The following Essay was written by Lieut. BADDELY, R. E. as a candidate for one of the prizes offered by the Society for the best treatise on the subject to which it relates, and which was unanimously awarded to that gentleman at the general annual meeting of the Society on the first Tuesday of December, 1830.

An Essay on the localities of METALLIC MINERALS *in the* CANADAS, *with some notices of their Geological associations and situation, &c. by Lieut.* BADDELY, *R. E.*

INTRODUCTORY.

Having observed among the subjects upon which the Council of the Literary and Historical Society of Quebec, is desirous to obtain information, one which my previous studies and inquiries have rendered me somewhat familiar with, I presume, emulous of the Society's honorary award, to rank myself in the list of competitors for so desirable a mark of its notice.

The subject to which I allude is thus described: "On the deposits of ores along the coasts of the St. Lawrence, within the limits of the Lower Province."

In obeying the call of the Society, I trust it will not be deemed a liberty if, in conveying to it the information I

possess on this subject, the prescribed limits be broken down and the field of research carried into both Provinces. To do so, it is proposed to make use of all the information which can be obtained, either from the reports of credible eye witnesses, or from that which is to be found already in the hands of the public.* This, joined to what little original matter I may have myself to communicate, will, it is hoped, as a compilation merit the approbation, as I know it will receive the indulgence of that Society, whose efforts to collect and reduce the ore of intelligence which exists in the country, claim not only the encouraging notice of its inhabitants, but that of the whole civilized world.

GENERAL OBSERVATIONS.

I propose to commence this Essay with some general observations upon those ores which are either known to occur in this country or which have been reported to do so. Among the former iron ores rank first as much on account of the profusion in which they are distributed over many portions of the two Provinces as because of their superior usefulness to all other ores.

ORES OF IRON.

Seven species of iron ore have been noticed in Canada, viz. the magnetic oxide, specular iron ore, the red oxide, the brown oxide, the argillaceous oxide, the carbonate of iron, (sparry iron ore,) and the sulphuret of iron, (iron pyrites). To these, for the sake of analogy, I am disposed to add an eighth—the carburet of iron, which, indeed,

* Some years ago I presented a paper to the members of the Literary and Historical Society, entitled "Localities of Canadian Minerals," which they did me the honor to have published; from this, either in form or substance, my principal extracts will be taken.

although containing very little iron and placed by most mineralogical writers under the class "combustible minerals," is by some introduced among the iron ores.

MAGNETIC OXIDE OF IRON.

As yeilding the best iron and in greatest quantity, merits the first attention.

The magnetic oxide of iron has been found abundantly in Canada, but only in one place where it has been smelted; at least I have no certain knowledge of more than one, although it is reported that a portion of the ore formerly employed to supply the furnace, at that period in operation, in the seigniory of Batiscan, L. C. was of this species of ore.

The quantity of this description of ore in the township of Marmora and Belmont, U. C. is probably inexhaustible.—Its quality is generally good, in many instances excellent, and a large portion of it can be brought by water to the smelting works situated on the Crow River, at a comparatively trifling expence.—(Note 1.)

About four leagues in rear of St. Paul's Bay, L. C. there is another considerable deposit of the black oxide of iron or magnetic oxide. It was known and partly explored, according to Charlevoix, when the French were in possession of the country, but I believe no smelting furnace was ever established in the neighbourhood.—(Note 2.)

In the townships of Houghborough and Camden, U. C. it is said to occur in great abundance; as also at Hull on the Ottawa.—(Note 3.)

As an alluvial sand it is often found forming ripples and ridges at parallel levels, and distances on the shores of rivers, particularly on the shores of those rivers in the districts of Quebec and Three Rivers, which have their

estuaries on the northern shore of the St. Lawrence.—(Note 4.)

Magnetic oxide of iron *in situ* is characteristic of primary formations and is, when met with, generally perceived to form beds in granite or gneiss, or mica slate, or chlorite slate, or serpentine, or greenstone, (primary,) or sienite. It is with the two last that is has been observed to be associated in this country. Rocks abounding in hornblende, and such are many of those in Canada, often contain it.—According to some authors it has been observed in transition and even secondary rocks, but such an occurrence, I believe to be very rare, if it be even well established as a fact. The Swedish bar so much esteemed every where is manufactured from this species of ore.

SPECULAR OXIDE OF IRON.

From the mines close to the establishment at Marmora is taken an ore, which I consider as belonging to this species. It is believed to be the only place in this country where it has been found in any abundance. It occurs associated with red and yellow ochre, sparry iron, and argillaceous oxide of iron, near the junction of the primary and transition rocks, forming discontinuous veins or beds in the former, a sienite. No information can be given as to the quantity which remains, as the spot which has been opened in exploring it and the other ores with which it is associated, is now, apparently, exhausted; but there is great probability that more would be found if sought for.—It is with difficulty extracted. The splendent lustre and pavonine tarnish so frequently present in this species of ore, and from which circumstance it has been named, is absent from the ore in question, but all its other characters agree.

The geological position of specular iron ore is generally among the primary formations, but sometimes also with transition. The largest known deposit of this ore is in the Island of Elba, where it forms mountain masses. It has been long known and admired for its splendent lustre and for its beautiful pavonine tarnish. It is considered, when abundant a profitable and valuable ore. "It furnishes good iron both cast and malleable, but the latter is said to be harder than that obtained from magnetic iron. It generally yields from 65 to 75 per cent."—CLEAVELAND.

RED OXIDE OF IRON.

This ore has been noticed in two or three places in Canada, but most abundantly in the neighbourhood of Henderson's Lake, on the Gannanoqui, where it forms apparently an extensive bed in a ferruginous sandstone (old red sandstone).—(Note 5.)

At the Furnace Falls about three miles below this deposit there was formerly a smelting establishment, where some few articles were manufactured, not however from the ore above alluded to, as that was discovered long after these works were deserted, and none of it appears to have been smelted for any other purpose than experiment, which is said to have been favorable.

The red oxide of iron (red ochre) found at Marmora associated with sparry ore &c. is like the latter used as a flux for the more obstinate ores.

On the Magdalen Islands, in the Gulf of St. Lawrence, a very fine description of red ochre is obtained well adapted for a pigment.—(See 1st vol. of the Transactions, p. 44.)

The position of the Furnace Falls is one highly favorable for the establishment of a smelting furnace, and if there be

an abundance of ore of a good quality in the neighbourhood, which I cannot, however, take upon myself to say there is, it well deserves the notice of government, or that of some monied company or individual. I have been informed that with very little expense, the river might be rendered navigable from the head of these falls to the Rideau.

BROWN OXIDE OF IRON.

I have not seen any other variety of this species than the ochrey or yellow ochre and umber. The first is, like the red ochre, found always associated with other ores of iron, from which, like rust from malleable iron, they seem to have had their origin. As a stain upon rocks the two oxides are often seen here as elsewhere. There appears, however, to be an independent bed of it at St. Augustin, Lake Calvaire, L. C. and in the parish of l'Ancienne Lorette.—(see 1st vol. Transactions, p. 44.)

Captain Bayfield noticed "brown iron ore crystallized and otherwise," on the islets of Gargantua, Lake Superior.

Umber, which is a variety of this species, is so named from the circumstance of its having been first noticed in the dutchy of Spoletto, anciently called Umbria. It has been found at Beauport, near Quebec, on land belonging to Sheriff Sewell.

Umber has been sometimes classed with earthy minerals, very erroneously, I think, as it contains 48 per cent. of iron, and 20 per cent. of manganese. Its use as a pigment is well known, and for that purpose it is brought principally from the Isle of Cyprus, where it occurs in beds.

ARGILLACEOUS OXIDE OF IRON.

The argillaceous oxide of iron, which is next in abundance in this country to the magnetic oxide, and from

which it is probably derived in a great measure, is found abundantly in many places in the two provinces, particularly in rear of the two seigniories of Batiscan and Champlain, L. C. where, and in the neighbourhood of which seigniories it is procured in considerable quantity.—It is the only extensive deposit of this species of ore, which has yet been worked in Lower Canada, and the furnace at the forges of St. Maurice is entirely supplied by it. It belongs to that variety of the argillaceous oxide called bog ore.—(Note 6.)

Bog ore is characteristic of an alluvial formation, indeed it is one itself, as no doubt exists of its being a deposit from water holding iron in solution. The supposition that it grows is a very vulgar error.

"The iron obtained from bog iron ore, is what is termed cold short, and therefore can rarely be used for plate iron, —never for wire."—PHILLIPS.

CARBONATE OF IRON.—SPARRY IRON ORE.

The carbonate of iron is found in the immediate neighbourhood of the works at Marmora, where it is associated, as has been said, with the red and brown oxides of iron, and specular iron ore. A vein of it has been worked chiefly as a flux for the furnace. The vein has been found to be continuous, but the ore is not easily extracted.

A vein of the carbonate of iron, with pearl spar, has been observed to traverse grey wacke at Dr. Mills's quarry at Cap Rouge.

"Sparry iron is a very valuable ore, more especially as it is readily converted into steel, and is hence sometimes called steel ore."—CLEAVELAND.

SULPHURET OF IRON.—IRON PYRITES.

