middle one three feet. There is said to be a fourth bed beneath, with a thickness of four feet, which has not been quarried. The strata are so nearly horizontal, that it is difficult to determine their dip; it is therefore probable that the stone will spread to a considerable extent in the vicinity. Along the concession line, it is known for twenty-six acres to the S. W., and five acres to the N.E., and on the road across the concession, it is visible for a breadth of ten acres; beyond which, in sinking wells to a depth of twenty feet in blue clay, no rock is met with. The produce of the quarries of La Chevrotière has a deserved celebrity in Quebec, where it has been used in the construction of churches and other buildings.—*Trenton formation, Lower Silurian.*

Dolomites or Magnesian limestone.

1. Owen Sound..... *Geological Survey.*

a. A foot cube of dolomite, dressed.

This beautiful and enduring stone can be obtained in unlimited quantities, the formation from which it is derived being here 150 feet in thickness, and divided into beds varying from a few inches to six feet. This stone possesses the very great advantage of being free from any substance producing stains. Its color rather improves with the weather, and the beauty of no building erected of it appears, as yet, to be marred by the growth of lichens. It is especially adapted for heavy masonry, and blocks of any required size can be obtained. The quarries are about half a mile from the harbor.—*Niagara formation, Middle Silurian.*

2. Noisy River Falls, Nottawasaga, lot 3, range 11 ..... *Geological Survey.*

a. A foot cube of dolomite, dressed.

This stone is from the lower part of the Niagara formation, and is rather more compact than the Owen Sound specimen. The cliff is here about fifty feet high, and might be quarried with the greatest facility. Few of the beds are less than two feet in thickness, and some of them are about five feet, but the locality is not near to any navigable water or railway.—*Niagara formation, Middle Silurian.*

3. Rockwood, Eramosa, lot 5, range 4..... *Geological Survey.*

a. A foot cube of dolomite, dressed.

This specimen is also from the Niagara formation, which is here more than 100 feet thick. The greater part of it consists of thick-bedded light grey porous crystalline dolomite. The beds vary from a few inches to ten feet in thickness; about thirty feet of it is almost white. Buildings of cut stone obtained from this band, are observed to improve in color after exposure, and at a short distance, have a silvery white appearance. The piers of the long railway viaduct over the valley of the Eramosa, at Rockwood, are built of stone from this formation, and have a very substantial appearance. The axis of an east and west anticlinal, runs under Rockwood, carrying a spur of the Niagara formation several miles to the eastward of the general trend of the outcrop. A north and south anticlinal passes under the same place; being one of a series which produces southward indentations in the outcrops of the palæozoic strata all the way from Kingston to the main body of Lake Huron. —*Niagara formation, Middle Silurian.*

4. Guelph, lot 20, range D..... *Geological Survey.*

a. A foot cube of dolomite, dressed.

This stone is from the immediate vicinity of the thriving town of Guelph. The quarries expose fifteen feet of strata similar to the specimen. The thickest bed is four feet, and the thinnest about three inches. The stone is a light grey crystalline dolomite, like the last, somewhat cellular, but strongly coherent. It is easily worked, is suitable for the best architectural purposes, and appears to be of a durable character. The Guelph formation extends over a large area, and much of it is of the same character as the specimen.—*Guelph formation, Middle Silurian.*

5. Oxbow, Saugeen River, Brant, lot 2, range 8..... *Geological Survey.*

a. A foot cube of dolomite, dressed.

b. Journal bearer, from a lower bed of the same rock.

The beds from which the block *a* is obtained, are near the summit of the Onondaga formation, and yield probably the best dolomite for fine architectural purposes, which has yet been discovered in the country. It resembles the Caen stone in the facility with which it can be worked, but it is closer grained, and by no means so absorbent, and is thus better adapted for withstanding the Canadian climate. Two bands, of about ten feet each, occur here, in the upper part of the Onondaga formation. The higher one is exposed at the surface, in a position offering every facility for quarrying it. The bed from which the specimen was procured, is two feet thick, free from stains, and splits with great precision with the plug and feather. The whole upper band is composed of thick beds of the same character; the thickest one in the lower band measures over three feet. The locality is near a projected line of railway, and is twenty-two miles from Southampton Harbor by the present road. It overlooks the Saugeen River, down which large scows can be floated to Southampton.

The specimen *b* is from a very light grey oolitic bed, seventeen inches thick, immediately beneath the previous bed. It has been used for supporting water wheels, in mills in the neighborhood, and found to answer well, becoming highly polished under the action of a revolving shaft.—*Onondaga formation, Upper Silurian.*

Sandstones.

1. Lyn, Elizabethtown, lot 26, range 2 ..... *Geological Survey.*

   a. A foot cube of sandstone, dressed.

2. Nepean, lots 27, 28, 29, ranges 5, 6..... *Geological Survey.*

   a. A foot cube of sandstone, dressed.

3. Augmentation of Grenville ..... *Geological Survey.*

   a. A foot cube of sandstone, dressed.

4. Quin's Point, Seigniory of La Petite Nation ..... *Geological Survey.*

   a. A foot cube of sandstone, dressed.

   These specimens, 1-4, are derived from the Potsdam sandstone, which constitutes the summit of the lowest group of fossiliferous rocks of Canada. A quarry has been opened on the outcrop of the rock, at Lyn, by Mr. B. C. Brown, and the stone from this, and from a quarry on the property of Mr. Keefer, at Nepean, in the same formation, has been used in the construction of the new Parliament buildings at Ottawa. At Lyn, the beds of sandstone are massive, and are seen resting on the Laurentian gneiss.—*Potsdam group, Lower Silurian.*

5. Pembroke..... *Geological Survey.*

   a. A foot cube of sandstone, dressed.

   This fine freestone is much exposed in the vicinity of the Allumette rapids, near Pembroke. A quarry has been opened on it, on the land of Mr. Peter White, where it occurs in beds varying in thickness from six to eighteen inches. It is easily wrought and carved, and although soft, is tough, and retains sharp angles and corners.—*Chazy formation, Lower Silurian.*

6. Hamilton, Barton..... *Geological Survey.*

   a. A foot cube of sandstone, dressed.

   This fine grained compact greenish-gray sandstone is from a deposit of about ten feet in thickness. Some of the beds are thick, but others are thin enough for flagstones; the stone is free from iron stains, but subject to a growth of lichens in shaded and moist situations.—*Grey band, Medina formation, Middle Silurian.*

7. Georgetown, Esquesing, lot 22, range 7 ..... *Geological Survey.*

   a. A foot cube of sandstone, dressed.

   This is from a bed of light grey freestone, which belongs to a band of about twenty feet in thickness. The beds are mostly thick, fine grained and compact; some split into good flagstones; but all are rather hard for grindstones. It has been used in constructing culverts on the Grand Trunk Railway, and numerous buildings in Toronto, among which are the University and other important structures, and it appears to answer well.—*Grey band, Medina formation, Middle Silurian.*

8. Nottawasaga, lot 2, range 6..... *Geological Survey.*

a. A foot cube of sandstone, dressed.

b. A foot square of do., pierced for a stove pipe.

These specimens are from a band of fine grained soft light grey freestone, supposed to be twenty feet thick. The beds are from two inches to three feet in thickness; some of them *ready*, or marked by lines of stratification. The stone yields good grindstones, but has not yet been much used for building purposes, although from the specimen *a*, it would appear to be well suited for such. From the facility with which parallel-faced blocks of the required thickness can be obtained, this stone is well adapted for stove-pipe holes, for which it is much used.—*Grey band, Medina formation, Middle Silurian.*

9. North Cayuga, lot 48, range 1..... *Geological Survey.*

a. A foot cube of sandstone, dressed.

A band of white sandstone runs through Haldimand County in Western Canada, and is largely developed on the Oneida and North Cayuga town-line, north of the Talbot road. Its beds are massive, ranging in thickness from one to three feet, and when fine grained, it is well adapted for building purposes. A quarry has been opened in it, on the land of Mr. William DeCew, from whom this specimen of building stone was obtained.—*Oriskany formation, Devonian.*

Labradorite.

1. Abercrombie..... *Geological Survey.*

a. A foot cube of labradorite rock, dressed.

The opalescent variety of labradorite occurs in cleavable masses in a fine grained base of the same mineral character, which forms mountain masses. Where these are thickly disseminated in the paste, the stone becomes a beautiful decorative material, applicable to architectural embellishment, and to articles of furniture. Its hardness is about that of ordinary feldspar, and it would, in consequence, be more expensive to cut and polish than serpentine or marble, but it is not so readily scratched or broken, and would therefore be much more lasting. Professor Emmons states that a block of the stone submitted to the action of a common saw, such as is used in sawing marble, moved by the waste power of a common water-mill, was cut to the depth of two inch $\frac{1}{10}$in a day. This is understood to be one-fifth the amount that would be cut in a block of good marble, in the same time, by the same means. It would thus appear that though the operation is slower in the case of labradorite, there is no greater amount of mechanical contrivance required than for marble, and that slabs could be prepared for chimney pieces, for pier tables, and other articles of furniture, at a cost beyond that of marble, not greater than is proportionate to the superior beauty and durability of the material.—*Laurentian.*

Gneiss.

1. St. Charles Reservoir, Jeune Lorette ..... *H. O'Donnell, C.E., Quebec.*

a. A foot cube of gneiss, dressed.

This stone has been used for building the dam and reservoir of the Quebec water-works, on the St. Charles river. The gneiss, which is obtained a short distance above the reservoir, is hornblendic, being composed of translucent, colorless quartz, white orthoclase, (the

feldspar predominating over the quartz) and black hornblende, all running in irregular parallel planes, showing the gneissoid structure very distinctly, and having at a little distance, a general grey color. The rock may be split in almost any direction by means of wedges, but most easily in that of the gneissoid layers, particularly when these are even. The layers are occasionally affected by undulations and contortions, but these do not materially affect its dividing by means of wedges. The rock splits and dresses with most difficulty at right angles to the gneissoid layers, but is capable of receiving fine smooth faces, with sharp edges and corners. Masses of almost any size can be blasted out from the rock, and large blocks have been dressed and applied to the masonry work of the reservoir, which will no doubt prove a structure of the most lasting character.—*Laurentian.*

2. Grenville ..... *Geological Survey.*

a. A foot cube of gneiss, dressed.

The porphyroid orthoclase gneiss, which this specimen represents, forms great mountain ranges among the Laurentian rocks, rising into the highest peaks of the orthoclase region, and generally constituting the main body of rock, which separates the great limestone bands from one another. These masses of gneiss appear sometimes to attain several thousand feet in thickness, but are divided at unequal intervals, by thinner and less feldspathic bands, in which the stratification is more distinct.—*Laurentian.*

Syenite.

1. Grenville ..... *Geological Survey.*

a. A foot cube of syenite, dressed.

2. Grenville ..... *Geological Survey.*

a. A foot cube of syenite, dressed.

3. Barrow Island, River St. Lawrence, opposite Gananoque..... *Geological Survey.*

a. A foot cube of syenite, dressed.

The intrusive masses of the Laurentian series consist chiefly of syenite and dolerite. These rocks occur in many parts of the country, but their relative ages have been ascertained principally by the investigation in the counties of Ottawa and Argenteuil. What appear to be the oldest intrusive rocks are dykes of a rather fine grained dark greenish-grey greenstone or dolerite, varying in thickness from a few feet to a hundred yards. Their general bearing appears to be E. and W. These greenstone dykes are interrupted by an intrusive syenite, a mass of which occupies an area of about thirty-six square miles in the townships of Grenville, Chatham, and Wentworth. The specimens 1, 2, are derived from it, and 3 is from an area of a similar character, occurring between Kingston and Gananoque. In Grenville, the syenite is penetrated by dykes of what has been called felsite-porphyry, hornstone-porphyry, or orthophyre, having for its base an intimate mixture of orthoclase and quartz, colored by oxyd of iron, and varying in color from green to various shades of black. Throughout the paste, which is homogeneous and conchoidal in its fracture, are disseminated well defined crystals of a rose-red or flesh-red feldspar, apparently

orthoclase, and, although less frequently, small grains of nearly colorless quartz. All of these intrusive masses are cut by another set of dolerite dykes, which probably belong to the Silurian, or perhaps to the Devonian period.—*Laurentian.*

Granite.

1. St. Joseph, Beauce..... *Geological Survey.*

a. A foot cube of granite, dressed.

This band of granite, which has a considerable proportion of quartz, has been used in the seigniory of St. Joseph for millstones, and would yield a strong and durable building stone, is about fifty or sixty feet thick. It runs with the stratification, near to a band of serpentine, and is supposed to be an altered sandstone, and not an intrusive rock.—*Quebec group, Lower Silurian.*

2. Barnston..... *Geological Survey.*

a. A foot cube of granite, dressed.

An intrusive granite of Devonian age occurs in considerable abundance in the Eastern Townships, and forms many isolated hills, the whole of them of small size, with the exception of Great Megantic Mountain, which occupies an area of about twelve square miles. The rock splits well with plug and feather, and can be obtained in blocks of almost any required size. It forms a handsome building stone, and has been used for bridges on the St. Lawrence and Atlantic Railway. It is composed of white quartz and white orthoclase feldspar, with black mica. An area of this rock occurs in Stanstead, covering six square miles, and there is another in Barnston, from which the specimen now exhibited was obtained. Granite of the same character, and probably of the same age, is widely distributed in the State of Maine, and is traceable to New Brunswick, where it is overlaid by the Carboniferous rocks.—*Devonian.*

MARBLES.

Limestones.

1. Arnprior..... *Geological Survey.*

a. Striped light and dark grey marble, large pattern.
b. " " " " small pattern.
c. " " " " cut across the beds.

At the mouth of the Madawaska, in McNab, a great extent of crystalline limestone is marked by grey bands, sometimes narrower, and sometimes wider, running in the direction of the original bedding, and producing, where there are no corrugations in the layers, a regularly barred or striped pattern. When the beds are wrinkled, there results a pattern something like that of a curly grained wood. The colors are various shades of dark and light grey, intermingled with white. These arise from a greater or less amount of graphite, which is intimately mixed with the limestone. The granular texture of the stone is somewhat coarse, but it takes a good polish, and gives a pleasing marble. Mr. W. Knowles has opened a quarry in limestone of this description at Arnprior, and erected a mill for the purpose of sawing and polishing it for chimney pieces, monuments, and other objects. A monument of it has been erected in the Mount Royal cemetery.—*Laurentian.*

2. Elzivir..... *Geological Survey.*

a. White marble.

3. Grenville..... *Geological Survey.*

a. Yellowish-white marble.

4. Augmentation of Grenville..... *Geological Survey.*

a. Spotted green and white marble.

In the township of Grenville and its Augmentation, a band of crystalline limestone, which has an extensive run through the country, presents, in many places, a peculiar variety of marble, having a white ground marked with a number of small green spots, arising from the presence of serpentine; which occasionally forms angular masses several inches in diameter. This disseminated serpentine, more or less aggregated, usually runs in bands parallel with the beds, and clearly marks the stratified character of the rock. These bands, as in the case of the Arnprior marble, are sometimes even, and at other times corrugated, giving diversities of pattern in cutting. Sometimes the serpentine, instead of green, is sulphur-yellow, as in the specimen from Grenville. In many parts of the country, the Laurentian limestones are free from foreign minerals, and give white marbles. These, however, are usually too coarse grained for statuary purposes, and sometimes they are barred with slight differences of color. The specimen from Elzivir, obtained from Mr. Billa Flint, of Belleville, is an instance of this. Many years ago, a mill for cutting and polishing a marble like the specimen from the Augmentation of Grenville, was erected on the Calumet, lot 19, range 3, of Grenville, where a similar rock occurs; but the demand for the marble was not sufficient to make the enterprise profitable. —*Laurentian.*

5. St. Armand..... *C. R. Cheeseman, Phillipsburg.*

a. White marble.
b. White "
c. White " clouded with pale green.
d. Dove-grey marble, marked with white.

The marbles, of which Mr. Cheeseman exhibits specimens, occur in great abundance in the immediate vicinity of Phillipsburg, on Lake Champlain. They are all easily cut, and take a good polish. Should a railway, which is projected between St. Johns and St. Albans, be carried into operation, it is probable there would be some demand for the stone. No quarries have been opened on any of the beds, and these specimens are taken from surfaces that have long been exposed to the influence of the weather.—*Quebec group, Lower Silurian.*

6. St. Armand..... *Geological Survey.*

a. Black marble.