No mineral appears to be more generally distributed over the world than sulphuret of iron, and it has, of course, been frequently met with in this country. It is seldom, however, found in any considerable quantity in one spot, when this is the case it is important, because at a trifling expense it can be converted into an article of commerce called copperas or green vitriol, which is a sulphate of iron. The process is, I believe, as follows: the iron pyrites are gathered together in heaps six or eight feet high upon platforms, these are exposed to the action of the atmosphere for about a twelve month, when they are found to have undergone a spontaneous decomposition and a sulphate of iron has been formed. This sulphate of iron being soluble in water has, a large portion of it, been received into troughs communicating with the platforms by pipes or drains. The liquid thus obtained is afterwards evaporated and sulphate of iron in a concrete state is formed. This species of decomposition is effected in the following manner, the sulphur combined with the iron to form iron pyrites attracts oxigen from the air and passes into sulphuric acid which acting upon the iron forms sulphate of iron.—Some varieties of pyrites require to be roasted before this decomposition will take place.

Iron pyrites is never smelted as an ore of iron unless it be intimately mixed with other ores so as to be inseparable, such is the case with much of the ore at Marmora. Its presence is considered injurious to ores.

Five considerable deposits of iron pyrites have been noticed, viz. on an island on the south shore of Drummond Island;* on another island off the north coast of the same

* This Island has lately passed from under the British dominion.

island; on an island in the eastern part of Neepigon Bay, Lake Superior; and at Becketts Mills, Short Hills, Niagara district, and in the township of Elizabeth.

No copperas works have yet been established; but in the United States there are several, and one at Strafford in New Jersey is said to have yielded three tons of copperas in two days.

Sulphur is sometimes extracted from iron pyrites by sublimation.

Iron pyrites has been often mistaken for an ore of gold. Its superior hardness and unmalleable character will distinguish them. It is true that the former does sometimes contain gold, but never, I believe, in sufficient quantity to render its extraction profitable.

The sulphuret of iron is found in all formations from the oldest to the newest, but the magnetic variety or proto sulphuret occurs only among rocks of the primary order.

GRAPHITE.—CARBURET OF IRON.—PLUMBAGO.

This, as has been said, is more usually classed with combustible minerals, but from its chemical name and from its being found in some abundance it is here introduced as a metallic one.

According to reports there is a large supply of this mineral in the township of Houghborough, also at Hull on the Ottawa, where it is mixed up very plentifully with magnetic iron. Between these two places it occurs frequently disseminated through many rocks and minerals.—The names of plumbago and black lead, which are so frequently given to this substance, encourage an erroneous opinion to prevail that it is an ore of lead, with which it scarcely possesses one character in common. Carbon and

iron are alone its constituents, the former at the rate of from 91 to 96 per cent.

Besides its other well known uses, graphite has been lately employed to diminish the friction of wheel work, &c.

ORES OF MANGANESE.

In the state of an oxide, manganese is almost as universally distributed over the globe as iron, though mines of the former are much more rare than those of the latter.—It exists in variable proportions in the garnet, schorl, epidote, augite, &c. &c. but particularly in the brown and sparry iron ores; also in bog ore. In this country it has not been frequently noticed, and only, as I am aware, in the lower province; but I believe that it has been often overlooked, as it is not probable that it will be found to be rare in a country abounding so much in iron, its constant associate elsewhere.

EARTHY OXIDE OF MANGANESE,—WAD

One sub species of the earthy oxide only, has been observed, that provincially named wad. It occurs, as bog ore often does, on the banks of a small stream, and is evidently a recent alluvial formation.—(Note 7.)

The oxide of manganese, is more frequently found in primary and transition rocks, than in secondary, but the earthy variety is probably forming daily.

ORES OF SILVER.

Reports have been received frequently respecting the discovery of silver ores, but I believe them all to have been erroneous. Silver, indeed, has been found in the galena from St. Paul's Bay in sufficient quantity, as it is said, to be worth extracting; but admitting this to be the

case, the quantity of the galena itself is insignificant.—(Note 8.)

All the sulphurets of lead (galenas) contain a portion of silver, and where that portion is large, and consequently worth extracting, they are called argentiferous, from such, a large proportion of the silver of commerce is extracted.

That ores of silver should be found in this country, is by no means improbable; its rocks are precisely those for the most part in which they occur in other countries, such as granite, gneiss, micaceous and argillaceous slates, greenstone (primary), sienite, hornblende slate, gray wacke, compact limestone, and secondary slates. They should not be sought for above the mountain or carboniferous limestone which, in the lower province at least, appears to be the last rock deposit that has taken place.

ORES OF COPPER.

Ores of copper have not been found in Canada in such portions as to indicate its presence in abundance. Forming insignificant veins in and coatings upon rocks, principally of the trap formation, copper has been seen; also distributed in grains, plates, and wires, through angular detached masses of porphyritic trap.—(See 1st vol. of the Transactions, pages 23 and 39.)

These traces, however, together with the large detached masses of native copper, which have been noticed by Schoolcraft and others, as occurring in the neighbourhood of Lake Superior, may lead, one of these days, to the discovery and successful exploration of copper mines in that section of the country.

It is almost exclusively the native copper which has been observed in this country. The sulphuret and carbonate have been noticed, but it only appears in mere specks and thin coatings. On the south side of Lake Superior, and consequently within the boundary of the United States, a vein of malachite has been noticed, which may, upon examination prove of importance.—(See 1st vol. of the Transactions, pages 26 and 36.)

Ores of copper are much more usually found in primary than in secondary rocks.

ORES OF GOLD.

Gold has not been noticed in Canada, but so near the frontier as to induce me to give the following extract from an American paper, the particulars of which there appears to be no reason to question the accuracy of:—

"VERMONT GOLD.—We some months since noticed the discovery, in Vermont, of several specimens of the precious metal, and now learn, from the *Boston Traveller*, that it has been analized by General Field, who has forwarded a specimen for the Havard University. The *Traveller* states that 'the gold was found in the high way, deposited with a quantity of clay, sand, and gravel; the soil was alluvial, and upon examination it appeared to have been brought down and deposited by a small rivulet, from a high hill. The specimen of gold when found, weighed 8½ ounces, was of a conical form, and had firmly adhering to its base a number of small transparent rock crystals. The gold is soft, ductile, flexible, and malleable. Specific gravity 16-5, and the lustre that of virgin gold. The soil of the region is argillaceous, affording beds of excellent potters clay, and the rocks *in situ*, are all of the primitive class.'"

Professor Eaton says in No. 1 of the 18th vol. of Silliman's Journal, page 52 :—" If General Field's specimen of gold, found in Newfane, Vermont, was a native specimen, we may anticipate the discovery of gold in the talcose slate, from Georgia to Canada, along the east side of the green mountain range."—(Note 9.)

Gold is far from being of rare occurrence; it is said indeed, that the sand of few rivers is entirely free from it, although the proportion, in almost all cases, is so small as to be undeserving of notice, in a commercial point of view.

Mica and talc often resemble in colour, *external* lustre, and flexibility, the native ores of gold and silver. The former earthy mineral is sufficiently distinguished from these, by its elasticity, specific gravity, and want of the *true* metallic lustre. Talc is distinguished from them by the two last characters.

Gold, *in situ*, is almost entirely confined to primary rocks ; it has been observed, however in secondary. But it is among the alluvial deposits that it is more generally found.

ORES OF ANTIMONY.

Antimony, as an ore, has been said to have been frequently met with, but I know of no locality. It has been supposed to exist in the neighbourhood of St. Paul's Bay, L. C.

ORES OF LEAD.

SULPHURET OF LEAD.—GALENA.

Lead, as a sulphuret, has been found in many places, particularly near Lake Memphremagog, L. C. where it is said to occur in great abundance. Silver also has been reported to exist in the same place, put there appears to be much greater certainty of the presence of the former than

of the latter, as a distinct ore.—(Note 10.)

The Indians are said so know of several localities of lead ore; but there appears to exist a tradition among them, which is inimical to their making disclosures on such subjects. Many individuals have seen fragments of ore which the Indians bring down the Gannanoqui. Those I have seen, however, myself, were small and unpromising in their aspect. Some of the Indians are said to supply themselves with bullets from the ore they find, but this is very doubtful.

Native lead, a very rare ore, has been said to have been observed in Ohio, near the mouth of Au Glaize River, where it is described as occurring in slips, or slender prismatic masses in crystallized galena.

Ores of lead hold much the same geological position as those of silver, and may therefore be also expected to occur frequently in these provinces.

ORES OF ZINC.

Ores of zinc, in small disseminated portions, are not uncommon in the country. It is the sulphuret of that metal which is usually found, the black, and more rarely the yellow, blende. It is worthy of remark that, at Kingston, the sulphuret of iron, the sulphuret of zinc (Note 11), and sulphuret of strontian, are often associated together in the same hand specimen.

The red oxide has been named as a Canadian mineral, but its locality is not described.

These ores are found usually in primary rocks, but they occur also in transition and secondary, particularly in compact limestone. The yellow sulphuret is supposed to belong to the oldest formation of zinc.

ORES OF MERCURY.

No ores of mercury have been observed in the Canadian territories; but on the shores of Lakes Erie and Michigan, in the United States, it is said to occur as a sulphuret, mixed up with sandy alluvium.—(Note 12.)

Mercury is found sparingly in clay slate and secondary limestone,—most abundantly in the sandstone and shale, of the coal formation; and, as in the present instance, sometimes in alluvial deposits. It is among the most recent of ores; iron, and perhaps manganese being the only two which had been deposited subsequently.