About a mile and a half south-eastward from Phillipsburg, there occurs a black marble, similar to this specimen. The beds dip to the eastward at an angle of about twelve degrees; a quarry was many years ago opened on one of them, which has a considerable thickness. The stone was exported to the United States, and much esteemed in New York, but the opening of quarries of black marble at Glen's Falls, where there is a great water-power, interfered with the demand, and caused the enterprise to be abandoned.—*Quebec group, Lower Silurian.*

7. St. Joseph, Beauce ..... *Geological Survey.*

a. Red marble, veined with white.

This red marble occurs near the river Guillaume, associated with red shales and sandstones, resembling those of Sillery, near Quebec. The red limestone is succeeded by a band of a peculiar argillaceous rock resembling the *gabro rossi* of the Italians.—*Quebec group, Lower Silurian.*

8. Caughnawaga..... *Geological Survey.*

a. Grey marble.

b. Grey " with red spots.

Similar grey marbles, with red spots, occur in the same formation as the rock of Caughnawaga, behind the city of Montreal, and on Isle Bizard; while beds in the same formation, at St. Lin, in the county of L'Assomption, are wholly red. In all of these localities the rock is filled with fossils, which are plainly seen on the polished surfaces.—*Chazy formation, Lower Silurian.*

9. St. Dominique ..... *Geological Survey.*

a. Dove-grey marble.

The marble of St. Dominique is easily cut, and takes a good polish. It is surprising that situated so near to Montreal, with a railway running near, it has not been applied to various purposes in the city, for which a stone not so good, is at present used.—*Chazy formation, Lower Silurian.*

10. L'Orignal..... *Geological Survey.*

a. Grey marble, with thickly disseminated white spots.

b. Dark grey marble, with more thinly disseminated white spots.

The bed from which the specimen (*a*) is taken, varies in thickness from three to six inches; it is near the surface, and easily quarried, but it has hitherto been but little used. The locality is a quarter of a mile from the S. bank of the Ottawa, four miles west of L'Orignal village, and sixty-four above Montreal. The white spots are caused by small bivalve shells (*Atrypa plena,*) filled with calcspar. Of the darker variety (*b*) there are two beds, of six inches and one foot respectively, near the surface, and overlying the previous bed (*a*). Blocks large enough for chimney-pieces and tables are readily obtained.

11. Esquimaux Island, Mingan group ..... *Geological Survey.*

a. Drab marble.

This drab colored marble occurs in great quantity on Esquimaux Island, of the Mingan group, where the stone might be easily loaded on board of small vessels. It cuts with great facility, and takes a uniform polish.—*Chazy formation, Lower Silurian.*

12. Pointe Claire ..... *Geological Survey.*

a. Brownish black marble.

b. Greenish black "

13. Cornwall ..... *Geological Survey.*

a. Black marble.

These black marbles, from Pointe Claire and Cornwall, are derived from two beds, each about two feet thick, at the base of the Birdseye and Black River formation. These are apparently the only beds of the formation that will take a sufficiently even polish to be fit for the purpose. In the higher beds there are patches, which, from being more argillaceous than other parts, receive but an inferior polish, and produce a bad effect.—*Birdseye and Black River formation, Lower Silurian.*

14. Pakenham ..... *Geological Survey.*

a. Brown marble.

The Birdseye and Black River formation at Pakenham, on the Mississippi, a tributary of the Ottawa, yields a very peculiar dark smoke-brown or snuff-brown marble. The stone takes a good polish; but small pieces of chert are sometimes met with, which renders it necessary to be careful in selecting slabs to be wrought. Mr. Dickson, of Pakenham, on whose property the bed occurs, and from whom the specimen exhibited was obtained, had at one time fitted up an apparatus, driven by the waste power of his saw-mill, to polish slabs for chimney-pieces and other uses. But there was, at that time, no consumption for the material in the neighborhood, and no railway for carriage to a distance, and the marble works were abandoned.—*Birdseye and Black River formation, Lower Silurian.*

15. Gloucester ..... *Geological Survey.*

a. Brownish-grey marble.

16. Montreal ..... *Geological Survey.*

a. Grey marble from the Trenton formation.
b. Grey " from the Chazy formation.

The Montreal marble is derived from a bed in the Trenton, and another in the Chazy formation. Slabs for chimney-pieces and table-tops are sawn and polished by Mr. Hammond, and used for common purposes.— *Trenton and Chazy formations, Lower Silurian.*

17. Dudswell, lot 22, range 7 ..... *Geological Survey.*

a. Cream-white marble, striped with yellow.
b. Dark grey and yellowish marble.
c. Fawn-yellow and white "

Were the limestones of Dudswell worked, it is probable good marble might be obtained from them. The specimens exhibited, of cream-white and yellow, and dark grey and yellow, are from beds that overlie one another. The yellow streaks in both of these marbles are composed of dolomite, while the light ground of the one, and the dark ground of the other, are of carbonate of lime. When the dark grey approaches black, which it sometimes does, and the yellow streaks are narrow, the marble bears a strong resemblance to the Portor marble from Northern Italy, sometimes known as *black and gold.* On analysis, the resemblance between the two is farther sustained by the fact, that in both cases the ground is a pure limestone, and the yellow veins are dolomite. It is not unlikely, that if the rock were extensively quarried, some beds might be found in which the resemblance to the Portor would be closer than in the specimens exhibited.—*Upper Helderberg formation? Devonian.*

Serpentines.

1. Orford, lot 6, range 13 ..... *Geological Survey.*

   a. Brecciated, dark green serpentine.
   b. " light green "

2. Orford, lot 12, range 8..... *Geological Survey.*

   a. Dark green serpentine, striped with light green.

3. Melbourne, lot 22, range 6 ..... *Benj. Walton, Montreal.*

   a. Green and white serpentine.
   b. Dark and light green "

4. Melbourne, lot 20, range 5..... *Geological Survey.*

   a. Brecciated green serpentine.

5. St. Joseph, Beauce ..... *Geological Survey.*

   a. Brecciated green serpentine, veined with white.

The band of serpentine, from different places on which, these specimens have been obtained, has been traced on the south side of the St. Lawrence, from Potton to Cranbourne, a distance of 140 miles; in forty miles of which, it is repeated twice by undulations, giving an additional eighty miles to its outcrop. It is again recognized 250 miles farther to the N.E., in Mount Albert, in the Shickshock Mountains; and about seventy miles beyond this, in Mount Serpentine, approaching Gaspé Bay. All the specimens of these rocks, which have been analysed, contain small quantities of chromium and nickel, and the band is associated in its distribution with soapstone, potstone, dolomite and magnesite. The whole of these occur in large quantities, and in them, as well as in the serpentine, chromic iron occurs, sometimes in workable quantities. These rocks, or others immediately near them, contain the metals iron, lead, zinc, copper, nickel, silver and gold; with the drift gold, derived from these strata, are found platinum, iridosmine, and traces of mercury. In 1847, these serpentines, from their distribution, were described in the reports of the Geological Survey as an altered sedimentary rock. All subsequent observations have confirmed this, and beautifully stratified masses of it have at length been discovered in Mount Albert.—*Quebec group, Lower Silurian.*

None of the serpentines, and, with the few trifling exceptions that have been mentioned, none of the marbles of Canada, have yet been quarried for economic purposes. All of the specimens of them exhibited by the Geological Survey, are consequently from parts of the strata that have long been exposed to the influence of weather, and are of course inferior to the unweathered portions beneath. There appears little doubt that, in time, both the limestones and serpentines will afford a great amount of beautiful material for architectural purposes, and support a great amount of industry.

SLATES, FLAGSTONES, LIME, BRICKS, AND DRAIN TILES.

Roofing Slates.

1. Walton Quarry, Melbourne, lot 22, range 6.....*Benjamin Walton, Montreal.*

a. Specimens of roofing slate.

This band of slate is in immediate contact with the summit of the serpentine. It has a breadth of one-third of a mile, and dips about S.E. $< 80°$. Mr. Walton commenced opening a quarry upon it in 1860, and found it necessary, in order to gain access to the slate, to make a tunnel through a part of the serpentine. To complete this, and to expose a sufficient face in the slate to pursue profitable working, has required two years of time, and $30,000 of expenditure. The face now exposed has a height of seventy-five feet; but the band of slate crosses the St. Francis and the fall from the position where the quarry is now worked, to the level of the stream, is upwards of 400 feet, the distance being one and a half miles, so that by commencing an open cutting on the slate, at the level of the stream, a much greater exposure can be ultimately attained. Up to a comparatively recent period, the usual coverings of houses in Canada have been wooden shingles, galvanized iron or tin-plate, but so many destructive fires have occurred from the use of the first of these, that they are now interdicted in all large towns. Slate, as a covering, costs about one-third more than shingles, but one-half less than tin, and one-third less than galvanized iron. In the following table are shown, 1st, the sizes of the slates, in inches; 2nd, the number of such slates in a square (of 100 square feet); and, 3rd, the price per square at which Mr. Walton supplies his slates, placed on the railroad cars at Richmond, which is within one and a half miles of the quarry.

Sizes.	Number	Price.	Sizes.	Number	Price.	Sizes.	Number	Price.
24 x 16	86	$4 00	20 x 10	169	$4 00	14 x 10	262	$3 00
24 x 14	98	4 00	18 x 11	175	4 00	14 x 9	291	3 00
24 x 12	114	4 00	18 x 10	192	4 00	14 x 8	327	3 00
22 x 12	126	4 00	18 x 9	213	4 00	14 x 7	374	2 75
22 x 11	138	4 00	16 x 10	222	3 75	12 x 8	400	2 75
20 x 12	141	4 00	16 x 9	246	3 75	12 x 7	457	2 50
20 x 11	154	4 00	16 x 8	277	3 60	12 x 6	533	2 25

The quarry has now been in operation since the spring of 1861; 2000 squares have been sold, and some of the slates have been sent to a distance of 550 miles from the quarry; a quantity of them having been purchased for Sarnia on the River St. Clair. To show that slate, as a covering, is well adapted to resist the influences of a Canadian climate, it may be here stated that slates from Angers in France, have been exposed on the roof of the Seminary building on the corner of Notre Dame and St. François Xavier Streets, in Montreal, for upwards of 100 years, without any perceptible deterioration. The strong resemblance between these and the slates of Melbourne, as well as those from Bangor in Wales, may be seen in the following comparative analyses by Mr. T. Sterry Hunt:

	Welsh.	French.	Melbourne.
Silica	60.60	57.00	64.20
Alumina	19.70	20.10	16.80
Protoxyd of Iron	7.83	10.98	4.23
Lime	1.12	1.23	0.73
Magnesia	2.20	3.39	3.94
Potash	3.18	1.73	3.26
Soda	2.20	1.30	3.07
Water	3.30	4.40	3.40
	100.03	100.13	99.63

The proximity of the serpentine leaves no doubt as to the geological horizon of these slates.—*Quebec group, Lower Silurian.*

2. Orford, lot 2, range 5..... *Geological Survey.*

a. Specimens of roofing slate.

3. Tring ..... *Geological Survey.*

a. Specimens of roofing slate.

4. Kingsey, lot 4, range 1..... *Geological Survey.*

a. Specimens of roofing slate.

5. Cleveland (formerly Shipton,) lot 6, range 15..... *Geological Survey.*

a. Specimens of roofing slate.

The Cleveland slates are a continuation of the Melbourne band. The Shipton Slate Company opened a quarry on them in 1854, and found them to be of superior quality. This quarry is now for sale. The slates of Orford may be on the same band, about ten or twelve miles to the S. E.; but the geological horizon of the Tring slates is uncertain, though they probably belong to the Quebec group. The Kingsey slates appear to be lower in the series than the magnesian group of strata.—*Quebec group, Lower Silurian.*

Flagstones.

1. Georgetown, Esquesing..... *Geological Survey.*

a. Specimen of flagstone.

This is a hard, fine-grained sandstone; and the surfaces are even and parallel. Many of the beds of the band, which is twenty feet thick, can be split into flagstones; which are used in the city of Toronto. Similar flagstones, used at Hamilton, are obtained from the same band there, and an equally good quality can be obtained wherever the band occurs.—*Grey band, Medina formation, Lower Silurian.*

Hydraulic lime.

1. St. Catherines..... *J. Brown, Thorold.*

a. Raw cement stone.

b. Prepared cement.

The bed which yields the Thorold cement is a dark brown dolomite of the Clinton formation. During the construction of various railway, and other public works, the quantity of cement manufactured by Mr. Brown averaged 80,000 bushels annually, but at present the quantity made does not exceed one-tenth of the amount. The present price of the cement is from twenty to twenty-five cents per bushel of sixty lbs.—*Clinton formation, Middle Silurian.*

2..... Walkerton ..... *Geological Survey.*

a. Raw cement stone.

b. Prepared cement.

The beds of this deposit are from two to eleven inches thick, occasionally separated by layers of shale, making in all fifteen feet. Cement has not yet been manufactured from this stone; and none is made within 100 miles of the locality, although there would, no doubt, be considerable demand for it in the neighborhood, were it prepared at the place. The locality is in the bank at a mill-dam on the Saugeen River, where an unlimited water-power for grinding the cement may be had.—*Onondaga formation, Upper Silurian.*

3. Limehouse ..... *Geological Survey.*

a. Raw cement stone.

b. Prepared cement.

This stone occurs in a band of nine feet thick, in beds varying from three to seven inches. The cement is manufactured in considerable quantities by Messrs. Bescoby and Newton. It sets slowly, and hardens during several weeks, after which it is said to possess great strength.—*Clinton group, Middle Silurian.*

4. Nepean ..... *Geological Survey.*

a. Raw cement stone.

Though the rock occurs in Nepean, its produce is usually designated as the Hull cement, from having been manufactured for several years, by Mr. Wright of Hull, opposite to Ottawa. The rock is a limestone holding about twelve per cent. of carbonate of magnesia, and it yields a strong and lasting cement. The bed to which it belongs, has been traced for nearly 100 miles through the country, preserving a very uniform character.—*Chazy formation, Lower Silurian.*

5. Rockwood ..... *Geological Survey.*

a. Raw cement stone.

This specimen comes from a band three and a half feet thick, associated with a layer of chert, and separating into beds averaging six inches. It is not worked, but could be easily quarried, and a good water-power for grinding is ready at the spot.—*Niagara group, Middle Silurian.*

6. Magdalen River..... *Geological Survey.*

a. Raw cement stone.

These specimens of black dolomite are derived from the Mountain Portage, about five miles up the Magdalen River from its mouth. The stone occurs in beds of from two to four inches, interstratified in black graptolitic shales, and yields a very strong hydraulic cement, setting in a few minutes under water, to a very hard and tenacious mass of a yellowish color. Similar bands occur at the Grande Coupe, six miles below Great Pond River. The range of the formation containing these bands, being from Gaspé to Quebec, makes it probable that a considerable quantity of the stone may be obtained from various places along the south shore of the St. Lawrence. The stone differs from that at Quebec, from which Capt., now Major-General Baddeley, R.E., first prepared a cement, now manufactured by Mr. P. Gauvreau. This contains no magnesia, while the Gaspé stone is a dolomite.—*Hudson River formation, Lower Silurian.*

Common lime.

1. Guelph ..... *Geological Survey.*

a. Raw limestone.

b. Prepared lime.

This lime is prepared from the Guelph dolomite or magnesian limestone. The stone takes rather longer to calcine than pure limestone; it slacks without the evolution of much heat, to a very white powder, much prized for whitewash and for mortar, which sets quickly. The stone occurs in unlimited quantities.—*Guelph formation, Middle Silurian.*

2. Walkerton..... *Geological Survey.*

a. Raw limestone.

b. Prepared lime.

This remarkably white lime is burnt from a band of drab-colored magnesian limestone, seven feet thick. It makes a superior whitewash and a strong cement.—*Onondaga formation, Upper Silurian.*

3. Montreal..... *Geological Survey.*

a. Raw limestone.

b. Prepared lime.