LOCALITIES OF METALLIC MINERALS.

IRON.

IRON, OXYGEN.—(NOTE 13.)

Magnetic Oxide of Iron—is abundant in the townships of Marmora, Belmont, Camden, and Houghborough, U. C.

.. .. at Hull on the Ottawa—abundant.

.. .. in the rear of St. Paul's Bay, L.C. —abundant.

.. .. in the rear of the Seigniory of Batiscan.

.. .. in granite, near Tadousac (Note 14)

.. (*iron sand*) on the shore of the St. Maurice, above the forges, L. C.—in profusion.

.. .. on the shore of the St. Lawrence, between Tadousac and Moulin a Baude.

.. .. near Kingston, on the northern shore of Lake Ontario—very fine, with garnets.

.. .. in profusion on the north-eastern shore of Lake St. John, L.C.

Specular oxide of Iron—in sienite at Marmora.

IRON OXYGEN WATER, &c.

Red oxide of Iron, (pisiform)—on the eastern shore of Beverley or Henderson's Lake, on the Gannanoqui river, U. C.—a large bed.

Red oxide of Iron, (*compact*)—north east of Lake Echemin, L. C.
.. (*black hematite*) Encampment Douce, Lake Huron.
.. (*scaly*) same place.
.. (*red ochre*) on Lake Superior.
.. .. Marmora Works.
.. .. with the pisiform variety, on the Gannanoqui.
Brown oxide of Iron "crystallized and otherwise," is met with on the islets of Gargantua.
.. (*yellow ochre*) Marmora Works.
.. .. St. Augustin, Lake Calvaire.
.. .. on the Magdalen Islands.

IRON, OXYGEN, MANGANESE.

.. (*umber*) at Beauport near Quebec, L.C.

IRON, OXYGEN, MANGANESE, PHOSPORIC ACID, &c.

Argillaceous oxide of Iron (*bog ore*)—township of Marmora.
.. .. .. seigniory of Champlain.
.. .. .. seigniory of Batiscan.
.. .. .. River du Loup (upper end)
.. .. .. in rear of St. Paul's Bay.
(*Extracts from Gourlay.*)
.. .. .. at Charlotteville, eight miles from Lake Erie, —abundant, (Note 15.)
.. .. .. township of Trafalgar, U. C.—much.
.. .. .. township of Bertie, do.

Argillaceous oxide of Iron (*bog ore*)—township of Stamford, U. C.
.. .. .. township of Grantham, —great plenty.
.. .. .. township of Pelham—a little.
.. .. .. township of Crowland, —a little.
.. .. .. township of Canborough —some.

A variety of the argillaceous oxide of iron is found at Marmora, in a thick bed in sienite.

Iron Ores, (species not mentioned)—in the townships of Westminster and Dorchester; also in great abundance in the township of Leeds.

IRON, OXYGEN, CARBONIC ACID.

Argillaceous oxide of Iron,—(*clay iron stone*) is found half an inch thick, forming a vein traversing Amygdaloid, at Point Mamaise, Lake Superior.

There is said to be a rich ore of iron at the base of Long Point, (U. C.) but its species has not been named.

CARBONATE OF IRON.—SPARRY IRON ORE.

IRON, OXYGEN, CARBONIC ACID.

Sparry Iron Ore,—Marmora Works, U. C.
.. with pearl spar, forming a vein in grey wacke at Dr. Mills's quarry at Cap Rouge, L. C.
.. (pseudo volcanic) in the township of Yonge, U. C.
.. in sienite or greenstone, Kingston Mills.

SULPHURET OF IRON.—IRON PYRITES.

IRON, SULPHUR.

Only the most remarkable deposits of this species will be mentioned.

Sulphuret of Iron,—An island on the south shore of Drummond's Island, Lake Huron, has been described as almost entirely composed of it. It is also found in large quantities on an island off the north coast of Drummond Island.

.. on an island in the eastern part of Neepigon Bay, Lake Superior.

.. at Becketts Mills, Short Hills, Niagara District—a large bed.

.. in the township of Elizabeth—a large bed

.. in the township of Yonge, U. C. (Note 16.)

.. on Lake Ontario near Kingston, with sulphuret of zinc and sulphuret of strontian.

.. with magnetic iron, in the township of Marmora, U. C.

.. in a course limestone conglomerate, which forms a precipice on the northern side of the town of Quebec, the three following varieties of iron pyrites are found, viz:—1st, polyhedral shaded masses, about the size of a bullet.

2d, radiated iron pyrites.

3d, hepatic iron pyrites. These varieties are found in a species of shale, much decomposed, which often sur-

Sulphuret of Iron,—

rounds the blocks of limestone in this conglomerate. The hepatic variety partakes sometimes so much of the general decomposition of the shale it is found in, as to have lost its metallic lustre and specific gravity.

.. twin crystals of cubic iron pyrites have been observed disseminated through some of the clay slate in the district of Quebec. If one of two cubes of metal of the same dimensions, be cut in a particular manner, it is possible to put the other through it; the appearance of these twin crystals is similar to what would be observed in trying this experiment.

.. a large deposit associated with gypsum, on the Magdalen Islands.

PLUMBAGO.—CARBURET OF IRON.—GRAPHITE.

CARBON, IRON.

Carburet of Iron,—in the township of Houghborough.

.. .. at Hull on the Ottawa, mixed up with magnetic iron.

.. .. disseminated through several of the rocks between these two places.

.. .. on the shores of the Gannanoqui, and in some other places, chiefly in the eastern section of the Upper Province.

.. .. in amygdaloid at Point Marmaise, Lake Superior.

.. .. Hawksbury on the Ottawa.

Carburet of Iron,—in a creek near Kingston—query, what creek?

.. (*graphite slate*)—on Judge Taschereau's seigniory of St. Mary's, L. C.

.. .. near the Furnace Falls, on the Gannanoqui.

MANGANESE.

OXIDE OF MANGANESE.

MANGANESE, OXYGEN, WATER, &c.

Earthy oxide of Manganese,—(*wad ?*) at Sillery near Quebec.

COPPER.

NATIVE COPPER.

COPPER—PURE.

Native copper in large detached masses near or upon the southern shore of Lake Superior. This is obviously not a Canadian locality, but it and similar notices should not be omitted in a compilation like the present.

Native Copper,—disseminated through tabular masses on the beaches of Isle Royale, in small plates, grains, and wires. From the appearance of these masses, Captain Bayfield, R. N. supposes them to have originally formed veins in a dark brown porphyritic trap, and from their untravelled form, that they are near the parent rock.

in small masses on the beaches of Point Keewowanan Lake Superior.

SULPHURET OF COPPER.—COPPER PYRITES.

COPPER SULPHUR.

Sulphuret of Copper,—in small quantity in a confused mass of quartzy veins at the bluff at the lower end of the narrows of Pelletau, Lake Huron.

.. .. in small quantity in argillaceous schist at the mountain portage above Lake Superior.

.. .. in amygdaloid at Point Marmaise, Lake Superior.

.. .. encrusting the sides of an empty vein in greenstone near Michipicoten.

CARBONATE OF COPPER.

COPPER, OXYGEN, CARBONIC ACID.

Carbonate of Copper, (green)—in amygdaloid at Point Marmaise, Lake Superior

.. .. .. on the north shore of Lake Superior, many fragments of an impure green carbonate of copper, of an untravelled aspect, are found.

.. .. .. as a trace upon many of the rocks in these provinces.

.. .. .. in a vein of considerable dimensions on the east point of Copperas Harbour, Point Keewawonan, south shore of Lake Superior.

ZINC.

ZINC OXYGEN.

Oxide of Zinc, (*red*)—it has been said that this variety has been meet with in Canada, no locality however is given.

SULPHURET OF ZINC.—BLENDE.

ZINC, SULPHUR.

Sulphuret of Zinc, (*black blende*)—with fine radiated sulphate of strontian, sulphuret of iron and flesh-coloured calcareous spar, in a compact silico alluminous limestone on the northern shore of Lake Ontario, near Kingston.

.. .. (*yellow*) do. do. not so common.

.. .. .. in black and grey limestones, from Bytown, it is disseminated in very small crystals according to Dr. Holmes.

.. .. (*black*) in calcareous spar, do.

LEAD.

SULPHURET OF LEAD.—GALENA.

Sulphuret of Lead,—in the township of Patton, near Lake Memphremagog.

.. .. one mile upwards from where Craig's road crosses the river Nicolet, in the township of Chester, L. C.

.. (*argentiferous*) in a white marble, mixed with chlorophane from St. Paul's Bay, L.C.

Sulphuret of Lead,—

.. (*common galena*) Hawksbury on the Ottawa.
.. .. Fort Wellington, U. C.
.. .. north-west of Lake Huron.
.. .. somewhere on the shores of the Gannanoqui.

TITANIUM.

TITANIUM OXYGEN.

Oxide of Titanium,—it is probable that this mineral enters into the composition of much of the magnetic sand of this country as it frequently does in others.

TITANIUM OXYGEN SILEX LIME.

Silico calcareous oxide of Titanium, (*sphene*)—is found, according to Dr. Holmes, at Grenville, on the Ottawa

MERCURY.

MERCURY, SULPHUR.

Sulphuret of Mercury,—on the shores of Lake Erie and Michigan, in the American territories.

NOTES

ON THE

LOCALITIES OF METALLIC MINERALS IN CANADA.