This limestone, which yields the best stone for the purposes of construction at Montreal, also burns to excellent lime, and the refuse which accumulates in the process of quarrying the building stone, is used for that purpose. The quantity of lime manufactured at Montreal is estimated to be 270,000 bushels per annum, and the price is about $0·16¾ per bushel.

Common bricks.

1. Owen Sound..... *Geological Survey.*

a. Red bricks.

These bricks are made from a drab-colored clay, which has been dug to a depth of four feet. White bricks are made from the same clay by using a different sand. The deposit is not extensive.—*Drift.*

2. Walkerton, Brant, lot 31, range 2, south ..... *Geological Survey.*

a. Red bricks.

These bricks are made from a bed of nine feet of purplish-brown finely laminated clay, reposing on twenty feet of highly calcareous sand.—*Drift.*

3. St. Jean, County of Lotbinière..... *Geological Survey.*

a. Red bricks.

These specimens are manufactured from a thinly laminated blue clay, which the brick-makers of the place state to be upwards of 100 feet thick, and which requires a mixture of one-third of sand for the manufacture. In 1852 about 2,000,000 bricks were manufactured there by seven brick makers.—*Drift.*

4. Montreal..... *Peel & Compte, Montreal.*

a. Common red bricks; price $5.50 per 1000.

Messrs. Peel & Compte manufacture 6,000,000 common bricks annually, which are sold at from $5 to $6 per 1000.

The red bricks of Montreal are manufactured from a blue clay of marine origin, which is interstratified with reddish layers, and runs under a deposit of sand. The clay has been excavated to a depth of twenty feet, and may be deeper, as the same formation is known

to have a greater thickness in other localities. Its marine origin is proved by the occurrence of sea shells, of about six species in the pure clay, and about thirty in the sandy clay immediately overlying it; all probably the same as species now inhabiting the ocean. Our knowledge of the fossils of these deposits has been greatly extended by the researches of Dr. Dawson, of McGill College, who has more than doubled the number of shells known a few years since, and added to the list many species of *Bryozoa*, *Foraminifera*, and other small forms. The remains of the capeling (*Mallotus villosus*) and the lump-sucker (*Cyclostomus lumpus*) are obtained from the same clays near Ottawa, and a clay-pit of Messrs. Peel & Compte, on Côteau Baron, has yielded nineteen of the caudal vertebræ of a cetacean, similar to a species discovered in Vermont by the late Mr. Zadock Thompson, and named by Mr. C. H. Hitchcock, *Beluga Vermontana*. On Côteau Baron these remains were accompanied by one of the pelvic bones of a seal, by sea-shells, and by fragments of white cedar, *Thuya occidentalis*. The locality is about 140 feet above the level of the sea. In another of Messrs. Peel & Compte's pits there has recently been found a nearly entire skeleton of the Greenland seal (*Phoca Grænlandica*,) a species still living in the Gulf of St. Lawrence; from the size of the head, the animal appears to have been six feet long, and full grown. Within a few days, a clay-pit of Messrs. Bulmer and Sheppard has given many of the bones of some other animal, supposed to be a seal, of much smaller dimensions. The brick yards are situated to the north-east of Mount Royal, on a plateau of considerable extent; above which, well-marked sea margins occur on the sides of the mountain, at elevations of 220, 386, 440 and 470 feet above the sea level, with marine shells up to the last mentioned height.—*Alluvion.*

5. Montreal ..... *Bulmer & Sheppard, Montreal.*

a. Common building bricks, price $ 5 per 1000.
b. Pressed front bricks, " $10 "
c. Radiating front bricks " $ 7 "
d. Circular bricks for shafts " $12 "

The quantity of bricks manufactured by Messrs. Bulmer & Sheppard is equal to 6,000,000 per annum. In this manufacture they use Boaden's brick-making machine.—*Alluvion.*

6. Hanover, Brant..... *Geologica. Survey*

a. White bricks.

The specimens are manufactured from a brownish laminated clay, which burns white, and is underlaid by a considerable deposit of sand. Either red or white bricks are made of this clay, according to the sand used.—*Drift.*

7. Toronto..... *Geological Survey.*

a. White bricks.

The deposit of clay, from which these white bricks are manufactured at Toronto, has a thickness exceeding sixty feet, and extends eastward, at least as far as Cobourg. It appears to be unconformably overlaid by a bed, which is three feet thick, giving red bricks. The white brick-clay lies in very even horizontal strata, while the other undulates with the general surface, not however descending to the bottom of deep ravines. The average annual manufacture of white bricks in Toronto is from three to five millions, and the ordinary price at the kiln is from $5.50 to $6.00 per 1000. The price of common red bricks is from $3 to $4 per 1000, and the average annual manufacture, including all kinds, is from eight to ten millions.—*Drift.*

Drain tiles.

1. North Plantagenet..... *C. P. Treadwell, L'Orignal.*

a. One-and-a-half-inch red agricultural drain tiles.

These tiles are manufactured by Thomas Gibb, at Treadwell, North Plantagenet, from a blue clay which forms a considerable deposit on the banks of the Ottawa. The price of these tiles is $10 per 1000.

2. Quebec ..... *H. O'Donnell, C.E., Quebec.*

a. Clay used in making sewerage pipe tiles.

b. A six inch sewerage pipe tile.

These tiles are manufactured by Messrs. W. & D. Bell, from a deposit of clay, varying in thickness from three feet to thirty feet, on the river St. Charles, between one and two miles from Quebec. They are used for main sewers and house drains, in the city of Quebec, where 151,000 feet of them have been laid. They are united by means of rings of the same material, which cover the joints, and permit alterations and repairs without breaking the pipes. When in place, the pipes are capable of resisting a pressure of fifty lbs. to the square inch, and, when properly glazed with a composition, (the base of which is oxyd of lead,) which is applied either within and without, or within only, they remain free from the incrustations that are found to gather on the inside of iron pipes. The prices of these drain-tiles are:

4 in.	6 in.	9 in.	12 in.	15 in.	18 in.	internal diameter.
$0.15	$0.21½	$0.33½	$0.60	$0.84	$1.18½	per linear foot.

5.

GRINDING AND POLISHING MINERALS.

Whetstones.

1. Stanstead, lot 15, range 1..... .... *Geological Survey.*

a. Cut whetstones.

2. Hatley, Massawippi Lake ..... *Geological Survey.*

a. Cut whetstones.

3. Bolton, lot 23, range 6..... *Geological Survey.*

a. Cut whetstones.

4. Kingsey, lot 7, range 2..... *Geological Survey.*

a. Cut whetstones.

In the Eastern Townships, stones of a good grit for the purpose of whetstones are found in several places. A band of this kind runs from Whetstone Island in Memphramagog Lake, lot 15, range 1, of Stanstead, by Lee's Pond to the head of Massawippi Lake, in Hatley; a distance of nearly twelve miles, and it may be available much further. The rock appears to be a mica slate, passing into an argillite, and its stratigraphical place would seem to be above the magnesian series. There is also a range of whetstone rock on each side of the anticlinal running from Melbourne to Danville, beneath the magnesian rocks. This rock again appears on the north-west side of the Shipton and St. Armand synclinal, in Kingsey, and good samples of the stone occur on lot 7, range 2 of the township, where whetstones were some years ago manufactured by Messrs. Gilmour & Jackman. They are much softer than the Memphramagog stones, the rock being probably more argillaceous. The Bolton stone very much resembles that of Memphramagog, but its stratigraphical place is probably the same as that of Kingsey.—*Quebec group, Lower Silurian.*

5. Collingwood, lot 25, range 6 ..... *Geological Survey.*

a. Cut whetstones.

These whetstones are obtained from about twenty feet of thin, even bedded, and very fine grained sandstones and arenaceous shales, at the top of the Hudson River formation. The inhabitants of the neighborhood make whetstones for their own use, from this rock, but it has never been extensively worked. The same rock is found in the same geological position at Meaford, Cape Rich, and on the Grand Manitoulin Island.—*Hudson River formation, Lower Silurian.*

6. Nottawasaga, lot 24, range 11..... *Geological Survey.*

a. Cut whetstones.

The specimens are taken from about twenty feet of freestone, representing the Grey-band. The rock is in every way suited to make superior scythe stones, although they have never yet been manufactured from it.—*Medina formation, Middle Silurian.*

7. Noisy River Falls, Nottawasaga ..... *Geological Survey.*

a. Cut whetstones.

These specimens are from a few feet of very fine grained compact sandstone at the foot of the falls, and immediately underlying the dolomite of the Clinton formation. It appears to be the upper part of the Grey-band. The rock is not worked in this locality.—*Medina formation, Middle Silurian.*

8. Madoc, lots 4 and 5, range 5..... *Geological Survey.*

a. Cut whetstones.

The mica slates associated with the crystalline limestones of the Laurentian series are frequently of the character required for scythe stones, and a band of this description occurs in Madoc, on the property of Mr. O'Hara, who at one time cut and wrought the rock into whetstones for sale. The whetstone rock occurs not far from crystalline limestone, and in immediate contact with a thick band of conglomerate, of which the matrix weathers white, and appears to be a dolomite. The pebbles, which are frequently large, some of them being six inches in diameter, are chiefly of quartz, but there are others of feldspar, and some which are calcareous. The quartz pebbles are for the most part distinctly rounded, and their colors various, some being bluish, and others white or pinkish on fracture. Those of feldspar are red and white.—*Laurentian.*

Hones.

1. Ottertail Lake, Thessalon River..... *Geological Survey.*

a. Cut hones.

Some of the silicious slates of the Huronian series yield very fine hones. They are usually of a green color, and belong to the lower part of the series.—*Huronian.*

Grindstones.

1. Nottawasaga, lot 24, range 11..... *Geological Survey.*

a. A grindstone, twenty-eight inches in diameter.

This grindstone is from the Grey-band, which is about twenty feet thick at this locality, and the whole of it appears equally well qualified for making grindstones. It splits well into the various thicknesses required for these stones, and they have been made from it, by hand, in considerable numbers, both at this place, and in the township of Mulmur. The same rock is found in many places near the escarpment of the Niagara formation, in Nottawasaga and Mulmur. The grindstones made from it, are declared by practical men, to be superior to those imported; but they have never yet been manufactured by machinery. A lathe for turning them could be erected on one of the numerous streams which cross the formation, for about $1000 (£200 stg.). Grindstones roughly hewn by hand, sell for 1½ cents per pound on the spot, which is the price of the imported Ohio stones, as sold on the coast of Lake Huron.—*Grey band, Medina formation, Middle Silurian.*

Millstones.

1. Grenville, lot 3, range 5 ..... *Geological Survey.*

a. A buhrstone, dressed.

This buhrstone occurs on the property of Mr. James Lowe. On his land and that of some of his neighbors, it constitutes a series of veins, cutting an intrusive mass of syenite, which occupies an area of thirty-six square miles, among the Laurentian rocks of Grenville, Chatham, and Wentworth. The veins consist of yellowish-brown or flesh-red cellular chert; the colors, in some cases, running in bands parallel to one another, and sometimes being rather confusedly mingled, giving the aspect of a breccia. The cells are unequally distributed, some parts being nearly destitute of them, while in others they are very abundant, and of various sizes, from that of a pin's head to an inch in diameter. On the walls of some of the cells, small transparent crystals of quartz are implanted; and in some of them are impressions of cubical forms, resulting, probably, from crystals of fluor spar, which have disappeared The stone has the chemical composition of flint or chalcedony. On Mr. Lowe's ground, one of the veins runs nearly east and west, and stands in a vertical attitude; while its breadth varies from about four to about seven feet. When the vein is banded, the colors run parallel with the sides. The attitude and associations of the chert clearly shew that it cannot be of sedimentary origin, and its composition, taken in conjunction with the igneous character of the district, suggests the probability that it is an aqueous deposit, which has filled up fissures in the syenite, and is similar in its origin to the agates and chalcedony which in smaller masses are common in [illegible] rocks. For a distance of perhaps 200 yards on each side of these veins of chert, while the quartz of the syenite remains unchanged, the feldspar has been more or less decomposed, and is converted into a sort of kaolin. As this process involves a separation of silica from the feldspar, it is not improbable that it has been the origin of the veins of silex.—*Laurentian.*

2. Cayuga, north of Talbot Road..... *Geological Survey.*

a. A barley millstone.

Millstones for grinding oats and barley are manufactured by Mr. W. De Cew, of De Cewville, in the County of Haldimand, from whom this millstone was obtained. The stones, which are highly esteemed for the purposes to which they are applied, are derived from a bed of sandstone, varying in thickness from six to ten feet, which in some parts of its distribution, abounds in fossils. It constitutes the base of the Devonian series of Canada.—*Oriskany formation, Devonian.*

6.

MINERAL MANURES.

Gypsum.

1. Oneida ..... *Thomas Martindale.*
   - *a.* Crude gypsum.
   - *b.* Prepared "

2. Oneida ..... *Jno. Donaldson.*
   - *a.* Crude gypsum.
   - *b.* Prepared "

3. York, Grand River ..... *Alexander Taylor.*
   - *a.* Crude gypsum.
   - *b.* Prepared "
   - *c.* Plan of the mine, by Mr. J. De Cew.

All the gypsum mines at present worked in Canada, occur on the Grand River, in a distance of thirty-five miles, extending from Cayuga to Paris. The formation, to which they belong, however, runs from the Niagara River, to the Saugeen, on Lake Huron, a distance fo about 150 miles; and it seems probable that as the country to the north-west of Paris becomes more settled, further discoveries of workable masses will be made in that direction All the mines appear to be confined to one stratigraphical position in the formation, which is probably about the middle. The mineral occurs in lenticular masses, varying in horizontal diameter, from a few yards to a quarter of a mile, with a thickness of from three to seven feet. The layer of gypsum appears to be in general both underlaid and overlaid by beds of dolomite, much of which is fit for the purposes of hydraulic cement, and the gypsum itself is sometimes interstratified with thin beds of dolomite. In some parts, there appear to be two workable ranges of gypsum, one a few feet above the other. But this, perhaps, is only to be considered a thickening of the gypsiferous band, with an interstratification of a thicker mass of dolomite.—*Onondaga formation, Upper Silurian.*

The following is the amount of gypsum raised annually from the quarries on the Grand River:—

T. Martindale, Oneida,	3500	tons.
J. Donaldson, "	1500	"
A. Taylor, York,	3000	"
Thompson & Wright, Paris,	4000	"
J. Brown, Cayuga,	2000	"
	14000	"

The greater part of this gypsum is employed for agricultural purposes, and the prices at which it is sold are as follows:—

Plaster, unground,	$2.00	per ton.
" ground for the land,	3.50—4.00	"
" " " stucco, raw,	5.50—7.00	"
" " " " calcined,	16.00	"

Fresh-water Shell Marl.

1. New Edinburgh ..... *Geological Survey.*
   - *a.* Specimen of marl.

This deposit is on the property of Messrs. John & Thomas MacKay, of Rideau Hall, New Edinburgh, and is five feet thick. Among the shells which it contains, are the following species: *Physa heterostropha, Limnæa pallida, Planorbis bicarinatus, P. campanulatus, P. parvus, Amnicola porata,* and *Valvata tricarinata.* With a thin covering of vegetable

mould, the marl supports a growth of large forest trees, under which it extends some distance along the east side of a small lake or pond, which occurs in the course of a small stream, discharging by a narrow ravine into the Ottawa close by. The surface of the pond is twenty-six feet above the river in summer, but only six feet in the freshets of spring; the river in summer is 118 feet above the sea. The marl bed is on a level surface, twenty-five feet above the pond, and, after spreading over a breadth of 200 yards, it appears to run under a terrace five feet higher, which maintains a level surface for considerable distance. This, instead of overlying the marl, may be the margin of the lake in which it was deposited. The pond is 200 yards wide, and on the west side there are evidences of three periods of recession, in distinct terraces; which are at heights of thirty, sixty, and seventy-five feet, respectively, over the level of the pond, or 174, 204 and 219 feet above the sea, each with a sudden step rising to the next. The upper step, or perhaps the upper two steps, may exhibit former limits of the sea. The clays of the banks of the Ottawa, at this part, are of marine origin, and nine miles farther down the river, at Green's Creek, hold the remains of two species of sea fish, which have been already mentioned (page 45), the *Mallotus villosus*, or common capeling, and the *Cyclostomus lumpus*, or lump-sucker; with *Saxicava rugosa*, *Leda Portlandica*, and other sea shells. The two flappers of a seal were obtained from the same clay, as well as sea-weeds, and leaves of large exogenous trees.—*Alluvion.*

2. Sheffield, lots 15 and 16, range 2 ..... *Geological Survey.*

a. Specimen of marl.