NOTE 1.

The iron establishment in the township of Marmora is situated at the upper end, or north-western extremity of a peninsula, formed by the Bay of Quinte on the south-east, the Moira on the east round by the north, and the Trent on the west and north-west. The mouths of the Trent and Moira, on the Bay of Quinte, are about ten or twelve miles asunder, but in the latitude of the Marmora works, owing to two branches diverging from the main course of their respective rivers and approaching each other, there are only three or four miles of interval between the two waters. That branch alluded to which diverges from the Trent about forty miles from its mouth, is called the Marmora or Crow river, and it is upon the left bank of this river, about nine miles upwards from its junction with the main branch, that the works are situated.

The Moira river is one succession of rapids and falls, and is the principal seat of the mills in that part of the country. It cannot therefore be looked to as affording any expectation that it will ever be rendered navigable. To render the Trent navigable would not be attended with so much difficulty, but it would still be considerable, for although no falls occur for thirty-five or forty miles from its mouth, there are several rapids and shallows, which would require the construction of locks and dams, and the lowness of the

shores are unfavourable to the erection of such works.—Bearing in view this latter circumstance, the difficulties to be overcome will be better understood by introducing here the following description, for which I am principally indebted to Mr. Manahan, the superintendant and one of the proprietors of the Marmora works. At its mouth the Trent is about seven hundred feet wide; one mile upwards it ceases to be navigable even for boats, owing to rapids and shallows, which continue for eight miles. Mr. M. thinks that a dam constructed at the foot of these rapids where the banks will allow of its being twelve feet above the river would throw two or three feet of water upon the highest shallows and consequently absorb the rapids; that is, he supposes, that the river has only a fall of nine feet in these eight miles.* From the head of these rapids the river is navigable for seven miles, five of which hold the same course as before, that is from the north. Here the river bends suddenly to the westward, which direction it maintains for perhaps eighteen miles, after which it again turns to the north and continues with that bearing until it reaches the confluence of its waters with the Crow or Marmora river, a further distance of about nine miles.—From the angle of the first bend, I believe it has been proposed to carry a canal nearly in a right line to the works, distant about sixteen miles. Beyond the seven miles which have been described as navigable, a small rapid occurs commonly called Chisholm's Fall. Here much of the water is diverted by a bay, the damming up of which, it is thought, will throw sufficient water on these rapids to render them navigable for boats. For sixteen miles further

* This fall of nine feet is assumed merely on estimation, it may be more.

to the "Percey Landing" the river is navigable for steamboats; here shallows and rapids again occur for three miles to what are called the "Big Falls," on the Trent.—A navigable channel for boats, through these rapids, might be obtained, it is said by the removal of some of the many boulders which here crowd the stream. In all the course of the river thus far there is not one very favorable situation for the construction of a dam, the most so is that which has been mentioned, near the mouth of the river. The "Big Falls" are occasioned by the river running over a ledge of limestone rock about eighteen feet high—above the falls the river is one continued rapid to the "Middle Falls" a distance of five miles, these falls are at the foot of Crow Bay, about one mile or more from the confluence of the two rivers. Pursuing the Marmora or Crow river to the right it is navigable for two miles, where a succession of rapids and falls continue for one mile. Hence it is navigable for two miles further, after which a winding rapid of about one hundred and fifty yards in length is met with. A further distance of two miles of navigable waters brings you to the first falls below the iron works, and distant from them about two miles, which are navigable. The main branch of the Trent to the westward communicates with the Rice Lake and Otonibe river, interrupted by one heavy fall called "Healey Fall" and partial shallows.

The general character of the soil between the Trent and the Moira is good, which is sufficiently indicated by the description of timber upon it. As the works are approached, however, a considerable change for the worse is perceived. The limestone which had been previously well covered up by soil, gradually obtrudes itself upon the eye, until at last little is seen upon the surface of the ground besides its dry

and whitened tables. In other places we meet with swampy land rendering necessary the disagreeable description of primitive road known in this country by the name of corduroy bridge. Indicative of this change the pine and a scanty herbage takes the place of the elm, the oak, the beech, and the maple.

Having afforded all the information I possess respecting what is generally understood by the term topography of a place, I proceed to give its geological and mineralogical characters, as far as my acquaintance with the subject will permit.

The greatly predominating formation from the Bay of Quinte to the Marmora works in one direction, and from the Moira to the Trent in another, is transition limestone, the same as that found to characterize Kingston and much of its neighbourhood. A line drawn from the Marmora works, about thirty miles northward of the mouth of the Trent, to Kingston mills, five miles northward of Kingston, would probably pass in every part of it, very near to the line of junction of the primary and transition rocks, and mark the limits on that side to the limestone I am speaking of. The characters common to this limestone in general, at least wherever I have consulted them, are, 1st—light bluish grey colour; 2d—a slight degree of translucency usually on a thin edge; 3d—a compact structure in most cases; 4th—a fracture often approaching conchoidal; 5th—the odor of flint when struck, and not of bitumen.—Its organic remains are also characteristic, among these may be named producta terebratulæ, orthoceræ, trilobites and encrinites; these are found in the surface and upper strata, more rarely below them, and apparently not at all in the lowermost. The orthoceratites for their size, often

demand particular attention—a portion of one in my possession from the surface stratum near Kingston must have been five feet long and two feet in its greatest circumference, they are seldom very distinct, and generally occur in a rubbly limestone on or near the surface. The terebratulæ appear to hold the lowest position in a fine semi crystalline limestone.

The minerals which have been noticed either imbedded or disseminated in this formation, are likewise characteristic of it. The earthy varieties are chert or hornstone, basanite, chlorite, calcareous spar, and sulphate of strontian. From the hardness and flinty aspect of some portions of the strata they appear to be passing into chert, while well characterized hornstone is occasionally seen forming prominent concretions on the surface of the limestone.—On the shore of Garden Island, opposite Kingston, concretions of hornstone looking like blotches of tar or pitch, are very conspicuous, they have even the pitchy lustre in fracture, the same as is noticed in the limestone at the Marmora works, although there the pitchy resemblance is not so perfect. Ovate convex concretions of basanite are not uncommon—they are good touch-stones. A green mineral, supposed to be an earthy chlorite, is often much mixed up with the ingredients composing the lowermost strata.

Calcareous spar often forms narrow viens in the middle and uppermost strata and rounded concretions in the lowermost.

Sulphate of strontian occurs like the foregoing, forming spherical concretions in the lowermost strata.

The metallic minerals are sulphuret of iron and sulphuret of zinc, (black and yellow blende). The sulphuret of iron

is thickly disseminated through some of the limestones in the middle of the series, and also in larger crystalline pieces among the lowermost strata, with sulphuret of zinc, sulphate of strontian, and calcareous spar—the whole forming rounded nodules in the limestone. These nodules, often entirely composed of fine light blue radiated sulphate of strontian, are sometimes as large as a child's head, and when detached from the limestone, which they are very easily, a very fair imitation of a trencher, or soup-plate is observed. This limestone has the aspect of being more silieceous and alluminous than that lying above it; and differs from it also by possessing nothing of a crystalline character,* which the other does, for although in both cases the structure is compact, in the former the fracture is dull, while in the latter it is glimmering, arising from the reflection of light from the polished surfaces of minute laminæ.

The limestone formation I am describing, has a stratification which is nearly horizontal, except where, by the apparent upraising of the older rock beneath it, since it was deposited, a partial uncontinuous dip of the strata is occasioned. These strata are sometimes separated by thin seams of shale.†

* Although not crystalline, some of this limestone, as it lies on the shore, in nearly horizontal strata, resembles basalt in form exceedingly. Mr. Finch, of New York, now lecturing at Montreal, was particularly struck with this feature in the limestone.

† The limestone of Kingston, the groundwork of the foregoing description, is characterized in some places by a remarkable concretionary structure, which may be thus described:—ovate, or rounded portions of the limestone are separated from the main body, by thin partings of shale, the wanderings of the edges of which shale upon the surface of the limestone, has been aptly compared by Dr. Bigsby, to the sutures of the human skull. These concretions are easily separated from the main mass, and exhibit the shale generally surrounding them on all sides except the uppermost. This shale

It will be perceived that the foregoing description of this formation, contains much which is of a very local nature, as far as regards opportunities of observation, and this must be the case with all observations on the same subject for many years to come, until the clearing of the country shall open a better view of its geology and mineralogy to the notice of the traveller. But I feel convinced, in the mean time, that future examination will not discover any characters in this formation essentially different from those here given, although facts of geological and commercial interest, may doubtless be elicited.

The older rock I have alluded to, as underlying this limestone, is at all times one of these four—a sienite, or greenstone, a sienitic granite, or sienitic gneiss. They appear to pass one into the other, and to have a contemporaneous formation. As hornblende appears to be rarely absent, without it be to give place to epidote, the presence of which is very characteristic of these rocks, they may be called amphibolic. As to the question, whether a genuine granite occurs within the limits I have described, I am of opinion that it does not, without it be as veins traversing the other primary rocks. Mica is a rare ingredient in them, and it appears to be in almost every case accompanied by hornblende. As to the stratification of these rocks, when most assuming that appearance, it is an ambiguous case, whereas in the majority of instances, no signs of it exist. Wherever the limestone prevails, the country is flat and tabular, rising sometimes in terraces, and always

when first exposed to view, is of remarkably plumbagenous lustre, and being marked with small pilastres, something like those on a stove, fluted columns and flat surfaces, its appearance is at once singular and pleasing. Its lustre however, does not continue without means being taken to preserve it, as exposure to the air changes its colour to a dull brown.

nearly horizontal. Where the older rocks come in, the surface is strongly undulated, sometimes rising in mamellary masses of bare rock, at others in higher projections, but almost always of a rounded form.