This deposit, which is on the property of Mr. McDonell, extends over an area of 200 acres and perhaps more, with a thickness, over the greater portion, of at least ten feet. On the surface there is a thin soil, bearing a luxuriant growth of prairie grass. The species of shells observed here are *Planorbis bicarinatus*, *P. parvus*, *Physa heterostropha*, *Amnicola porata*, with undetermined species of *Limnæa*, *Valvata*, *Cyclas*, and *Pisidium*. Another locality in Sheffield, where marl occurs, is on lot 12, ranges 3 and 4, extending over at least 300 acres and perhaps more than 400. The place where it occurs is chiefly a swamp or marsh, and it is covered over by an accumulation of excellent peat, averaging four feet in thickness. Still another locality in the same township, is in White Lake, and the brook leading from this to Beaver Lake.—*Alluvion.*

3. Montreal ..... *Geological Survey.*

a. Specimen of marl.

This deposit, which is very pure and white, occurs at Thornberry on the west side of Mount Royal. It is overlaid by peat, but does not seem to be of very great extent. The species of shells met with in it are *Planorbis campanulatus*, *P. bicarinatus*, *P. trivolvis*, *P. parvus*, *Limnæa umbrosa*, *L. stagnalis*, *Physa marginata*, *P. heterostropha*, *Valvata bicarinata*, *Amnicola porata*, *Melania acuta*, *Cyclas similis*, *Pisidium dubium*, and an undetermined *Unio*.—*Alluvion.*

4. Nepean ..... *Geological Survey.*

a. Specimen of marl.

This deposit is on the property of Mr. Sparks, of Ottawa. It is a foot thick, and is covered with a thin layer of peat. The species of shells found in it are *Physa heterostropha*, *P. marginata*, *Planorbis bicarinatus*, *P. parvus*, *P. campanulatus*, *Limnæa modicella*, *Amnicola porata*, *Valvata tricarinata*, and *Pisidium*.—*Alluvion.*

5. West Hawkesbury, lot 18, range 4..... *Geological Survey.*

a. Specimen of marl.

The marl is found on the property of Mr. George Cross, in the bottom of a prairie-like flat, traversed by a small brook; it is known to cover between three and four acres on this lot, but it is believed to be more extensive, and to continue into the next lot eastward. The specimen was obtained near the edge of the deposit. The bed is here three and a half feet deep, and is overlaid by four feet of peat. The surface is overgrown with grass, reeds, and moss, and the locality appears to have been the former site of a small lake. The marl taken from the upper half of the bed, becomes white when dry, and is filled with well preserved shells; that from the lower half is of a bluish color and more tenacious character. Branches and trunks of trees, in a good state of preservation, are found in the marl, but not in the peat. The marl has proved a very efficacious manure to the adjoining lands, which are of a sandy character. In digging it, the effluvium evolved is so offensive, that few men can bear it. The peat is also used as a manure by the proprietor. The following species of fresh-water shells have been obtained from this marl: *Limnæa stagnalis, L. umbrosa, Planorbis trivolvis, P. campanulatus, P. bicarinatus, P. parvus, Physa heterostropha, Amnicola porata, Valvata tricarinata, Cyclas similis,* and an *Anodonta.—Alluvion.*

6. Brant, lot 6, range 1, N. of Durham road ..... *Geological Survey.*

a. Specimen of marl.

The marl here occurs in a flat meadow, skirting a small stream, and extends over an area of seven acres. The bed is two feet deep, and is covered by a foot of peat, which supports a growth of prairie grass. The marl from the lower part of the bed is of a blue color when wet, while that from the middle is whitish, and has been used by the people of the neighborhood as a whitewash, but not yet as a manure, the lands being naturally very calcareous. Most of the shells are finely comminuted, and only an occasional whole specimen preserved. These appear to belong altogether to small species, and among them occur *Planorbis parvus, Valvata humeralis, V. tricarinata, Amnicola porata,* and several small species of *Pisidium.—Alluvion.*

7. Carrick, lot 25, range 15..... *Geological Survey.*

a. Specimen of marl.

This deposit is about six acres in extent, with an ascertained depth of twenty-seven inches. It is very white, and overlaid by a thin stratum of black mould. The surface has the aspect of prairie land, and is intersected by a brook. Similar prairies, in which marl is said to be found, occur at intervals along the brook, for four miles, and the whole area underlaid by marl, is estimated at forty acres. It has hitherto been used only for whitewashing. Among the shells which it contains, the genera *Limnæa, Planorbis, Physa, Valvata, Amnicola, Cyclas* and *Pisidium* are represented. A great many deposits of marl, similar to this and to the last, are met with in the counties of Bruce and Grey.—*Alluvion.*

8. Bentinck, lot 26, range 1..... *Geological Survey.*

a. Specimen of marl.

This bed occurs in low ground, close to the town of Durham. Its extent is uncertain, but it is known to cover eight or ten acres. At the spot where the specimen was taken, its depth was four feet. It is very solid and pure, and is covered by heavy timber. *Physa heterostropha, Planorbis parvus, Valvata tricarinata,* and *Amnicola porata,* with small species of *Pisidium,* are among the shells which it contains.—*Alluvion.*

9. Anticosti .... *Geological Survey.*

a. Specimen of marl.

Marl Lake, at the west end of Anticosti, has a superficies of about ninety acres, and appears to have a bottom covered with shell marl. The thickness of the marl seems to be considerable, but its exact measure has not been ascertained. The creek which empties the lake into Indian Cove, carries down a large quantity of the marl to the sea, where it becomes spread out for a considerable distance over the rocks of the vicinity. This is the most northern deposit of marl which has been met with. Among the species of shells which it contains are *Limnæa acuta, Planorbis parvus, P. trivolvis?* with another small undetermined species, *Physa heterostropha, Valvata sincera, Pisidium dubium*, and one or two species of the last genus, supposed to be new. The most abundant species observed is *Limnæa acuta*, (Lea,) the next most abundant is *Valvata sincera* (Say,). Two small species of land snails were met with in the marl, *Helix arborea* and *H. striatella.*—*Alluvion.*

10. Belleville ..... *Geological Survey.*

a. Specimen of marl.

This deposit is on the land of Mr. Yeoman of Belleville, but does not appear to be extensive. The species of shells observed are *Valvata humeralis, Pisidium dubium*, with an undetermined *Limnæa* and a *Pisidium.*—*Alluvion.*

11. St. Armand ..... *Geological Survey.*

a. Specimen of marl.

This shell marl occurs on a pond, a mile south-east of Phillipsburgh, on lots 156 and 157 of St. Armand, on the lands of Mr. Strite and Mr. Taylor. The marl is visible all around the pond, and consists of the comminuted remains of fresh-water shells to a depth of several feet, resting on a deposit holding marine shells, probably of the age of the drift. The fresh-water species are *Planorbis parvus, P. campanulatus, Limnæa umbrosa, Physa heterostropha, Valvata tricarinata*, and *Amnicola porata.* The whole depth is in some parts seven feet, and the area of the deposit may be between thirty and forty acres. The specimen exhibited was obtained from Mr. Strite.—*Alluvion.*

Calcareous Tufa.

1. Noisy River Falls ..... *Geological Survey.*

a. Specimen of tufa.

This tufa covers the extensive slopes on both sides of the river, from the base of the Niagara escarpment to the edge of the water. It is constantly soft and moist, and is cut into by numerous springs, which flow down the long slopes. It probably covers an area of 300 acres in the vicinity of the falls, with an average thickness of five feet. Tufa of this character is found in many places along the base of the Niagara formation, in the counties of Grey and Simcoe; the most important is that on the great slopes of the Beaver River, in Euphrasia and Artemesia, which is supposed to extend over more than 1000 acres, in the form of a strip on each side of the river.—*Alluvion.*

7.

MINERAL PAINTS.

Iron ochres.

1. Ste. Anne de Montmorenci ..... *E. Caron, Ste. Anne.*

a. Brownish ochre.
b. Brownish-black ochre.
c. Yellow ochre.

This deposit of ochre is situated on the property of Mr. E. Caron, about a mile and a quarter above the mouth of the Ste. Anne River. It appears to extend over about four square acres. The locality is on the top of a bank, overlooking the main road, from which it is removed about a quarter of a mile. The surface of the bed has a slope to the south-east, of about fifty feet in one hundred and fifty yards, but its bottom keeps nearly level with the lower side for some distance back, and then rises quickly to the higher side. The thickness of the deposit is thus seventeen feet in the deepest part, and varies from that to four feet. Its form gives great facilities for excavating the ochre, as by beginning on the lower side, a considerable face of it would be exposed, and the water would run from it without the necessity of cutting drains. The three colors exhibited occur at the surface, but the lower and by far the larger part, is of a pale green color. In this green portion the iron is in a lower state of oxidation than in the yellow, but like it, becomes red upon ignition in the air.—*Alluvion.*

2. Cap de la Madelaine ..... *Geological Survey.*

a. Greenish-black ochre.
b. Yellow ochre.

In the St. Malo range of the seigniory of Cap de la Madelaine, about two miles below the church, and two miles back from the St. Lawrence, there is a deposit of ochre, extending over about 600 square acres. It is interstratified by peat, and underlaid by shell marl, which in successive borings along a transverse section from S. E. to N. W., were found to be arranged as follows, in descending order,—ochre, peat, and marl being indicated by the letters O, P, M:—

Paces, 50	100	145	181	281	441
Ft. in.	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*
O, 0 6	O, 2 0	O, 1 6	O, 2 0	P, 9 0	O, 2 0
P, 0 6	P, 4 0	P, 8 0	P, 4 0	M, 0 6	P, }
O, 0 6					O, } 7 0
P, 2 0					P, }
					M, }
3 6	6 0	9 6	6 0	9 6	9 0

In the remaining 320 paces, the ochre is wanting, and we have twelve feet of peat, gradually thinning out. A very great quantity of red and yellow ochres might be obtained from this locality, and where the ochre is mixed with the peat, masses of the mixture might be cut out and dried, and afterwards burned. Experiments on a small scale shew that the quantity of peat in the mixture is often sufficient to calcine the ochre.—*Alluvion.*

3. Pointe du Lac..... *Geological Survey.*

a. Purplish ochre.

b. Yellow ochre.

An ochre bed of about 400 acres in extent, is situated on the St. Nicholas range of Pointe du Lac Seigniory, on the property of Mr. Pierre Chaillon and his brother. Its thickness varies from 6 inches to four feet, and it may have an average of about eighteen inches. Its prevailing colors are red and yellow, but there occurs also in some parts a beautiful purple ochre, and in others a blackish-brown. In 1851, Messrs. H. A. Monroe & Co., of New York, made arrangements to prepare the ochres for sale. Two furnaces were erected in the vicinity of the ochre bed, and an agent established to carry out the details of the manufacture, and to attend to the forwarding of the prepared ochre to New York; where the sale of it was effected. From the natural tints that have been mentioned, eight colors are said to have been prepared. The deposit being but little mixed with sand, the chief impurities to be got rid of, consisted of the roots of those plants which had been growing on the surface; some of these were found to penetrate to a considerable depth. Two modes were resorted to for this purpose; one by dry sifting, which was used when the natural colors of the ochres were to be preserved, as in the case of the yellow, the purple, and the blackish-brown varieties. The other mode was by burning. The yellow is a hydrated peroxyd of iron, the purple also is probably in some peculiar state of hydratation, but the red is the anhydrous peroxyd. By exposure to a sufficient heat, the water of combination is driven off from the yellow and purple, and both becoming anhydrous peroxyd, assume the tint of the natural red ochre, from which, as from the other two, the vegetable matter in this operation is burnt out. The blackish-brown variety is scarcer than the others, and affords colors of a more valuable description. Purified from roots, without fire, it is sold under the name of raw sienna; and is admirably adapted for graining. When subjected to fire, it assumes a brown of less intensity, and is sold as burnt sienna. As it does not turn red by burning, it is probable that there may be in this ochre, an admixture of manganese. The enterprise at Pointe du Lac appears, for the present, to be abandoned.—*Alluvion.*

4. Nottawasaga, lot 2, range 11..... *Geological Survey.*

a. Yellow ochre.

This deposit covers about half an acre, on the south bank of the river, and is produced by chalybeate springs issuing from the Clinton formation. When dry, it has a good yellow color. An excavation of two and a half feet, near the centre of the deposit, did not reach the bottom. Small deposits of yellow ochre are met with in similar situations near the Clinton formation in other places.—*Alluvion.*

5. Owen Sound, town plot..... *Geological Survey.*

a. Yellow ochre.

This ochre contains a small amount of calcareous tufa, and is of a bright yellow color. The bed occurs at the foot of a bank, in which the Clinton formation crops out, on the S. W. side of the town; its extent has not been accurately ascertained, but it does not seem to be great. It appears to have been deposited by springs which have long since changed their course, and is four feet deep in the middle, thinning out towards the edges.—*Alluvion.*

Sulphate of Barytes.

1. Burgess, lot 4, range 6..... *Geological Survey.*

   a. Specimen of sulphate of barytes from a vein.

2. Lansdowne, lot 2, range 7 ..... *Geological Survey.*

   a. Specimen of sulphate of barytes from a vein.

The barytes of Burgess and Lansdowne is derived from veins intersecting Laurentian rocks. In the latter township, as well as in Bedford, the mineral, associated with calcspar, constitutes the veinstone of some of the lead lodes met with there. The vein yielding the Lansdowne specimen cuts Laurentian limestone. In an unsuccessful attempt to mine the vein for lead, it was ascertained that twenty-eight feet of the lode, with a breadth of twenty-seven inches, consisted of highly crystalline almost colorless barytes, of which the vein in this part would yield about ten tons to a square fathom in the plane of the lode. The most abundant source of barytes in Canada, so far as known, appears to be the veinstones of lodes carrying copper ore, on the north shore of Lake Superior, between Pigeon River and Fort William, and in Thunder Bay. These, however, belong to the Quebec group. In Canada the mineral is as yet applied to no use, but in some parts of the United States it is refined and ground in large quantities, for use as a paint, and also for adulterating white lead. The value of the crude barytes suited for such a purpose, is about $10 per ton, while the wholesale price of the paint is $30 per ton.—*Laurentian.*

8.

MINERALS APPLICABLE TO THE FINE ARTS.

Lithographic stone.

1. Marmora, lot 7, range 4 ..... *Geological Survey.*

   a. Prepared lithographic stone, with *fac simile* autographs of Canadian Governors.

At Marmora, the Laurentian rocks are overlaid by about twenty feet of brownish-grey and light brownish-buff unfossiliferous compact limestone, with a conchoidal fracture, several beds of which would be well suited for the purposes of lithography, were it not for small imbedded lenticular crystals of calcareous spar, which, when abundant, unfit the stone for such an application. One of the beds, however, which is two feet thick, and of impalpable grain, is a lithographic stone of excellent quality. The lower half is much better than the upper, which is somewhat affected by the lenticular crystals of calcspar. The upper inch, which is just above the thus marked part, fits upon it in tooth-like projections, having columnar sides at right angles to the bed, of an inch long in some places; and usually covered with a thin film of bituminous shale. The same tooth-like forms occur in the lower part, but they are there more obscure. The band to which the bed belongs, presents occasional exposures of a similar character, all the way from Hungerford to Rama, a distance of 100 miles; but though the stone has been highly commended by all the lithographers who have tried it, no one has attempted to quarry it for use. The stone exhibited, presents the *fac simile* autographs of all the governors of Canada, both French and English, from the time of Champlain in 1612 to that of Lord Monck in 1862; with the exception of two of the French governors in the first half of the seventeenth century.—*Birdseye and Black River formation, Lower Silurian.*

2. Brant, lot 31, ranges 1, 2..... *Geological Survey.*

a. Prepared lithographic stone, with Bank cheque and transfer, No. 1.

b. " " " " " No. 2.

c. " " shewing natural fracture, with vignette of an Indian chief.