Such is a description of a few of the features of this part of the Upper Province, merely intended as introductory to a more ample detail of the rocks and minerals in the neighbourhood of the Marmora works, to which I now return.

The Marmora works have been described as being seated on the left bank of the Marmora river, about thirty miles by land from the mouth of the Trent. The road between these two places runs, for much the greater portion of it, if not entirely, over the transition limestone which has been described.

This limestone in general is tolerably well concealed by a soil, which, in most instances, affords good farms. —As the works are approached the soil becomes gradually more scanty and the dough white surfaces of tabular masses of limestone frequently present themselves to view.— When the visitor approaches within sight of the works little besides a pavement of the same is beneath him. These exposed masses separated from one another by small cross fissures are split and corrugated, and have much the same appearance that fine wheaten dough would have if its surface were cut and cross cut with an axe or wedge.— These appearances,* probably the result of frost, are characteristic of much of the limestone of the district, and may be seen to great advantage near Kingston.

The limestone immediately at the works forms three

* Small markings on the surface of the limestone like the impressions of crows feet are not uncommon in the vicinity of Kingston, they may with probability be attributed to frost also.

distinct terraces rising one above the other. The lowermost is nearly on a level with the water—the next, on which the principal buildings are constructed, is from fifteen to twenty feet higher, and the third may be about fifty feet above the river; on the opposite side of the river the limestone forms a cliff nearly perpendicular, and of about the same height. An anonymous writer in No. 2, of the *Canadian Review*, states the whole body of limestone here to be two hundred feet high, this I think greatly overrated, one hundred is certainly the outside. He also says that an argillaceous sandstone of a red, grey, and green colour is found at the lower terrace, forming alternating layers; this is a mistake, these stratified masses are limestones, as their free effervescence in acid declares them to be—neither are they seen resting on sienite, although they may be fairly presumed to do so, as that rock crops out near at hand. The cascade is caused by its appearance, and it is seen in many places above on the left bank of the river, but the limestone conceals it on the right bank. Its constituents appear to be red felspar and light green epidote.—I did not perceive, as in the neighbourhood of Kingston, the actual contact of the sienite and transition limestone, although they were separated by a very few feet of soil and verdure, which of course concealed it, if it takes place; neither did I perceive that conglomeration in the limestone near the sienite, which is so remarkable near Kingston, where masses of the sienite both round and angular are found imbedded in the lowermost strata of limestone or at the junction of the two rocks, (see the 18th vol. of Silliman's Journal.) Near this junction and forming a bed in the sienite is observed a white crystalline marble of a finer grain than any other I have yet observed in this country.—

Indeed, the marbles in Canada hitherto discovered, are generally remarkable for their laminar structure. In hand specimens, this marble is almost as fine as the Carrara, but it can not be employed for sculpture, as it does not appear that solid blocks of it can be procured. This marble is again seen forming a mountain mass on the side of Crow lake, nearest to the works. It is here penetrated by hornstone, which in consequence of its more durable character, projects in ribs and concretions from its surface. If would be desirable to open a quarry here in order to see if the marble improved upon sinking into it, which is very probable. It is here associated with quartz rock, of which the largest portion of the mountain appears to be composed. This rock is stratified, and its strata are nearly vertical and directed about north and south.

What geological and mineralogical facts I have further to communicate will be stated in giving a description of the different ores of which there are at least eight distinct deposits.

FIRST ORE BED.

Commencing with those ores close to the works, on the left bank of the river, they may be described as forming a bed or vein in the sienite. One extremity of the marble before mentioned falls obliquely upon the northern side of this vein, which has itself a dip and direction about north-east. This vein appears to be nearly exhausted, or if not it offers no sufficient inducement in the present day to continue its exploration while such an abundance of good ore can be so much more easily procured.

The ores which have been found in this vein are the following, specular oxide of iron, red and yellow ochre, sparry iron ore, and argillaceous oxide of iron.

MINERALOGICAL CHARACTERS.*

SPECULAR OXIDE OF IRON

Colour on a fresh fracture lavender blue, externally rusty red——opaque——structure compact granular——fracture uneven—lustre glistening metallic—yields to the knife but strikes fire under the hammer—*colour of powder dark brownish red*—shape of fragments prismatic—*specific gravity* 4-9 *slightly magnetic—not soluble in warm muriatic acid*—infusible alone before the blow-pipe, but with borax forms a bead coloured by iron.

The characters in Italics have induced me to name this the specular oxide of iron, although it certainly possesses nothing of that brilliancy of lustre and pavonine tarnish so frequently characterestic of that ore.

It is found enveloped by the other ores and is the only one of metallic lustre among them. It should yeild 63 or 64 per cent. by calculation.

SPARRY IRON ORE AND RED OCHRE.

Colour dark red (Indian red,) with yellow laminar parts interspersed, sometimes these parts form a yellow band in the middle of the mass, which on a cross fracture by a strong contrast between the real and the yellow produces a pleasing effect—opaque—structure between earthy and laminar, the mass having the appearance of being composed of red ochre and sparry iron. The laminar parts have about the hardness of fluor, but the earthy portion

* It is perhaps necessary to say that in giving these characters or others which may follow, I have been uninfluenced by a communication in the 1st vol. of the Society's Transactions, in which the characters of a *few* of the Marmora ores appear. Having the advantage of the writer of that article, which a visit to the spot has afforded, my observations both on its rocks and minerals, erroneous or not, are at least unbiassed either by that communication or by any other.

yeilds to the nail and soils the fingers; specific gravity, 2-8. It rapidly effervesces and in a great measure dissolves in muriatic acid. Blackens in the exterior flame of the blow-pipe and fuses in the interior into a black scoria, which is generally magnetic. Sometimes, however, it requires to be roasted on charcoal with grease to render it so.—It is used as a flux for the other ores.

I observed another excellent variety of this ore cropping out of the ground near the works, but I cannot say whether it was a loose mass or otherwise, it had a crystalline structure and its colour was a mixture of brown and white. If in abundance it deserves to be explored.

RED AND YELLOW OCHRE.

These ores, or rather pigments, are too well known to require a particular description. They occur forming the sides of the vein. The yellow ochre is of an indurated description of that substance.

ARGILLACEOUS OXIDE OF IRON.

In the excavation a large mass of this may be seen; a passage has been opened through it, in order to extract the other ores. It is the predominating ore, but of too poor and infusible a character to be worked. It looks like some varieties of trap or shale, and although very tough and difficult to remove, when first exposed, the action of the atmosphere renders it very brittle, and even friable.

Colour, greenish black, with seams of a reddish and lighter green,—opaque,—structure imperfectly foliated, sometimes curved; fracture, uneven. It is easily scratched by the knife, even when hardest; powder, yellowish green —no lustre; specific gravity, 3-1; insoluble in acid; infusible before the blow-pipe, after exposure to which,

on charcoal, it becomes magnetic; to borax it communicates a lively greenish yellow colour.

GRAPHIC SLATE.

Associated with the above, and forming a sort of incrustation upon it, is a mineral which has been confounded with it. It agrees very closely, in all its characters but one, with graphic slate. This excepted character is the peculiar phenomenon which it exhibits when exposed to a candle or the blow-pipe, and which has not been mentioned by mineralogists as belonging to graphic slate. The moment it is exposed to red heat, it expands, exfoliates, curls up, and rapidly falls into powder. It has been mistaken for graphite, but the streak it communicates to paper, is very different to the shining metallic trace which the latter affords. On the contrary, it is quite dull black, like that of black chalk, of which species it appears to be unquestionably a variety. When first collected, it marks paper very freely, but after keeping it in a dry room, it does not do so as readily. Its specific gravity is 2-6. It is not in the least magnetic after roasting on charcoal, but to borax it communicates a yellowish colour, showing the presence of a small portion of iron.

These ores appear to hold the following relative position, —the argillaceous oxide forms the walls of the vein; the red and yellow ochre, with sparry ore, form the lining next the walls; and the specular ore is found in the middle, not however, in continuous masses, but rather in fragments.

Chlorite, scaly talc, and quartz, sometimes form veins in the sienite, which holds these ores imbedded.

SECOND ORE BED.

The next deposit of ore I have to describe is on the right

hand shore of Crow or Marmora lake, near to the entrance into it from the works, and a few hundred yards back in woods. There have been deposited two species of ores—the magnetic oxide, and the argillaceous oxide, (bog ore.)