These are specimens of magnesian limestone of a yellowish drab color and fine texture, with a conchoidal fracture. The locality is the bed of a small stream, on lot 31, between ranges 1 and 2, south of the Durham road, Brant, and about half a mile south of the village of Walkerton. About fifteen beds of stone, apparently of the same character as the specimens, occur in a vertical section of nine feet, the thickest being eleven inches. Layers of dark colored shale separate some of the beds. The band is underlaid by about sixty-five feet of soft clayey strata, constituting the bank of the Saugeen River, at the top of which it occurs. The existence of this stone being a very recent discovery, only a preliminary trial of it has been made. The beds from which the specimens were taken, are intersected by a number of parallel joints, which render the specimens procured somewhat narrow; but the geological place of the band having been ascertained, it is probable that wider slabs may be found on the strike, in some other locality.—*Onondaga formation, Upper Silurian.*

3. Oxbow, Saugeen River, Brant, lot 3, range 7..... *Geological Survey.*

a. Prepared lithographic stone, with drawing of a steam-ship.

b. Transfer in two colors from *a.*

This stone is of the same character and from the same formation as the last. The locality is at the edge of the river, on the east side of the lot indicated in Brant. Two beds, of four and five inches respectively, occur here, but they were covered with water at the time the place was visited.—*Onondaga formation, Upper Silurian.*

9.

MINERALS APPLICABLE TO JEWELLERY.

Agates.

1. Michipicoten and St. Ignace Islands, Lake Superior ..... *Geological Survey.*

a. Specimens of agates cut and polished.

These agates occur on the south and north shores of Lake Superior, particularly on the island of St. Ignace, and on Simpson's Island to the east of it; but the largest and best are derived from the trap of Michipicoten Island, where they strew the shore in great abundance. On this island, agate occurs not only in the form of nodules in the trap, but in veins, filling cracks and dislocations, which traverse the trap, and run in several directions. —*Quebec group, Lower Silurian.*

Labradorite.

1. Grenville ..... *Geological Survey.*

a. Cut and polished specimens of labradorite from boulders.

2. Abercrombie ..... *Geological Survey.*

a. Cut and polished specimens of labradorite from a bed.

This beautiful opalescent mineral occurs in disseminated cleavable masses, imbedded in a finer grained paste of the same mineral character, but destitute of opalescence. The rocks composed of the series of triclinic feldspars, to which this mineral belongs, have been termed anorthosites, in describing the Laurentian system; in which they occupy a very conspicuous place. Great mountain masses of the rock occur in Abercrombie, in the county of Terrebonne, and boulders derived from these lie scattered over the plains to the south. They are abundant in the neighborhood of Grenville, on the Ottawa.—*Laurentian.*

Albite (peristerite).

1. Bathurst, lot 19, range [illegible] ..... *Geological Survey.*

a. Specimens of albi[illegible]anu[illegible]d.

This mineral, the peristerite of Thompson, so called from its beautiful bluish opalescence, is a variety of albite. It occurs in large cleavable masses, with disseminated grains of quartz, in veins cutting Laurentian strata. The specimens exhibited were obtained from Dr. James Wilson, of Perth, the discoverer of the mineral, who collected them in the locality indicated. A vein of the same character occurs on the north side of Stoney Lake, near the mouth of Eel Creek, in Burleigh. Its course is about N. 55° E., and it intersects a white crystalline limestone, interstratified with blackish-grey gneiss. The vein consists of a fine grained mixture of reddish white albite and quartz, in which are enclosed large cleavable masses of the opalescent albite, with occasional portions of fine granular black tourmaline.—*Laurentian.*

Orthoclase (Perthite).

1. Burgess, lot 3, range 6 ..... *Geological Survey.*

a. Specimen of orthoclase cut and polished.

This mineral, which is the perthite of Thompson, occurs in large cleavable masses, constituting, in association with quartz, a pegmatite, which occurs in considerable veins, cutting the strata of the Laurentian series. It is a variety of orthoclase feldspar, presenting different shades of mahogany-brown, the colors being arranged in bands. The surfaces of one of the cleavages present golden reflections, emanating from a multitude of small points, and the mineral very much resembles aventurine, or sunstone. These specimens were obtained from Dr. James Wilson, the discoverer of the variety.—*Laurentian.*

Jasper conglomerate.

1. Bruce mines, Lake Huron, ... *Geological Survey.*

a. Specimens of jasper conglomerate intended for a vase.

This beautiful rock consists of white quartzite, in which are imbedded a multitude of blood-red jasper pebbles, and occurs in mountain masses in the Huronian series. While the enclosed jasper pebbles constitute a material fit to receive the work of the jeweller, the whole rock is capable of being applied to the manufacture of vases and such like objects of vertû. Many boulders of the rock lie scattered along the north coast of Lake Huron, and they are abundant at the Bruce Mines.—*Huronian formation.*

Epidosite.

1. Shickshock Mountain..... *Geological Survey.*

a. Specimens of epidosite cut and polished.

This green rock, which is an intimate mixture of epidote and quartz, occurs in massive beds, and extends over considerable areas in the Shickshock Mountains, on the south side of the St. Lawrence, in Gaspé.—*Quebec group, Lower Silurian.*

10.

MISCELLANEOUS MINERALS.

Feldspar.

1. Bathurst, range 9..... *A. Cowan, Kingston.*

a. Feldspar, from Bathurst.
b. " " Brewer's Mills, Rideau Canal.

This feldspar occurs in considerable quantity on the land of Mr. Neil McEwan, and appears to form a vein of probably twenty feet in width.—*Laurentian.*

Sandstone for glass making.

1. Williamstown, Beauharnois..... *Geological Survey.*

a. Specimen of sandstone.

The Potsdam sandstone in the neighborhood of Beauharnois is in many places so free from iron as to afford an excellent material for glass making. One of the exposures giving the best examples of the stone, is at Williamstown, on the land of Mr. Donald McKillen, from which the specimen exhibited was obtained. Stone from the same formation was some years ago used for making glass at St. Johns and Vaudreuil; but it was found difficult to compete with foreign importations.—*Potsdam formation, Lower Silurian.*

Moulding sand.

1. Dundas..... *Geological Survey.*

a. Specimen of sand.

This sand occurs on the surface, in patches from a few rods to several acres in extent, on the tops and sides of hills of coarser sand. The best is found next the surface, and the layer seldom exceeds a foot in depth. It is the only moulding sand used in Gartshore's extensive iron foundry in Dundas, where superior castings are made. Since to obtain a fine casting, as much depends on the quality of the sand as the skill of the moulder, the occurrence of a good quality of this material in any locality is of sufficient importance to deserve notice.—*Drift.*

2. Owen Sound ..... *Geological Survey.*

a. Specimen of sand.

Moulding sand occurs in two places at Owen Sound, which together may have an area of six acres, with an average depth of eight or nine inches. It is used at the iron foundries in the town, and is said to answer well.—*Drift.*

3. Durham ..... *Geological Survey.*

a. Specimen of sand.

This is from a thin surface layer, covering between one and two acres. It is used in Cochrane's foundry in Durham, and is said to be of very good quality.—*Drift.*

Peat.

1. Chambly..... *Geological Survey.*

a. Specimen of peat.

This peat occurs near Chambly, on the south side of the St. Lawrence, and was some years ago cut, pressed, and sold as fuel by the late Mr. Scobell. The consumption, however, was scarcely sufficient to encourage the industry. As Canada is deficient in coal, when wood becomes scarce in the progress of settlement, peat will gradually assume some importance, as a fuel in many parts of the country. Peat occurs in great abundance in many places in the province; about 100 square miles of it extend along the south front of the Island of Anticosti. Successive areas of it are met with on the south side of the St. Lawrence, from Rivière du Loup to Ste. Marie de Monoir, opposite Montreal; on the north side it occurs at La Valtrie and other places. Large peat bogs occur between the Ottawa and St. Lawrence, and there are many of the same character to the westward. The peat, which is sufficiently matted to hold together when dried, usually supports a growth of prairie grass, or ericaceous plants, or of tamarac trees. That which occurs in cedar swamps is deficient in the fibrous plants which give it cohesion, and it falls to powder when dried.—*Alluvion.*

DESCRIPTIVE CATALOGUE

OF A COLLECTION OF THE

CRYSTALLINE ROCKS OF CANADA.

BY T. STERRY HUNT, F.R.S.

This collection, sent by the Geological Survey of Canada, is intended to illustrate some points in the natural history of its rocks, and is divided into four parts, which are as follows :—

I. Laurentian Rocks, ...	50	specimens,	green ticket.
II. Huronian Rocks, ...	20	"	blue "
III. Lower Silurian Rocks, ...	60	"	yellow "
IV. Eruptive Rocks, ...	20	"	white "

Of these, the first three are from stratified systems, and are generally distinguished as primitive or metamorphic rocks. As, however, we conceive eruptive rocks to be nothing more than displaced and altered sediments, we prefer to describe the whole collection as metamorphic or crystalline rocks, distinguishing the stratified masses which have not been displaced, as *indigenous*, and the eruptive ones as *exotic* crystalline rocks.

In the present collection, we have endeavored to do no more than present a few characteristic varieties of the principal types of rock met with in the three indigenous series. In the first and third of these, nearly all the great classes of crystalline rocks occur, and, with characteristic differences, will be found represented in each. The second series offers but a limited variety of rocks, many classes being imperfectly, or not at all represented. In the fourth division, we have selected only some of the more interesting varieties of the exotic rocks which occur in the vicinity of Montreal.

In the study of rocks, it is not possible to apply with exactness the rules of a natural-history classification, but we may conveniently arrange them in the following mineralogical groups:—

1. *Siliceous rocks;* as quartzite, chert, and jasper.

2. *Aluminous silicated rocks:* *a*, containing alumina chiefly in the form of a mineral of the feldspar family; *b*, as a mica or chlorite; *c*, as a silicate of high specific gravity, such as epidote, garnet, or chloritoid.

In this group, the feldspathic rocks are in great part reducible to two classes, 1st, *Orthosites:* in which the chief mineral is orthoclase, including trachyte, orthophyre, syenite, granite, gneiss, and argillite. 2nd. *Anorthosites:* having as their basis anorthic or triclinic feldspars. These rocks, through the introduction of hornblende, pass into diorite, and with pyroxene give rise to diabase and dolerite.

3. *Non-aluminous silicated rocks:* including serpentine, talc, pyrallolite, chrysolite, hornblende and pyroxene; the latter two minerals sometimes including a portion of alumina.

4. *Carbonated rocks:* limestone, dolomite and magnesite. These divisions suffice for our present purpose, though they exclude many substances forming rock masses, such as sea-salt, sulphate of lime, oxyds, hydrates and carbonates of aluminum and iron, carbonaceous minerals, etc.

I. ROCKS OF THE LAURENTIAN SYSTEM.

The rocks of this system are the oldest known on the globe, and are widely spread in North America; where they are traced from the coast of Labrador to Lake Huron, and thence northward to the Arctic regions. Along the north side of the St. Lawrence, they form the Laurentide mountains, and in New York, to the west of Lake Champlain, the Adirondacks. The Laurentian system has been identified by Sir Roderick Murchison in the Western Islands of Scotland and the adjacent coast, where it forms what was, until recently, termed the fundamental gneiss. The primitive gneiss of Scandinavia also probably belongs to the same ancient system.

The Laurentian rocks of Canada consist in great part of orthoclase gneiss, with quartzites, sometimes conglomerate, and crystalline limestones and dolomites. The total thickness of these strata is estimated at not less than 20,000 feet. Besides these, there is a great formation of anorthosite rocks, amounting to several thousand feet in thickness. These latter overlie the orthoclase and limestone series; and there are reasons for supposing a want of conformity between the two. A very distinctive and characteristic feature of the Laurentian system is the absence, so far as yet examined, of anything like argillite or clay slate. The metalliferous contents of this system are chiefly beds of magnetic and oligist iron, in the gneiss and limestone series. Iron and copper pyrites are also met with in interstratified layers, the former sometimes cobaltiferous; and both of these sulphurets, together with blende and galena, are met with in veins, which cut these strata, but are as late as the Silurian period, the overlying strata of which they sometimes intersect. In the anorthosites, the only ores met with are beds of titaniferous iron or ilmenite.

1. Gneiss, flesh-red, Grenville.
2. " white, with garnets, River Rouge.
3. " pink, " River Ouitchawan.
4. " micaceous, " Joachim Rapids.
5. " pink, granular, with garnets, Grenville.
6. " epidotic, " " Carleton Place.

The most characteristic gneiss of the Laurentian series is represented by 1, which forms great mountain masses, and is so coarse grained, that, except in large masses, it might be taken for an intrusive granite. The mica which it contains, is often black, and sometimes associated with hornblende; giving rise to syenitic gneiss. Small portions of a white triclinic feldspar (albite, or oligoclase), are occasionally found with the red or pink orthoclase; and some coarse grained pegmatites, which are perhaps intrusive, consist of albite and a little quartz, with only small portions of orthoclase. The white gneiss, 2, is porphyroid, holding large cleavable masses of a pure orthoclase, in a granular mixture of the same mineral, with a little quartz and white mica, and garnets. The red gneiss, with green compact epidote, is met with in several localities in Canada. Some varieties of the Laurentian gneiss become fine grained and micaceous, passing into mica schists; but these are of comparatively small amount.

7. Garnet rock, quartzose, Bay St. Paul.
8. " pure, Rawdon.

Beds of red garnet rock are not unfrequent among the quartzose gneiss and quartzites. In the former, the mineral sometimes forms thin layers, marking the stratification. In the latter, small crystals of garnet often abound, particularly near to the limestones, and sometimes give rise to masses like 7, or to beds of a rock like 8.

9. Quartzite, conglomerate, Bastard.
9A. " Rawdon.

The above conglomerate is interstratified with white crystalline limestones, holding graphite and chondrodite. It is worthy of note, that, while some of the pebbles are of vitreous quartz, others are of sandstone, in which the layers of sedimentation are very apparent.

10. Anorthosite, granitoid, Abercrombie.
11. " " Château Richer.
12. " " with ilmenite, Château Richer.
13. " granular, Château Richer.
14. " " Abercrombie.
15. " " white, Rawdon.
16. " granitoid, violet, River Kenogami.
17. " " greenish, ——— ?
18. " granular, Rawdon.
19. " compact, whitish, Grenville.
20. " " greyish, Rawdon.
21. " " bluish-green, ——— ?
22. " gneissoid, with ilmenite, Château Richer.
23. " " " much pyroxene, ——— ?
24. " " " hypersthene, Rawdon.
25. " granitoid, with ilmenite, Château Richer.
26. " with rutile and ilmenite, Bay St. Paul.

The above seventeen specimens show the principal varieties of these remarkable rocks, which are seen, at intervals, from Lake Huron to Labrador. They often form belts of many miles in breadth, which, as before said, overlie, apparently unconformably, the orthoclase rocks and limestones. A notable feature in this formation is the almost total absence of other rocks; in some portions of their distribution these anorthosites are seen to be interstratified with thin bands of orthoclase gneiss, and more rarely with quartzite; but great masses, of thousands of feet in breadth, are found to be made up of alternating varieties of these anorthosites, which, as will be seen, exhibit great varieties of texture. Coarsely granitoid rocks abound, consisting of large cleavable masses of feldspar aggregated, or imbedded in a granular base. We find granular rocks of every grade, passing into compact and impalpable varieties with a concheidal fracture. The composition of these feldspars varies from that of andesine, with sixty per cent. of silica (12), to varieties near anorthite, with only forty-seven per cent. of silica (the bytownite of Thompson). A beautiful pale blue cleavable variety (11) contains fifty-seven per cent. of silica, being intermediate between andesine and labradorite, while many others yield from fifty-two to fifty-five per cent. The white granular rock (15), and many others, have the composition of pure labradorite. The bases, besides alumina, are lime and soda, with a little potash, and traces of iron and magnesia. Ten analyses of chosen specimens of these feldspars, holding from forty-seven to sixty per cent. of silica gave for

their mean composition; silica 56.00, alumina 27.30, lime 9.42, soda 4.84, potash 0.84, magnesia, oxide of iron, water and loss 1.60 = 100.00. The oxygen ratios of the silica, the alumina, and the lime and alkalies, in the above mean, are as 7.0 : 3.0 : 0.96. From their variations in composition, we have been led to regard these triclinic feldspars, whose density ranges from 2.67 to 2.73, as indefinite crystalline mixtures of the two homœomorphous species, anorthite and albite. (See L. E. & D. Philos. Magazine for May, 1855; where also will be found analyses and descriptions of these feldspars.)