The principal spot where the magnetic oxide of iron *comes to day*, a term employed by miners, to express its appearing on the surface, is on the summit of a hill. Here it may be *seen* forming a bed of about twenty feet long, by about three or four feet wide. Whether the rock be a true greenstone, in a geological sense, or not, I cannot determine, as it appears to be rather coloured by epidote than hornblende; it is, however, very tough, compact, and possesses no appearances of stratification. This bed of ore has a position nearly due north and south, as regards its longitudinal direction, and a moderate dip to the north.—The walls of the bed appear to be vertical, and may probably sink to the level of the base of the hill, as fixed masses of the same ore, in the direction of this bed are found there, according to Mr. Manahan. This ore belongs to that sub species of the magnetic oxide, called native magnet, as it possesses not only strong attractive magnetism, but as strong a repulsive one also; and it is worthy of remark that in this instance, as in some others which have been noticed by other individuals, the position of the poles in the ore, corresponds with that of the bed; thus I invariably found, after trying the experiment repeatedly, that that portion of a fragment which had a northern position in the mass before it was removed, relatively to the opposite portion, attracted the south pole of the magnet, and repelled the north, while the opposite portion possessed an influence upon the magnet, directly the reverse.

MINERALOGICAL CHARACTERS.

Colour on a fresh fracture, steel grey externally, sometimes rusted; opaque; structure, laminarly compact; fracture, uneven, somewhat conchoidal; lustre shining, almost splendid metallic. Its hardness is a little variable; some portions yeild to the knife, strikes fire when struck with the hammer; colour of the powder, glimmering black; specific gravity 4·6. No change in nitric acid, strongly magnetic with polarity. Infusible alone before the blow-pipe, but fuses with borax, in the exterior flame, into a greenish yellow glass; if the heat be increased it intumesces and becomes green, and ultimately when the essay is sufficient in quantity it forms an opaque black globule.

Sixty per cent. of iron may be expected from this ore.

The difficulty of extracting this ore is considerable, it would otherwise be better worth exploring than, perhaps any other in the township.

ARGILLACEOUS OXIDE OF IRON.—BOG ORE.

Bog ore apparently of the sub species called meadow ore, is found in alluvium on the banks of a small stream at the foot of the hill on which is found the ore last described; much of it is of so dark a colour and earthy a fracture as to be mistaken for an ore of manganese, (wad.) It occurs in bullet shaped and reniform pieces varying from the size of a grape shot to that of a large potatoe, mixed up with sand; occasionally it resembles the excrement of some animals. Mr. Manahan informs me that similar deposits exist in several places in the neighbourhood, but as they have not been sought for particularly, they are not unlikely to occur in many others. In this opinion I agree with him, as there is not perhaps a portion of any country abounding in rock

ore which does not contain frequent deposits of that which we are discussing, I cannot say in what quantity it is found in this spot, but as Mr. M. found it thickly scattered throughout the whole depth of eight feet, it must be tolerably abundant. He also informs me that there is ore, which upon examination appears to consist of decomposing epidote and magnetic iron, this is frequently noticed among the bog ore, a fact of importance, as it seems to indicate that the magnetic iron of this *locale* is in some abundance. The last mentioned ore is very easily fusible, and is found to improve the working of the furnace.

THIRD ORE BED.

At the western extremity of Crow Lake, in the township of Belmont, about four miles from the works, there is another deposit of magnetic iron, forming a bluff on the left hand shore. From hence the main supply has been obtained for carrying on the works. Its quantity appears to be almost inexhaustible, but the quality of much of it is not by any means so good as that before described, being mineralized by sulphur and epidote. There is, however, a large portion very good, which from that circumstance and the ease with which it may be procured and broken up, is at this moment the favourite ore. What this ore bed may lose with respect to the per-centage of metal it may yield when compared with the other, it much more than recovers by the facility with which it may be procured—*the ore boat accompanied by two or three men provided with a pic-axe, shovel, and sledge hammer, may go to this bed in the morning and return in the evening with fifteen tons of ore.*

Mr. Manahan has noticed that the ore from this bed rejected on account of its containing too much sulphur, does, in the course of two years or thereabouts, become

greatly improved; and also that the ore on the top of the bed, particularly those fragments which have been long lying detached and exposed to the weather, have undergone a similar improvement in their quality. This might be expected to take place *a priori* because a part of the sulphur in the ore thus exposed, becomes converted into sulphuric acid and sulphate of iron, in which state it is washed from the ore by occasional rains. At some of the ore beds and among the rejected heaps at the establishment, this change is actually seen in progress and may be known by a white powdery coating on the ore, having an astringent ink-like flavour. I have no doubt that if copperas works were established here, that article of commerce might be obtained at little expense, and with considerable benefit to the iron works, as besides freeing the ore from sulphur, its exposure to the atmosphere to attain that end would render it brittle and more easily broken up for the furnace.

With regard to the rock associations of this bed, they are seldom seen, as the bluff appears to be almost one solid mass of iron ore, but I believe it to be a compact felspar coloured by epidote, as a large mass in my possession, from this place shews that rock traversed by veins of the ore, large masses of crystalline epidote are also seen. The anonymous writer before alluded to thinks that "large unrolled masses "of granular quartz and coloured by epidote bespeak the "contiguity of that rock in situ," I suspect that the compact felspar above mentioned is what has been mistaken for quartz rock, as of that rock I saw no traces—that which I have ventured to call compact felspar, is certainly not quartz, for it fuses easily with intumescence into a white enamel.

MINERALOGICAL CHARACTERS OF ORES FROM THE HEAD OF CROW LAKE.

1st.—A specimen of ore taken from the summit of the hill where it is found in loose masses detached from the rock beneath them.

Colour, on a fresh fracture, steel grey, sometimes much modified by epidote, which is mixed more or less with all the magnetic ores from this district; structure, when not influenced by the epidote, is fine grained; cross fracture, uneven, but fracture is effected more easily in the direction of even rusty seams which traverse it, the colour of these seams is generally red, but sometimes purple; lustre, glistening metallic. It yields, but with considerable difficulty, to the knife and portions strike fire under the hammer; not so frangible as the last magnetic ore examined, which is owing to the presence of the epidote; when free from it the powder of the ore is of a glimmering black colour; specific gravity, an average specimen 4-1. It is magnetic, but not with polarity; insoluble in nitric acid. Its blow-pipe characters are much the same as the last, and as that is the case with most of the ores I have to describe, they will not be given again unless to mark an important difference.

2d.—"The favorite ore" differs from No. 1 of the same bed, in being much more free from epidote and sulphur, and by occurring under a very slaty or schistose form, both of which circumstances render it much easier reduced to fragments for the furnace; it has also a greater specific gravity, viz. 4-4. It is very absorbent, and produces a hissing noise, when it is first placed in water.

3d.—This is of a light purplish steel blue colour on the recent fracture, but like most of the rest, rusty externally.

It contains specks of iron pyrites, as indeed does most of the ore from hence, it being under the form of sulphuret of iron, that the sulphur is present in the bed. Its structure is fine-grained, and fracture uneven; lustre, glimmering metallic; yields to the knife; powder, bluish black; no change in nitric acid; specific gravity, 4-3; magnetic, &c. &c.

4th.—This is like No. 3 in most respects; the form under which it occurs is, however, different. It is found in parallel layers with rusty surfaces between them. Its rectangular outline and steel grey lustre gives it the appearance of a piece of manufactured iron—specific gravity, 4-6. Mr. Manahan has observed that where fragments of ores are found of regular forms, they are sure to be of good quality.

5th.—Occurs as a cellular crust upon some of the other ores, from one-eighth to one-half of an inch in thickness. Colour, bluish black; opaque; structure, cellular and platy, the interstices between the plates forming the cells; fracture, uneven; lustre, pitchy and glistening; yields to the knife; very brittle; powder, snuff colour; specific gravity, 2-8; no change in nitric acid; magnetic, &c. &c.

The large masses of crystalline epidote which are found here, deserve some description, but I fear that the little acquaintance I possess of the crystallographic characters of minerals, will render it a very imperfect one.

Colour, a greyish or yellowish green; translucent on the edges. It occurs in masses composed of an assemblage of large crystals, crossing each other without order or regularity; these crystals appear to be four-sided oblique prisms. Fracture, uneven; lustre, between glistening and glimmering—some faces of the prisms have a shining lustre.

It scratches glass easily, but yields to the knife ; a light grey streak ; powder, grey and harsh to the touch ; specific gravity, 3-1. In the interior flame of the blow-pipe it rounds into a shining green, globule, but this depends upon the size of the fragment, for if it be larger than it ought to be, as large as a pepper corn for instance, (a favorite term with mineralogists, the absurdity of which has been exposed by Griffin,) it will turn brown at the extremity, but scarcely round at all ; on the contrary if a minute fibre be employed it will form a greenish or yellowish glass, with intumescence, and this observation applies in substance to many other minerals.

It appears to be characteristic of epidote that the portion of the essay in the exterior flame does not lose its colour.—Could its colouring principle be extracted it would probably therefore form a very permanent pigment. Iron pyrites is much mixed up with this epidote.

FOURTH ORE BED.

Beyond the last deposit on a western course at the distance of about four miles by land, (the water communication being circuitous and interrupted by two small rapids,) there is another large bed of magnetic ore situated on Belmont Lake. Having neither visited this place nor seen any of its ores, I can say nothing further respecting it.

FIFTH ORE BED.

Due west of the Marmora works, at the distance of three miles, and on the banks of a branch of the Moira river is another bed commonly called "Fosters Ore Bed." This deposit has been worked and a considerable quantity of ore taken from it. I cannot say that much more remains, because it appeared to me nearly exhausted, but Mr. Mana-

han, who has had better opportunities of judging, is of opinion that it is still abundant. As it was necessary to transport this ore to the works by land, having first extracted it from a tough sienite, the bed has been abandoned in favor of the ore on the Marmora Lake. Much of this ore is mixed up with calcareous spar, which, of course acts as a flux and assists its fusion, on this account it is sometimes used in the operations of the furnace to produce a hotter cinder.