The crystalline varieties of this rock often exhibit, in great perfection, the striæ resulting from their polysynthetic macles, and are sometimes beautifully opalescent: the original Labrador feldspar is from this formation. The foreign minerals of these rocks are few in number: quartz has been seen in small portions, but is a rare accident; granular red garnet is sometimes found marking the lines of stratification, generally with pyroxene, and epidote is said to occur with the anorthosites of the Adirondacks. A brownish-black mica, probably biotite, is met with in small quantities in the granitoid varieties, but pyroxene more abundant. It is sometimes dark green and granular, occasionally predominating in small beds, so as to form a pyroxenic rock, in which small kernels, or lenticular masses of cleavable feldspar are imbedded. In other cases, where its quantity is smaller, it may be seen passing into a brownish lamellar variety, like hypersthene; the typical form of which however occurs without any association of granular pyroxene. Hypersthene is seldom an abundant mineral; it passes from brownish-black, with bronze reflections, to a clear greenish variety, like diallage. Small amounts of carbonate of lime are occasionally met with, disseminated in the granular varieties of these anorthosites. Ilmenite is a characteristic mineral, sometimes in thin layers, marking, with pyroxene, the sedimentary layers; at other times in larger masses, or even in beds of great size; as at Château Richer, where it is mixed with rutile.

The predominant colors of these anorthosites are various shades of blue, passing into greenish and yellowish, rarely reddish, and sometimes nearly pure white. The lustre of the cleavable feldspars is vitreous, of the granular varieties waxy or dull. The weathered surfaces are always of an opaque white; but for which, some of the white granular anorthosites might be mistaken, at first sight, for quartzites.

The nomenclature of these rocks presents some difficulties. The name of labradorite-rock sometimes given, is applicable only to certain varieties, and the same may be said of hypersthenite and hyperite, when great masses of the rock are destitute of hypersthene. I have preferred to designate the granitoid, porphyroid, gneissoid, granular, and compact varieties of almost pure anorthic feldspar, which make up the great mass of the formation, as normal anorthosites. The interstratified beds, in which granular pyroxene predominates, would come under the denomination of dolorite or diabase, and the varieties with bronzite or diallage would, by most lithologists, be called euphotide or gabbro. Both of these names, however, would be wrongly applied; the name of gabbro, as Brongniart has shown, belongs to a diallagic ophiolite, or serpentine rock. The euphotide of Haüy consists of smaragdite (a mixture of hornblende and pyroxene) with saussurite, which as we have shown, is a compact epidote or zoisite, with a specific gravity of 3·33 — 3·38. Hence neither gabbro nor euphotide are feldspathic rocks, although the euphotide of Mount Rose occasionally includes portions of a cleavable triclinic feldspar, and thus presents a transition to the diallagic variety of diabase, with which modern lithologists have confounded this epidotic rock. (See Contributions to Euphotide and Saussurite, Am. Jour. of Science, March, 1859.)

The name of diorite is, by good authorities, restricted to rocks whose dominant elements are triclinic feldspars with hornblende. In smaragdite, however, we have a mixture of hornblende with pyroxene, and in many of the so-called euphotides, according to G. Rose, the hornblende entirely replaces the pyroxene; thus forming a transition between diorite and diabase; under which latter name we propose to include the compounds of triclinic feldspars with every variety of pyroxene, except the black augite of the basalt group.

To the rocks composed of augite and triclinic feldspars, are to be reserved the name of dolerite. The pyroxenic anorthosites of the Laurentian series are then varieties of diabase, which includes hypérsthenite or hyperite, the gabbro of Rose, and the euphotide of most modern authors, which latter rocks are forms of diallagic diabase, passing into diorite.

It may here be remarked that although these anorthosites, as well as the gneissic rocks of the Laurentian series, are traversed by joints in various directions, nothing corresponding to slaty cleavage has ever been remarked, and that the lamination of these masses is apparently, in every case, coincident with, and dependent upon, the original stratification of the sedimentary layers. It is only in the Huronian and Silurian series that we meet with a foliation distinct from the bedding; this is confined to the argillites, and is wanting in the more crystalline sediments.

27. Agalmatolite, Diana, New York.

This rock has not yet been met with in Canada, but forms considerable masses at several localities among the Laurentian series, in St. Lawrence county, New York; where it is associated with beds of oligist iron ore, and had been regarded as a serpentine, until Prof. C. U. Shepard shewed its aluminous character, and gave it the name of dysyntribite. The subsequent analyses of Smith and Brush showed it to be a hydrous silicate of alumina and potash, containing, accidentally, portions of lime and magnesia, and having the composition of the agalmatolite of China. Prof. Brush has since found this mineral crystallized in hexagonal prisms, with pyroxene, at Diana. It has the composition of the mineral gieseckite, with which it seems identical, and also agrees with pinite, and with what had been previously named wilsonite. This latter occurs in crystalline masses, with pyroxene and mica, in the Laurentian limestones in Canada. An analysis of the massive agalmatolite from Diana, gave to Smith and Brush, silica 46·70, alumina 31·01, peroxyd of iron 3·69, potash, with traces of soda, 11·68, water 5·30 = 99·88. Farther illustrations of this rock will be given in the descriptions of the Silurian rocks.

28. Steatite, Elzivir.

The mechanical and chemical analysis of this unctuous foliated rock, shows it to consist of talc, with small portions of quartz and of magnetic iron.

29. Pyrallolite, Grenville.

This rock forms considerable beds among the Laurentian limestones, both in Canada and New York; where it was first recognized by Prof. Emmons, and described by the name of rensselaerite. It appears, however, to be identical in chemical and physical characters with the pyrallolite of Nordenskiold, whose name must take priority. This substance occurs massive, granular, and crystallized in the form of pyroxene. It has a specific gravity of 2·7 to 2·8, and a hardness of 2·5 - 3·0, is unctuous, greenish in color, and except in its crystalline texture, cannot be distinguished from a compact talc; with which it is identical in composition. One of several concordant analyses gave silica 61·60, magnesia 31·06, protoxyd of iron 1·53, water 5·60 = 99·79. It is in fact a monoclinic talc, and has, without any good reason, been regarded as a product of the alteration of pyroxene.

30. Pyroxene rock, with hornblende crystals, Madawaska.

31. Hornblende rock, Indian River.

This is a stratified rock, consisting of hornblende with a mixture of feldspar. It perhaps belongs to the anorthosite formation, and may be considered a diorite.

32. Pyroxene rock, with sphene, Chatham.

Small beds and interstratified masses of pyroxene rock, occur among the Laurentian limestones, and present many varieties. In 30, we have a greenish-white massive and crystallized pyroxene, with a density of 3.27; associated with crystals of a dark green aluminous hornblende (pargasite), of density 3.05, and sometimes with black tourmaline. In 32, we have a rock made up of green pyroxene, with calcareous spar and quartz; holding crystals of sphene. Sometimes a feldspar enters into the aggregate, and the rock consists of quartz and pyroxene, with an orthoclase, which is found to contain potash, with but little soda. The loxoclase of Breithaupt, which belongs to a compound rock of this kind, is, however, according to Smith and Brush, an orthoclase, in which soda predominates; and in a similar rock, with sphene, is occasionally found a triclinic species, like oligoclase. Scapolite (a dimetric feldspar) sometimes takes its place, giving rise to a pyroxene and scapolite rock.

33. Ophiolite, opaque and earthy, Calumet Island.

34. " pale green, Burgess.

35. " retinalite, Talon Portage.

36. " calcareous, yellow, Grenville.

37. " " greenish, "

We distinguish by the name of ophiolite, all rocks with a base of serpentine. In the Laurentian series, ophiolites occur, interstratified with the limestones, but offer few varieties. Their colors are usually much paler than those of the Silurian series, from which they differ in containing smaller proportions of the oxyd of iron, and in the absence of those of chrome and nickel; which are constantly present in the latter. The Laurentian ophiolites are sometimes, however, of a dark red color, from the presence of disseminated peroxyd of iron. The retinalite of Thompson is but a light-colored and very pure serpentine, which is noticeable for its low specific gravity, 2.36—2.52, and its large proportion of water, which equals 15.0 per cent. These ophiolites sometimes include mica; and the calcareous mixture which they hold, is often dolomitic.

38. Limestone with apatite and phlogopite, Burgess.

39. " " chrondodite and graphite, Newborough.

40. " " apatite, fluor, and spinel, Ross.

41. " " brown tourmaline, Ross.

42. " " quartz, Bastard.

43. " " with pyroxene, ——— ? 47.

44. " " grey, with hornblende, Marmora. 48.

45. " " graphite and sphene, Grenville. 49.

46. " " pyroxene, Horton.

Four bands of crystalline limestone have been identified in the great Laurentian system, which are equal in volume to the ordinary limestone formations of the fossiliferous rocks. Reposing upon a vast thickness of orthoclase gneiss, we have the lowest limestone band, of about 1500 feet; to this succeed about 4000 feet of similar gneiss, followed by a second limestone formation of 2500 feet; including two bands of quartzite and hornblendic orthoclase gneiss, equal to one half the volume. Following this, are 3500 feet of orthoclase gneiss, with quartzites at the base, and a third limestone band above; whose thickness varies in different parts of its outcrop, from 60 to 1500 feet. This is overlaid by 1500 feet more of gneiss, and a fourth thin band of limestone; followed by 3400 feet of quartzite and gneiss, exhibiting towards the summit, interstratified portions of anorthosites, which mark the passage to the succeeding formation. The thicknesses assigned to these masses are, however, only approximative.

The Laurentian limestones contain most of the mineral species which are met with in the crystalline limestones of other regions. Among them are apatite, fluor, wollastonite, hornblende, pyroxene, chrondodite, phlogopite, orthoclase, oligoclase, scapolite, garnet, idocrase, tourmaline, serpentine, loganite, agalmatolite, clintonite, voicknerite, quartz, spinel, corundum, zircon, sphene, iron and copper pyrites, and graphite. Many of these minerals, such as serpentine, chondrodite, graphite, and mica, are disseminated so as to mark the stratification of the limestones. The mica, in the pure limestones, generally occurs in small scales, but sometimes in large crystals. These last are, however, most frequent in pyroxenic beds, and often with a soft steatitic mineral, having the form of pyroxene, and the composition of pyroxclerite; to which it sustains the same relation as pyrallolite does to talc, and constitutes a new mineral species, called loganite. The magnesian mica, or phlogopite, often yields plates more than a foot square; which may be seen in the accompanying collection of economic minerals.

The contortions in the stratification of the limestone, show that it was once in a plastic condition, and the traces of its movement at that time, are curiously preserved, in several places, by thin interstratified layers of quartzite; which have been not only folded and broken, but twisted and rolled upon themselves, as leaves of paper would be in an agitated liquid. Occasionally we see the limestone extended among the overlying and broken layers of quartzite or of gneiss, and taking, for short distances, the form of an exotic rock.

Phosphate of lime sometimes occurs in disseminated crystals or rounded masses, in these limestones. It is a fluor-apatite, with but about one two-hundredth of chlorine, and is occasionally accompanied by fluor-spar, as in 40. These beds have been traced for several miles in the limestone, and are sometimes associated with layers of nearly pure crystalline

apatite. To one who is accustomed to look upon the graphite, and the great beds of iron ore in this system, as evidences of the intervention of organic life during the Laurentian period, these layers of phosphate of lime seem to be accumulations of coprolitic matters, from the animals (perhaps marine) of that period; in fact, the ancient representatives of modern guano beds. In the unaltered strata at the base of the Silurian system, layers of both limestone and sandstone, abound in phosphatic coprolites, apparently derived from the Lingulas, Orbiculas, Conularias, and Serpulites, of those early times; the shells of all of which have been shown by us to have essentially the composition of the skeletons of vertebrate animals.—*Am. Jour. of Science* (2), xvii. 235.

47. Dolomite, with green mica, Indian River.

48. " " white mica, Madawaska.

49. " " tremolite, "

Great beds of crystalline dolomite, and of limestones more or less magnesian, occur, interstratified with the purer limestones of this series. They are often very fine grained, and sometimes resemble statuary marble; others contain a portion of peroxyd of iron, and weather to a reddish-brown. Foreign minerals are less abundant in the dolomites than in the limestones; but besides mica, tremolite, and quartz, serpentine sometimes abounds, forming a dolomitic ophiolite. We shall consider the chemical and geological relations of dolomites, and the theory of their formation, in describing the Silurian rocks.

II. ROCKS OF THE HURONIAN SERIES.

The rocks which have been designated as the Huronian series, rest upon those of the Laurentian system, and are in part made up of the ruins of the latter. The unaltered and horizontal Lower Silurian strata, in their turn, repose upon the inclined and metamorphosed Huronian rocks, which are therefore regarded as constituting a distinct and intermediate formation. This seems, from its geological horizon, not less than from its lithological characters, to correspond to the quartzose division of the Primitive Slate Formation of Scandinavia. The Huronian series is met with at Lake Temiscaming, on the Ottawa, and on Lakes Huron and Superior. It is not known farther eastward, but it is not unlikely that it constitutes some portions of the Azoic rocks of the Upper Mississippi, and of Arkansas and Missouri.

The thickness of the Huronian series on the north shore of Lake Huron, is approximatively estimated at 18,000 feet. Of this, more than 10,000 feet are quartzites, which are sometimes schistose and micaceous. The remainder consists of chloritic and argillaceous slates, which occasionally hold epidote, and, like the quartzites, often become conglomerates. Three small bands of impure limestone occur in this formation, two of which are associated with layers of chert or hornstone. Throughout the whole formation, are interstratified great beds of crystalline greenstone or diorite, sometimes several hundred feet in thickness.

We remark in this series of rocks, but a small amount of carbonate of lime, and an absence of well characterized gneiss or orthoclase feldspar rocks. An impure ferruginous serpentine has been observed in the series, near Marquette, but no steatites nor talc slates. Its metalliferous minerals consist of beds of specular iron, to which species the great mines of Marquette, in Northern Michigan belong, and of large quantities of sulphurets of copper. The copper ores sometimes occur disseminated in the diorites or chloritic slates, but more generally in well-defined veins of quartz, which traverse the dioritic rocks.

1. Quartzite, white granular, Island near Grant's Island.
2. " " vitreous, Grande Batture Point.
3. " brown " Thessalon River.
4. " " schistose, Lacloche.
5. Limestone, slaty, Clear Lake.
6. Quartzite, conglomerate, with jasper pebbles, Bruce Mines.
7. " " " "

Quartzite may be said to be the predominant rock in the Huronian series. Its colors are white, gray, brownish, and sometimes greenish or reddish, and its texture is various; it being sometimes vitreous, and at other times, a granular sandstone. It is not unfrequently schistose, and sometimes slightly micaceous or feldspathic, but true gneiss and mica slate have not been met with in this series. These quartzites often become conglomerate, from the presence of various colored pebbles of quartz and jasper. The latter are frequently blood-red in color, and being imbedded in a white or a greenish base, constitute a very beautiful rock.

8. Argillite, bluish, talcoid, Spanish River.
9. Hornstone, in limestone, Chert Point, Lake Superior.
10. Limestone,
11. " Lake Huron.

The limestones of this series are but small in amount. One band of 300 feet in thickness has however been traced for considerable distances. Its colors are chiefly greyish, greenish, or buff, rarely white, and its fracture is concheidal, and sometimes granular. It is often ferruginous and yellow-weathering, and is somewhat magnesian. Thin silicious layers give to its weathered surface a very uneven aspect. It is strikingly contrasted with the Laurentian limestones, by the absence of any pure crystalline varieties, or imbedded crystalline minerals. Two other bands, of 200 and 400 feet respectively, consist of similar impure limestones, with regular layers of yellowish chert, the latter predominating. Beds of this chert or hornstone are sometimes interstratified with the adjacent quartzites.