It contains sulphur, but apparently not so much as the last bed. Its geological relations are the same, that is to say, sienitic, but it differs mineralogically in containing, besides calcareous spar, octohedral chrystals of iron and garnet. Dr. Bigsby, I believe, says manganesian garnet, but using a flux of borax and nitre, I never could develope before the blow-pipe the amethystine tint so characteristic of the presense of manganese, when in any quantity; the colour of the globule was always green or yellow, like that produced by iron alone. Garnet also occurs here in amorphous masses, and may be considered an ore of iron, although, a poor one; it is, however, very easily fusible and valuable on that account as a flux.

MINERALOGICAL CHARACTERS.

Several of the ores from this bed, so nearly resemble some of those which have been described as occurring in the main deposit on the Marmora Lake, that it is superfluous to describe them, I shall confine myself therefore to those which appear to differ.

1st.—Colour, steel grey; opaque; structure, laminar, the mass having a tendency to break into fragments of a rhomboidal shape, with smooth sides; cross fracture, uneven; lustre, shining, (almost splendent); resino metallic.

It resists the knife, but is very brittle, almost friable. It is powerfully magnetic, but not with polarity; colour of powder, black; specific gravity, 4-9. In nitric acid it effervesces at first considerably, owing to the carbonate of lime between its laminæ. Before the blow-pipe it decrepitates like galena, which it more resembles in appearance than any ore of iron I every saw before, after which it seems to burn for an instant; in other respects its blow-pipe characters are the same as the other magnetic ores.

This is an excellent ore, as it bears its flux with it, and would probably yield 65 per cent.

2d.—Colour, brownish or yellowish grey; opaque; structure, fine grained; fracture, uneven; lustre, glimmering, resino metallic; yields to the knife, though not easily, and affords a yellowish powder under the hammer; specific gravity, 3-5; not magnetic even after roasting on charcoal. In the interior flame of the blow-pipe it forms, like the garnet, a black globule which is slightly magnetic. It contains crystals of garnet and iron; the latter are always some modification of the octohedron, the former are as usual dodecahedral. It is much mixed up with carbonate of lime, as its free effervescence in acid evinces, with borax it gives a glass coloured by iron.

This I consider to be amorphous garnet, a dark reddish brown variety of which is also met with.

The crystals of garnet are sometimes of a red, at others of a brown colour, but it is generally so intense as to render the crystals nearly opaque.

I have only one more observation to make on this bed, viz. that by a species of desquamation on the thin edges of the laminæ and along many of the lines of cleavage of the calcareous spar a peculiar feathered appearance is given to many of the clusters of its crystals, which, moreover, seems

always to accompany a portion of the rock or gangue that bears a remarkably pseudo volcanic aspect.

SIXTH ORE BED.

Southwestward of "Fosters Ore Bed," about a mile, another is found on the border of a marsh. It has been worked and several tons of ore have been taken away, but like the last mentioned bed it has experienced a temporary neglect, and for the same reason. Its ore, however, appears to be much easier extracted, and much more abundant.—Large crystals of iron upon the surface of some of the ore, and the pavonine tarnish on others, characterize this bed. It is magnetic, but contains much sulphur. Mr. Manahan, informs me that some portion of this ore is used in the furnace as an alloy ore, but other portions which are free from sulphur are equal to the best.

MINERALOGICAL CHARACTERS.

1st.—As has been said, some of the ore in this bed is characterized by having large crystals of iron upon its surface. These crystals appear, to be always some modification of the octohedron. The faces of the crystals are oblique rhombs, and are striated in lines parallel to the longest diagonal. It is seldom that more than five faces can be seen, as the others are either obliterated by the body of the ore, or what is more probable, never were formed. This ore is darker than any of the preceding; of a compact structure; very magnetic; specific gravity, 4-6, &c. &c.

2d.—A course granular variety of ore is obtained here, the cross fracture of which shows the pavonine or iridescent tarnish. It is very magnetic, and has a specific gravity of 4-9.

Almost all these beds appear to have, as in the present instance, a dip and direction towards the north.

SEVENTH AND EIGHTH BEDS.

It is said that on the opposite sides of the marsh before-mentioned, there are two more beds, affording large quantities of that ore, which has the pavonine tarnish.

NINTH AND TENTH BEDS.

I heard of these two beds, and saw the ore from one, which was excellent, but cannot describe their localities.

Before I conclude this note, some notice shall be taken of two reports which appear to be in circulation. One on the discovery of copper in the neighbourhood of the works, the other on the probable discovery of coal, both said to have had their origin with Dr. Bigsby. With regard to the first report, it might very well be true, as the geological relations of that ore agree with those of the country it is said to occur in; moreover the native copper of the copper mountains, in this quarter of the globe, has frequently a matrix of epidote. I, however, saw no copper ore, neither, I think, did Dr. Bigsby, or he would have mentioned it in some of his geological papers.

As to the occurrence of coal, one species of it, anthracite, (the best adapted, when mixed with a little charcoal, for smelting iron) might be found. I met with nothing, however, to indicate the probability of finding it. With regard to bituminous coal, it is very propable that it will be met with in this part of Upper Canada, if it preserve in this country the same geological relations it does in Europe.

Among the prizes offered by the Society, is one for the discovery of coal. It would have been within reach, had it been offered for the best essay on the probability, or the improbability of finding it.

However imperfect the foregoing description may be, I

think that a sufficient number of facts, both geological and mineralogical, have been adduced, to render it highly probable that the limestone of this district is of the transition class, while the crystalline rock below it is of the primary order; one of the youngest, perhaps, (as Doctor Bigsby has said of the sienite of Marmora) of the older class of rocks. Whether the latter is to be called granite or sienite, appears to be a mere dispute about words, in which I shall take no part, conceiving that whatever the minerals may be which are present, either predominating or otherwise, that the different aggregates are of contemporaneous formation, and pass one into the other.

A question has been mooted out in this country, whether a genuine granite, that is an aggregate composed exclusively of quartz, felspar, and mica, of a very crystalline texture, and exhibiting no signs of a mechanical formation has been observed; as far as my experience extends, such an aggregate is very rare, nor can I say *positively*, that I ever saw such, under any other form than as veins traversing other rocks. Hand specimens may be frequently seen and collected, in which the necessary conditions appear to be present; but no individual, ambitious of being thought a geologist, will judge from such partial *data*. Let him cast them from him, and visit the rocks *in situ*, before he presumes to give his opinion; it will then be entitled to attention though it prove erroneous.*

* Captain Bayfield has, since the above was written, informed me that beds of genuine granite are occasionally met with on the northern coasts of Lakes Superior and Huron, although, in general, the granite of those districts is sienitic.

NOTE 2.

For information respecting the ore in rear of St. Paul's Bay, I beg leave to refer the Society to my communication on the subject, in the 1st and 2d vols. of its Transactions, pages 145 and 76.

The only new fact I have to communicate on the subject is, that a fragment of the ore which has been left neglected in a dark corner for some time, is now found to possess polar magnetism, although it previously was found to be deficient in any kind of magnetic influence whatever, before it was roasted, and which circumstance was particularly stated in one of the communications alluded to above.

NOTE 3.

The Gatineau river enters the Ottawa from the northward, about one mile and a half below the entrance into the Rideau Canal. It is navigable for steam-boats for about four miles upwards from its confluence with the Ottawa,—here rapids occur. About one mile and a half west of these rapids, a bed of iron ore is met with. It is situated near the summit of a mountain, in the township of Hull, L. C. and forms a vein or bed in the former from ten to twelve feet thick. It appears to traverse the mountain on a south-west course, having a vertical position as regards the walls of the vein. On the opposite side of the mountain, at the distance of upwards of a mile, and in the direction of the vein, ore was again seen in great abundance. From the quantity of ore seen in these two places, as well as in other parts of these high lands, no doubt is entertained that there is a considerable deposit of ore in this portion of Lower Canada.

Judging from surface specimens, the rock with which the iron ore is associated is a friable white marble, containing, like much of the ore, small particles of plumbago or graphite.

Wood for making charcoal and limestome as a flux, abound in the neighbourhood; and a water power to almost any extent may be commanded. The ore is often strongly magnetic.

The substance of the foregoing communication was sent to me, at my request, by Mr. Burrows, the overseer of works on the Rideau, who has been before mentioned.

It is very probable that the graphite mixed with the ore may prove an advantage in its reduction, by causing a saving in the expenditure of fuel, and also by exerting a beneficial influence upon the cast metal.

NOTE 4.

Iron sand often exerts a strong cementing power on the shores of the St. Maurice, &c., there are banks of sand so indurated by its presence as to resemble sandstone.

I have often observed, as probably others have also, that rivers which bring down this metallic sand deposit it in narrow low ridges upon the shore at *higher* elevations than similar deposits of the *lighter* sand, a fact at first not easily explained; upon more particularly observing what takes place, however, it will be perceived that these ridges are deposited upon the *return* of the ripple to its bed, consequently that sand of greatest spacific gravity falling first will hold the highest position.

NOTE 5.