12. Argillite, greenish, Grant's Island, Lake Huron.
13. " " with pyritous copper, Root River, Lake Huron.

Beds of clay slate are sometimes met with in this series; they are occasionally bluish and talcose in their aspect, and at other times greenish, and apparently somewhat chloritic. We have noted the absence of clay slates from the Laurentian system; and their presence in the Huronian series, shows a condition of things approaching to that of the Silurian period, when we find these rocks in much greater abundance.

14. Silicious slates, Mississaugui.

15. " " Clear Lake.

16. " " conglomerate, Echo Lake.

17. " " " "

Great masses of a greenish slaty rock are met with in this series, which varies in hardness and texture, from a silicious slate, passing into hornstone, on the one hand, to an argillaceous or a chloritic slate, which is sometimes epidotic, on the other. These slates frequently include pebbles of crystalline rocks, which are chiefly feldspathic, and derived from the Laurentian strata. With these are, however, sometimes mingled others of quartz and of various colored jaspers. The pebbles vary much in their amount, and the rocks pass from ordinary slates, to what have been designated in the descriptions of this series, as slate conglomerates. The matrix of these is sometimes an argillaceous or chloritic slate, and occasionally becomes very quarizose, passing into a quartzite; so that it is not easy to draw the distinction between the conglomerate slates, and the jasper conglomerates of the quartzites.

18. Diorite, compact.

19. " fine grained, Dirty Lake.

20. " coarse grained, "

The diorites or greenstones of the Huronian series are intercalated in beds, alike with the quartzose and the argillaceous and chloritic members. They are sometimes coarse grained and crystalline, being made of dark green hornblende and a greenish feldspar. In other parts, the rock becomes finer and even compact in its texture, and it is frequently porphyritic from the presence of crystals of feldspar. Great masses of the rock become schistose, and are often intermingled with a considerable amount of chlorite, passing into dioritic and chloritic slates; which are often associated with a considerable amount of epidote, generally granular or imperfectly crystallized. In one locality, amygdaloidal strata, holding in their cells, quartz and calcite, are found interstratified with the chloritic and the porphyritic beds. In some few instances, the feldspar in the coarse-grained diorite becomes reddish, and the rock includes a little quartz, passing into a variety of syenite. The Huronian series is traversed, like the Laurentian, by dykes of greenstone trap; but the great beds of diorite just noticed, are considered to be altered sedimentary rocks.

III. ROCKS OF THE SILURIAN SERIES.

The Notre-Dame and Shickshock Mountains are the north-eastern prolongation of the great Appalachian chain, which extends from the Gulf of St. Lawrence, nearly to the Gulf of Mexico. These mountains, at least in Canada and New England, are altered sediments of Palæozoic age, and are referred to the Quebec group; which corresponds to the inferior part of the Lower Silurian series. They attain, in some places, a height of more than 4000 feet above the sea, and appear to be generally synclinal in their structure. The rocks are highly metamorphosed in the mountainous region, which constitutes a narrow belt, but on the north and west of this are found in a comparatively unaltered state. These hills, and the region around them, offer almost every variety of metamorphic sediments, but they are very deficient in intrusive rocks, of which scarcely a single dyke can be met with. The country on both sides of the altered mountainous belt, abounds in intrusive masses of various kinds, some of which will be described in the succeeding portion of this catalogue.

1. Gneiss, Sutton Mountain.

1A. Gneiss, granitic, St. Joseph.

Great masses of orthoclase gneiss are met with in this series. They are generally fine-grained, and are more quartzose than those of the Laurentian system; with which the practiced observer will never confound them. The coarse-grained and porphyritic reddish and white varieties are never met with, and the gneiss is generally of pale greyish or greenish hues. In some cases, great portions of it are so destitute of marks of stratification, that but for their relations to the adjacent beds, they might be taken for intrusive masses. The mica is generally white or greyish, and in small quantity.

2. Anorthosite, Melbourne.

2A. " Orford.

3. " with serpentine.

Rocks composed of triclinic feldspars, and representing the anorthosites of the Laurentian system, are common in this series; they are however never coarsely crystalline, and are often compact. In some cases the feldspar approaches to albite or to oligoclase in composition. Through an intermixture of hornblende, these rocks pass into diorite.

4. Diorite, St. Francis.

5. " Tring.

6. " Acton.

7. " "

8. " St. Joseph.

In the diorites of this series, the feldspar is sometimes the predominant element. One from Orford was found, by analysis, to consist of sixty-four parts of albite, and thirty-six of hornblende; another contained seventy-four parts of a feldspar, which was near albite in composition, but contained as much potash as soda. Others of these diorites exhibit a predominant of hornblende, often mingled with a chloritic mineral, and constitute veritable greenstones; which, however, appear to be in all cases sedimentary rocks. They are frequently so finely granular as to appear at first sight homogeneous, while at others they are rather coarsely crystalline, or sometimes porphyritic, from the presence of large feldspar crystals. The specimen from St. Joseph is associated with compact white garnet and crystallized hornblende.

9. Epidosite (epidote and quartz), Melbourne.

10. " schistose, with oligist iron, "

11. " chloritic, with epidote nodules, St. Armand.

12. Epidotic rock, with calcite and argillite, St. Joseph.

Epidote is a characteristic mineral of great portions of this series. Sometimes it forms with quartz, a fine-grained compact rock, which is found in thick beds in the Shickshock Mountains. At others, the epidote is disseminated in nodules, in a fine grained siliceous rock, which often becomes chloritic or argillaceous.

13. Garnet-rock, St. Joseph.

A massive white lime-alumina garnet occurs in beds in this series, sometimes in contact with ophiolite, or mingled with feldspar and hornblende (as in 8), or with an admixture of serpentine. This garnet-rock is extremely tough, in some cases imperfectly crystalline, and has a specific gravity, when pure, of 3·53. Other specimens, probably mingled with feldspar or hornblende, and greyish or greenish in color, have a density of 3·3—3·4.

14. Epidotic rock, argillaceous, St. Joseph.

15. " " " " "

These specimens, which should be placed with 12, from the same locality, are from a great mass of argillaceous rock, which passes into red shale in some parts, and in others, is concretionary in its structure. It would appear as if the clay had originally contained septaria, the fissures in which, as well as the interstices, have become filled with epidote, which is often crystalized, calcite, quartz, and sometimes talc. These altered argillites are in the immediate vicinity of the opholites, and, in some specimens, much resemble the *gabbro rossi* of the Italian geologists.

16. Mica-rock, Shipton.

This soft grey schistose rock, a bed of which has been wrought as a variety of potstone, has nearly the composition of a hydrous mica, with only three per cent of alkalies, and fifty-one per cent. of silica.

17. Mica-schist, Sutton.

18. " " St. Joseph.

19. " " Ireland.

20. " " Ste. Marie.

These mica-schists are very variable in their nature, and often highly quartzose; not unfrequently they have the aspect of what are called talcose slates, without however containing any magnesia, and owe their peculiar characters to a mica like that of 16, or perhaps to pholerite or pyrophylite. Pholorite is sometimes found in a pure state, in fissures in the sandstones of this series; and pyrophyllite forms beds, resembling steatite, in the same formation in the southern United States; where it also occurs crystallized with quartz.

21. Argillite, talcoid, Ireland.

22. " plumbaginous, Melbourne.

23. Mica-schist.

24. Sandstone, Granby.

25. Argillite, reddish, Ste. Marie.

26. " bluish "

27. " with orthoclase and quartz, Cleveland.

28. " chloritic, Durham.

29. " with red orthoclase, Cleveland.

The argillaceous rocks of this series present many varieties, from roofing-slates, and talcoid and plumbaginous shales, to others which are more or less chloritic or micaceous. The specimen 27 is remarkable from containing small oval masses of regular outline, consisting of orthoclase and quartz. Their exterior portion is generally of feldspar, the centre being filled with quartz; but sometimes the one or the other is wanting, and the kernels consist of quartz or of feldspar only. These oval masses, which are from one-eighth to one-half an inch in length, have their greater diameters parallel. The rock might be called an amygdaloid. Some portions of these argillites are penetrated by small veins and irregular masses of bright red orthoclase. This feldspar is occasionally found in veins with quartz, chlorite, and bitter-spar, intersecting these slates.

30. Chloritoid-schist, Leeds.

Chloritoid is abundant in quartzose mica schists, in this series. It is generally in small plates, but sometimes in tables one-fourth of an inch in diameter, often arranged in spherical aggregations. It has a specific gravity of 3·5, and the usual composition of the species. Chloritoid is identical with the barytophyllite and the sismondine of different authors. It is also supposed to be the phyllite of Thompson, and the ottrelite of Hauy, both of which closely resemble it in appearance.

31. Iron-schist or itabirite, Sutton.

32. " " "

33. " " Plymouth, Vt.

Great beds of a rock made of scales of specular iron, with quartz and chlorite, are met with in the altered Silurian strata. They are sometimes rich iron ores, and at other times contain but small portions of the metallic oxyd. These specular schists often include a portion of titanic acid, which is occasionally seen in the form of rutile or of sphene, crystallized in veins, sometimes with feldspar. These rocks are apparently identical with the itabirite of Brazil.

34. Magnetic iron in dolomite, Sutton.

Magnetic iron ore is often found in these rocks, in irregular beds or masses in serpentine. In Vaudreuil, there is found a bed of granular ore, of which two-thirds are pure magnetite, and the remainder ilmenite; the two being intimately mixed. Grains and octahedral crystals of magnetite also occur in the chloritic schists, and in the present specimen, the crystals are so abundantly disseminated in some parts of a bed of chloritic dolomite as to constitute a valuable iron ore. This dolomite is remarkable for containing eight per cent. of carbonate of manganese.

35. Copper pyrites in chloritic limestone, Ascot.

36. Variegated copper in micaceous schist, Sutton.

37. " " " " "

Copper is abundantly distributed in this formation, generally disseminated in the beds, and forming an integral portion of the rock, in the shape of grains or lenticular patches. The yellow and variegated sulphurets, copper glance, and sometimes native copper, are met with alike in quartzose, argillaceous, micaceous, and chloritic slates, in limestones, and in dolomites. At Acton, the latter two ores form the cementing material of a conglomerate rock, made up of limestone and silicious matters. The copper in these strata seems to have been a contemporaneous deposit from aqueous solutions.

38. Hornblende rock, with garnets, Shickshock Mts.

Beds of black crystalline hornblende rock, including small crystals of red garnet, occur with the serpentines of Mount Albert. In many other parts, hornblende in the form of actinolite, or a tough, fibrous variety allied to it, forms beds of great thickness.

39. Diallage rock, Orford.

Diallage is abundant, not only as a component of some ophiolites, but sometimes forming a rock, either by itself, or with a little mixture of an amorphous mineral, which approaches to pyroxclerite in its composition.

40. Ophiolite, (serpentine,) Orford.

41. " St. Joseph.

42. " Melbourne.

43. " conglomerate, Orford.

44. " schistose, Melbourne.

Under the name of ophiolite we include those rocks which have serpentine for their base. The normal ophiolites are nearly pure serpentine, while some are mixtures of serpentine and carbonate of lime (calcareous ophiolites), and others dolomitic and magnesitic ophiolites; containing respectively dolomite and carbonate of magnesia, often in large proportions. All of these varieties are met with in Canada, or in the adjacent state of Vermont. These compound ophiolites are sometimes porphyritic from the presence of diallage (the Italian gabbro). At other times, they have the aspect of conglomerates, exhibiting rounded or angular masses of pure serpentine of various sizes, imbedded in a dolomitic paste, itself more or less colored by intermingled serpentine. A magnesitic ophiolite from Vermont has a gneissoid structure, due to the arrangement of the crystalline magnesite spar, with lamellæ of talc, apparently marking planes of stratification. The ophiolite of Mount Albert is marked with red and green bands, (see specimen 59,) which have the aspect of sedimentary layers; and the relations of the ophiolite throughout this series, where its outcrop has been followed for hundreds of miles, are always those of an interstratified deposit, and never of an eruptive rock. It occurs with dolomite, magnesite, steatite, diorite and argillite, with each one of which it has been found in contact, and it seems sometimes to replace the other magnesian rocks. Its beds vary from a few yards to several hundred feet in thickness. The colors of these ophiolites are of various shades of green; generally much darker than those of the Laurentian series. A red color sometimes occurs in patches and bands, or pervades the whole mass; this, in some cases, at least, is due to an intermixture of red hematite. Foliated and fibrous varieties (baltimorite and chrysotile) are frequently found in veins in these ophiolites. Chromic iron is also a characteristic mineral, in grains, or in interstratified beds or lenticular masses, often of large size. Magnetic iron occurs in these ophiolites, both in grains and beds, sometimes with ilmenite.

The analyses of the serpentines of these ophiolites show them to contain from seven to ten per cent. of protoxyd of iron, to which they owe their color, besides small portions of oxyds of chrome and nickel. These two metals often occur in the magnesian rocks of this series, in the form of chromic iron and sulphuret of nickel; but are in many cases present as integral portions of the silicate. This is true, not only of the serpentines, but of the diallage and acti lite rocks, and many of the dolomites and magnesites. It would seem that chrome and nickel were constant accompaniments of the magnesian deposits of the present series. We have also detected these metals in the ophiolites of California, of Portsoy in Scotland, Cornwall, the Vosges Mountains, Mount Rosa and Corsica; while they are wanting in the Laurentian ophiolites of Canada, and in specimens of serpentine from Norway, supposed to be of the same formation.

45. Steatite, Bolton.

46. " with bitter-spar, Ireland.

Besides the so-called talcose slates of this series, which are for the greater part aluminous, true talc slates, or schistose varieties of steatite are not unfrequent. These are sometimes nearly pure talc, and at others mingled with hornblende, in the form of actinolite, or with bitter-spar. They yield to analysis a few thousandths of oxyd of nickel.

47. Chlorite (potstone,) Bolton.

The chloritic slates of this series are often mingled with quartz and with epidote, and sometimes with specular iron. In other cases, however, beds of pure, compact, and somewhat schistose chlorite, occur.

48. Magnesite, Sutton.

49. " Bolton.

Magnesite rocks have been met with in three localities in this series. That of Sutton occurs with dolomite and steatite, and consists of carbonate of magnesia with some carbonate of iron, intermixed with grains of a feldspathic mineral, and a green, chromiferous mica. The magnesite of Bolton forms an immense bed, between steatite and diorite, and contains a mixture of grains of quartz, besides small portions of both chrome and nickel. In a third locality, the magnesite, which is compact, earthy, and yellow-weathering, is interstratified with argillite, and resembles in appearance many of the magnesian limestones of the region.

50. Dolomite, Leeds.

51. " conglomerate, Leeds.

52. " " Shefford.

53. Limestone, Ste. Marie, Beauce.

54. " plumbaginous, Melbourne.

Dolomites, or magnesian limestones, are abundant in this series, and frequently accompany the ophiolites, into the composition of which, as we have seen, they often enter. These dolomites are generally ferruginous, often containing eight or ten per cent. of carbonate of iron, and sometimes as much carbonate of manganese. They are often mingled with a portion of clay, or of siliceous sand, sometimes considerable in amount, and very frequently become conglomerates, enclosing pebbles or rounded masses of pure limestone, and more rarely of sandstone, shale, or dolomite, in a paste of ferruginous red-weathering magnesian limestone. In some cases, these rocks have the composition of a true dolomite, in which the oxyds of iron and manganese replace a portion of magnesia. In others, the quantity of lime is not equivalent to the other protoxyds, and we have a passage to the magnesites already described; which are rocks consisting of carbonates of magnesia and iron, with little or no carbonate of lime. The carbonate of iron occasionally predominates in these, and in one instance, a bed of spathic carbonate of iron occurs. The foreign minerals of these rocks are few in number; chlorite, talc, hornblende, pyroxene, and brown garnet are sometimes met with, and a green chromiferous mica, probably allied to fuchsite, occurs in small scales, both in the magnesites and in the dolomites. An emerald-green garnet with six per cent. of chrome, is also, in one place, associated with these magnesian rocks. With the ferruginous dolomites, are often interstratified beds of pure limestone, which frequently enclose concretionary fibrous masses, made up of concentric layers, like the recent deposits of travertine from calcareous waters.

55.

56.

57.

58.

The conditions under which these dolomites and pure limestones are associated, are such as to leave no doubt that they have been contemporaneous deposits, and to forbid the notion of the formation of dolomite by any subsequent alteration of the limestones. In a series of investigations published in the Reports of the Geological Survey for 1857 and 1858, we have endeavored to explain the origin of these carbonates of lime and magnesia, and their associations in nature. It has there been shown that when waters holding bicarbonate of soda in solution, act upon sea-water, containing chlorids of calcium and magnesium, the whole of the lime is first precipitated in the form of carbonate, with but a very small proportion of magnesia. A farther addition of the alkaline carbonate, if fresh supplies of lime salts are excluded, gives rise to a very soluble bicarbonate of magnesia, which, by evaporation, is separated as a hydrous carbonate. This, when heated alone to 300° F., under pressure, to prevent the loss of carbonic acid, is changed into magnesite, but if mingled with carbonate of lime, a double salt results, which is dolomite. The sources of the alkaline carbonate are to be found in decomposing feldspars; the surface waters from regions of feldspathic rocks, and the springs which traverse the debris of such rocks, are still, at the present day, impregnated with carbonates of soda and lime; in the latter case, they are often accompanied with oxyd of iron and with rarer metals. In this way the metalliferous character of many dolomitic formations is explained. The carbonated rocks have thus been formed by a series of decompositions, the results of which are represented by the clays and argillites (which are feldspars that have lost a portion of their alkali), by the limestones and dolomites, and by the chloride of sodium in the sea, and in the rocky strata. All limestones, as well as dolomites, are the result of this chemical process, which furnishes the elements for the limestones of organic origin. Great masses

of carbonate of lime, in various formations, as for example the statuary marbles of Lower Silurian age, in Vermont, are purely chemical in their origin, and do not result from the metamorphism of fossiliferous limestones.

These views were first enunciated in the reports of the Canada Geological Survey, already cited, and in the Am. Jour. Science, May 1858, xxv, 102, and Quar. Jour. Geol. Soc. London, for 1859, p. 492. In a sealed packet deposited by Cordier, with the French Academy, some years ago, and opened since his death, the same views are suggested. —*Comptes Rendus de l'Acad., Feb.* 17, 1862.

The magnesian limestones, commonly associated with beds or masses of gypsum, appear to have been formed by a reaction pointed out in the above Reports; in virtue of which, solutions of bicarbonate of lime, when mingled with evaporating waters holding sulphate of magnesia, give rise to sulphate of lime, which is first separated, and to a more soluble bicarbonate of magnesia, which is deposited by farther evaporation, mingled with a farther portion of carbonate of lime. The sulphate of magnesia, which, in Canada, as elsewhere, often exudes from these dolomites, appears not to be due, to a subsequent reaction between the dolomite and the gypsum, but to have been an original element of these rocks.

55. Chert, Cape Rouge.

56. Sandstone, St. Nicholas.

57. " "

58. Agalmatolite, "

The agalmatolite of St. Nicholas, which had at first been taken for serpentine, was described, with analyses, in the Report of the Survey for 1850, under the name of parophite. The subsequent analysis of the dysyntribite of Shepard, from the Laurentian series, showed the identity of the two rocks which have, as already remarked on page 67, the composition of agalmatolite or of the onkosin of Kobell. The specimens from St. Nicholas form thin layers, often concretionary, in an earthy shale, which has apparently the same composition. In other localities in this series, however, the agalmatolite appears as a soft, unctuous, translucent, yellowish-green rock, which is either granular, or has an indistinctly ligneous structure, with a satiny lustre.

Deposits of silica, which are evidently of chemical origin, and which assume the forms of hornstone or jasper, as they include more or less argillaceous or ferruginous matter, are not unfrequent among the mechanical sediments of this series. The two specimens of sandstone from the unaltered strata of the Quebec group at St. Nicholas, are supposed to represent the granitic gneiss of the altered portions of the same formation. The cement, in some of these sandstones, is a feldspathic matter, rich in potash; and the analysis of the rock, as a whole, gives a composition identical with the mixture of quartz, orthoclase, and mica, which constitutes this gneiss. The metamorphism of these aluminous rocks consists, then, simply in the crystallization of the silicates of alumina and alkali in the sediments, a reaction which has taken place at no very elevated temperature; the alkaline silicates and carbonates, by which the waters of these sediments are impregnated, aiding the process. At the same time, the reactions between the silicious and argillaceous matters, and the earthy carbonates, in the presence of these alkaline solutions, give rise to chlorite, garnet, and epidote. These views, together with various experiments on the artificial formation of silicates, were published in the Am. Jour. Science for May 1857, p. 438, and the Proc. Royal Society for May 7, 1857. They are also given in the Report of the Geological Survey of Canada for 1856, p. 479; all of which appeared anterior to the first publication of Daubrée; who, in November 1857, brought forward some striking experiments in support of the theory of the metamorphism of sediments, at comparatively low temperatures, by the intervention of alkaline salts.

In the Report for 1858, p. 188, will be found some account of the results of local metamorphism of limestone near a trap dyke at Montreal. The limestone here contains a portion of an argillaceous matter, with 70 per cent. of silica, consisting of finely divided orthoclase and quartz. Where the beds have been rendered crystalline, near the intrusive rock, these substances have become saturated with lime, magnesia, and oxyd of iron; and there results a silicate of these bases, with alumina, containing only 40 per cent. of silica. By similar reactions, the various silicates of lime and magnesia, both hydrated and anhydrous, may be formed; including both serpentine and talc. Steatite is however doubtless but the result of the molecular metamorphism of sepiolite, a silicate of magnesia which occurs in beds in many Tertiary deposits; and ophiolites have probably originated in beds of a similar magnesian silicate. The source of these silicates may be traced to the spontaneous evaporation of natural waters, many of which deposit silicates of lime, magnesia, and oxyd of iron. The proportion of silica in solution in the waters of the Ottawa River, is one third of all the solid matters (which amount to 6 parts in 100,000), and a part of this remains dissolved, together with lime and carbonate of soda, in the concentrated water; which, like that of the St. Lawrence, deposits an earthy silicate by farther evaporation. (Report of Geol. Survey for 1853-56, p. 360.)

The problem of rock metamorphism is the conversion of mechanical or chemical sediments into definite mineral species, by molecular changes, or by chemical reactions between their elements. Pseudomorphism, which is the change of one mineral species into another, by the introduction, or the elimination of some element, presupposes metamorphism; since only the definite mineral species of metamorphic rocks can be the subjects of this process. To confound metamorphism with pseudomorphism, as some have done, is therefore an error. It may be further remarked, that, although certain pseudomorphic changes may take place in some mineral species, in veins, and near to the surface, the alteration of great masses of silicated rocks by such a process, is an unproved hypothesis.

IV. INTRUSIVE ROCKS.

The results of recent geological investigations in various parts of the world, lead to the conclusion that many rocks, formerly regarded as intrusive or exotic, are really sediments, altered *in situ*, or indigenous rocks. Such is the case with many granites, syenites, greenstones, amygdaloids, porphyries and serpentines; all of which are represented among the altered strata of Canada. These sediments at the time of their metamorphism, were however in such a plastic state, that they were sometimes displaced and forced among the overlying and disrupted strata. It is not improbable that the intrusive granites, which are so abundant among the Devonian rocks to the south and west of the Notre-Dame Mountains, are the equivalents of the feldspathic sandstone and granitoid gneiss of the lower Silurian series. It is worthy of note, that intrusive masses are extremely rare in the Laurentian system, so far as known, except in one small area in the counties of Grenville and Argenteuil, where a succession of eruptions of dolerite, syenite, and quartziferous porphyry, occurred before the commencement of the Silurian period. In the same way, the great masses of the Lower Silurian mountains are free from intrusive rocks. To the south-east of them, however, occur the Devonian granites just mentioned, and to the north-west, along the vallies of the St. Lawrence and Lake Champlain, are a series of intrusive dolerites, diorites, and trachytes. The most remarkable of these, in Canada form a line of isolated hills, eight in number, extending about ninety miles along the line of an undulation, which runs nearly east and west, or almost transverse to the Notre-Dame Mountains, and has disturbed the Lower Silurian strata. These hills, beginning from the west, are Rigaud, Mount Royal, Montarville, Belœil, Rougemont, Yamaska, Brome and Shefford Mountains, to which may be added Mount Johnson, or Monnoir, a little to the south of this line. Brome and Shefford are on the confines of the metamorphic region. These masses, which were intruded among the members of the Lower Silurian series, have

been left by denudation, as hills, covering areas of several miles, and sometimes more than 1000 feet in height, and present great varieties in composition. Brome and Shefford are granitoid trachytes, Yamaska, partly trachyte and partly diorite; to which latter rock also belongs Belœil, so far as examined, and Monnoir. Rougemont, Montarville, and Mount Royal are dolerites, and Rigaud is, in great part, a granitoid trachyte. Dykes of numerous varieties of trachyte and of phonolite, cut the dolerites of Mount Royal, and the shales of the Hudson River formation. The conglomerate of St. Helen, which overlies and encloses masses of Upper Silurian limestone, as well as fragments of granitoid dolerite, is in its turn traversed by dykes of a newer rock, which is also a dolerite. The strata in the vicinity of these intrusive masses are not altered, except near the line of contact. (See page 80.) The present collection includes only a few of the more characteristic varieties of these intrusive rocks.

1. Quartziferous Porphyry, Grenville.

In the county of Grenville, the Laurentian limestones and gneiss are successively cut by intrusive masses of dolerite, syenite, and quartziferous porphyry, all of which rocks are older than the Silurian period. The last of these, which is an orthophyre or felsite porphyry, has a compact, apparently homogeneous base, inclosing crystals of orthoclase, and more rarely, grains of quartz. The color of the crystals is of different shades of red, while the base varies from black to purplish and greenish hues, and is found by analysis to consist of an intimate mixture of orthoclase and quartz, colored apparently by oxyd of iron. This porphyry receives a fine polish, and some varieties of it are very beautiful.

2. Trachyte, granitoid, with hornblende, Shefford Mountain.

3. " " " mica, Brome Mountain.

4. " " " " Yamaska "

5. " compact, with pyrites, Montreal.

6. " " "

7. " " "

8. " " red-weathering, "

9. " " Lachine.

10. " porphyritic, Montreal.

The mountains of Shefford and Brome are masses of intrusive rock, which break through the shales of the Quebec group; the latter, which is the larger, occupying an area of about twenty square miles. These mountains are composed of a granular rock, which might be mistaken for granite, but for the absence of quartz. It is an aggregate of crystalline grains

of orthoclase feldspar, with a small admixture of hornblende or black mica, which appear in different parts to replace one another. The rock is sometimes fine-grained, but in other parts consists of cleavable forms of orthoclase, which are occasionally half an inch in length. Small grains of magnetite, and of yellow sphene are also sparingly disseminated. This rock, from the absence of any mineral as a cementing medium between the grains of feldspar, is very friable, and rapidly disintegrates at the surface. Its structure and composition are such that it may be designated a granitoid trachyte. The feldspar has a specific gravity of 2·56. One of several concordant analyses, from different localities, gave for its composition: silica 65·15, alumina 20·55, lime 0·73, potash 6·89, soda 6·67, volatile 0·50 = 99·99.

A variety of this trachyte, from a dyke near Chambly, consists of large well-defined orthoclase crystals, in a fine-grained, lamellar base, both having nearly the same composition as that just given. The vicinity of Montreal abounds in trachytic dykes, which are generally fine-grained; they are sometimes crystalline, and at others earthy in texture, and are occasionally porphyritic from the presence of feldspar crystals. They are generally white or grey, and more rarely lavender-colored or purplish in hue. These trachytes often contain disseminated earthy carbonates, in some cases amounting to from seven to fifteen per cent., and consisting of carbonate of lime, with considerable proportions of carbonates of magnesia and protoxyd of iron. These varieties of trachytes are often grey, granular, and sub-vitreous, but effervesce freely with acids. The more earthy of them are sometimes weathered to a little depth, and reddish from the peroxydation of the iron. The insoluble residue of all these rocks approaches in composition to the orthoclase above described. In some cases, these trachytes contain an admixture of a hydrated silicate, which gelatinizes with acids, and has the composition of a zeolite: through this admixture they pass into phonolite.

11. Phonolite, Lachine.

This rock forms a large dyke, traversing the shales of the Utica formation. It is a fawn-colored compact mass, with a somewhat schistose fracture, and has a specific gravity of only 2·41. It effervesces slightly, and gelatinizes with acids, and is found by analysis to consist of from forty-five to fifty-five per cent. of an insoluble potash feldspar, near to orthoclase in composition, with from thirty-six to forty-six per cent. of a soluble hydrous silicate of alumina and soda, closely approaching to natrolite; besides about seven per cent. of carbonates of lime and protoxyd of iron, in nearly equal proportions.

12. Dolerite (Oligoclasic), Mount Johnson.

The isolated Mount Johnson, or Monnoir, as it is sometimes called, consists of a granular diorite, made up of black crystalline hornblende and white cleavable feldspar, with small crystals of amber-yellow sphene. The rock is sometimes finely granular, but more generally coarsely granitoid or porphyritic; the crystals of feldspar, which is the predominant mineral, being frequently an inch or more in length. They have a specific gravity of 2·63–2·65, and the composition of oligoclase. Its analysis gave silica 62·05, alumina 22·60, peroxyd of iron 0·75, lime 3·96, potash 1·80, soda 7·35, volatile 0·80 = 98·91.

13. Diorite (Anorthic), Yamaska Mountain.

The diorite of Yamaska much resembles the last, being made up of black hornblende, with a white feldspar, and small grains of sphene and magnetic iron. It is sometimes granular, but the feldspar often presents striated cleavage planes, half an inch in breadth, which have a specific gravity of 2·75–2·76, and a composition near that of anorthite. Its analysis gave silica 46·90, alumina 31·10, peroxyd of iron 1·35, lime 16·07, magnesia 0·65, potash 0·58, soda 1·77, volatile 1·00 = 99·42.

This beautiful diorite makes up a large part of the mass of Yamaska mountain, but the remainder is a granitoid trachyte (4). This is more micaceous than that of Brome, and consists in great part of a feldspar, which approaches oligoclase or andesine in composition.

14. Dolerite, Montarville.

15. " "

16. " Mount Royal.

17. " " "

18. " (Peridotite), Rougemont.

19. " " Montarville.

20. " " Vermont.

The dolerites which form the mountain masses of Rougemont, Montarville, and Mount Royal, present great varieties in their composition. Some parts of the latter mountain consist of a granitoid aggregate of a greenish-white feldspar, having the composition of labradorite, with black augite. This latter sometimes prevails, to the almost complete exclusion of the feldspar, forming a crystalline augite rock. In other parts, the black and more augitic portions are arranged in short irregular bands, with a lighter and more feldspathic dolerite, as if two plastic masses, holding different proportions of augite, had been partially mingled in flowing. Grains of olivine sometimes occur in the more feldspathic portion of Mount Royal, and are still more abundant in a similar rock from Rougemont and from Montarville. In both of these masses, more or less augitic varieties occur, as at Mount Royal. The chrysolite or olivine, which is rare in the greater part of Montarville, predominates in one portion, which is a granitoid aggregate of feldspar and augite; the latter often in well defined crystals, with a little brown mica, and grains or imperfect crystals of yellowish olivine. This, in some specimens, equals forty-five per cent. of the rock, and consists of silica 37·17, magnesia 39·68, protoxyd of iron 22·54 = 99·39.

This peculiar rock, which, from the predominance of olivine or peridot, might well be separated from dolerite, may be distinguished by Cordier's name of peridotite. It is the more worthy of attention, from the fact that olivine has hitherto been regarded as characteristic only of fine grained dolerites or basalts. As an example of an extremely coarse grained or granitoid peridotite, the specimen 20 is subjoined. This rock, which consists of great crystals of cleavable feldspar, with masses of granular chrysolite, and small portions of green pyroxene, was found in a boulder, in the Connecticut valley.

TABLE OF CONTENTS.

I. ECONOMIC MINERALS.

1. *Metals and their Ores.*

2. *Minerals applicable to Chemical Manufactures.*

3. *Refracting Materials.*

4. *Minerals applicable to Construction.*

5. *Grinding and Polishing Minerals.*