The deposit here alluded to is situated on the eastern shore of Beverley or Henderson's lake, an enlargement of the Gannanoqui, in the upper portion of its navigable waters. It is about one quarter of a mile from the lake, on the opposite side of a cedar swamp, and on the summit of a small hill. An inhabitant of Beverley desirous of ascertaining whether it was in abundance or not, opened a portion of the ground about ten feet every way, and found a considerable quantity. He seems to have struck a vein of it at the depth of about eight feet, which dips towards the north-east. But it also appears in the section he has made in large heavy blocks on and near the surface. I examined the ground in several places to the northward and eastward of this excavation, and always found it near the surface, it was also met with to the westward. As I remained on the spot only twenty minutes or half an hour, it is not possible to pronounce as to the quantity in which it occurs, it however, appears to be considerable. To obtain positive information on this point, it would be necessary to cut a few sections or sink a few holes on the hill, which might be done at a trifling expense—an expense amply repaid by even the chance of finding an extensive bed of ore in so desirable a locality.

MINERALOGICAL CHARACTERS.

Only two varieties of ore occur here, red ochre and one (that predominating,) which possesses the following characters :—

Some parts are of a dark Indian red colour, and others iron grey ; opaque ; structure, pisiform or oolitic, the mass being composed of small globules of a reddish colour, and

unctuous lustre externally ; a fracture shews these globules on one side, and the rounded concavities they have vacated on the other, these hollows are sometimes of an iron grey colour, at others Indian red. The globules resist the point of a knife, but the mass yields to it a light red streak ; its powder also is of a lighter red than the mass. The structure of the globules is hollow, perhaps concentrically so, but they are so small as not to be easily examined on this point. The lustre of the ore is between dull resinous and shining metallic, but glimmering points and small laminæ of a higher lustre are frequently seen. The specific gravity is various, but it is between 2·9 and 4·6 ; no change in nitric acid. Before the blow-pipe it does not fuse, but turns black and magnetic. To borax it communicates the usual colour characteristic of iron.

I am not aware that a similar variety of the red oxide of iron has ever been noticed before. In its structure it resembles the "pisiform clay iron stone" of Phillips, but its frequent metallic lustre distinguishes it. It may be an intimate mixture of the two. Fluiry's name of "fer oxide globuliferne," is expressive of its appearance, although under that head he does not describe the same ore.

It has been said to smelt easily and to make very good metal. I am more doubtful of the accuracy of the latter statement than of the former.

2d.—The red ochre, besides coating the globules and the external surface of the ore, lines the sides of the veins and is much mixed up with the soil of the neighbourhood, indicating the proximity of a more solid ore. It is remarkable for its unctuousity.

If much ore of a good quality were found, which I am far from taking upon myself to say is the case, its locality is a

highly favourable one for working in. A few hundred yards of land carriage would bring it to the waters edge, from whence it might be transported down the Gannanoqui to the Furnace Falls, at which place every facility offers itself as regards water, wood, limestone and sandstone, for the establishment of Iron Works. By the construction of one, or at most two locks, the iron fabricated might be transported by water through the White Fish River into the Rideau Canal, below Jones' Falls. Nor if it were desirable is the water communication with the St. Lawrence below the falls of difficult attainment—two or at most three locks would effect this also.

I propose to close this note with some observations upon the rocks and minerals met with in ascending the Gannanoqui.

The Gannanoqui enters the St. Lawrence from the northward about twenty-one miles below Kingston. Advantage has been taken of a fall at its mouth* to establish saw and grist mills, which from their favorable position, great popularity of their owner and the liberal expenditure upon them of a large capital, are considered to be the most flourishing works of the kind in the Upper Province.

Upon landing on the right bank of the Gannanoqui, at its mouth, a conglomerate was first observed, which was supposed to belong to the old red sandstone formation, that rock having been subsequently noticed forming a precipitous bank towards the St. Lawrence on the left shore of the Gannanoqui. This conglomerate however, was not particularly observed. The old red sandstone, as it is presumed to be, has the appearance of being horizontally

* About fifteen feet high.

stratified, but this feature was not very distinct, owing to the rugged nature of the section in which it was examined. The prevailing, though not the essential colour, was here present in this rock, varying from brick red to yellowish red passing into yellow. It is also characterized by those red spots and protuberances, which have been given, though I believe, erroneously as a certain type of this rock. The action of the atmosphere causes the exposed surface of the rock to crumble away leaving in many places where these spots occur mamillary protuberances : they are sometimes hollow, and then have the appearance of miniature craters, occasionally these spots yield to weathering more readily than the other portions of the rock, in which case rounded holes on the surface are seen an appearance very common in the detached masses of this rock, which are found distributed over the country. The structure of this sandstone is generally fine grained, but it is often that of a coarse conglomerate. Sometimes coloured streaks or bands parallel to each other and to the lines of stratification are very distinct upon a cross fracture. This formation appears to be contemporaneously the same as that with which the iron ore is associated in the higher portions of the Gannanoqui. It also appears to have been formed from the debris of a rock common in this part of the country, the constituents of which are very red felspar ; light blue opalescent quartz ; a small portion of green hornblende with occasionally a little mica. This quartz which is easily recognised, is frequently seen in the sandstone. The rock alluded to may be seen near Kingston and at the Furnace Falls on the Gannanoqui.

Beyond this sandstone, to the eastward, a point projects out towards the St. Lawrence, (which bathes its foot)

composed of a very friable limestone, often of so crystalline a structure as to resemble calcareous spar. It often contains specks of graphite, and sometimes parts of it are discoloured by what appears to be the green carbonate of copper. Its colours are whitish, yellowish, and reddish. Similar aggregates have been met with in sinking the lock pits on the line of the Rideau Canal, and in one instance it has been observed to have a geological position below the red sandstone.

This limestone is perfectly useless as a building material, and for lime it would not answer well, because it flies and falls to pieces and powder in the kiln. When the lime is required for immediate use, it might answer, but the quickness with which it would pass from a caustic lime to a carbonate, would render delay destructive of its power of fixing in a state of mortar, Mr. M'Donald, the obliging proprietor of the mills, procures all the lime he is in want of from Kingston.

About one mile from the mouth of the Gannanoqui the navigable portion of it begins, and continues as far as the "marble rock or falls," a distance of about ten or twelve miles.* As the geological features of this part of the river are interesting, I shall endeavour to give some account of them.

The waters of the Gannanoqui have here apparently forced a contracted passage through a hill of rock, leaving a section on either side, varying from twenty to fifty feet above the river. On the left bank this section is through talcose schist and serpentine,—on the right it is through marble. Granite also on the left bank is seen forming a

* About five miles by land.

perpendicular scarp about one hundred feet from the river, and the same number of feet above its level. The talc, in the talcose schist, is of that variety called silver talc, and its lustre is so strongly that of silver, as to be easily mistaken by the inexperienced for an ore of that metal, (Note 8.)— In this rock veins of larger crystals of talc, of a light green colour, and very pearly lustre occur; they vary from half an inch to one inch in thickness. Other veins about half an inch wide, also occur of a mineral which possesses the following characters.

MINERALOGICAL CHARACTERS.

Colour on a fresh fracture, white, which by exposure becomes yellowish. When dry it is slightly translucent on the edges, but being absorbent and hydrophanous, it becomes deeply translucent on the edges after exposure to the action of water, in which it softens, becomes brittle, and eventually falls into two or more fragments. Structure, compact; fracture in the small, either even or flatly conchoidal; in the large, owing to the interposition of brown mottled seams of a glistening enamel lustre, the fracture is undulated. These seams often exhibit peculiar fibrous markings of a brown colour, occasioned probably by incrustations of rock cork or rock leather; they render the mineral very frangible in the large; in the small, when dry, it is not so, but when saturated with water, it is even friable. Its lustre is dull, but it easily acquires the shining polish of enamel. It is scratched by calcareous spar, but not by the nail unless it has been previously soaked in water and is still moist. It has a slight argillaceous odor when breathed on, and is slightly adhesive to the tongue, with the flavor of chalk rather than magnesia.* It has a

* It has been said that the carbonate of magnesia, and the pure earth

very soft and unctious feel, both in substance and powder —specific gravity, 2 2-3.

In powder it is partially soluble, without effervescence in the mineral acids, and their diluted solutions. When tested with Prussian alkali, or tincture of galls, the presence of a proportion of iron, which the low specific gravity, and pale colour of the mineral in question would not lead one to suspect the presence of, is indicated. By evaporation salts of a white colour, acicular form, and the flavour of copperas, are obtained from its solution in sulphuric acid; sometimes a slight acidulous taste like alum is noticed, but never the nauceous bitter of epsom salts. Its powder in water communicates a blue colour to test paper. Its solution in muriatic acid does not redden flame.*

In the mattrass, if not perfectly dry, it decrepitates violently, and giving out its moisture it turns black.— Before the blow-pipe, if moist, it decrepitates violently, otherwise not, and turns black, but not magnetic. A small thin fibre-shaped particle fuses in the interior flame, into a dull white enamel, but slowly and with difficulty. A larger essay is impossible. With borax it forms slowly, a colourless transparent glass. It phosphoresces a little on a shovel heated below redness.

From its geological position, and some of its other characters, I was induced at first to consider this mineral to be

have no flavor by which they can be distinguished from chalk, and the fact that the character of flavor is entirely omitted by mineralogists in describing these substances, makes it appear that that opinion is generally entertained by them. With due submission, however, to such high authority, it seems to me to be an important character omitted, as I am almost certain that I could detect these minerals in a state of purity, by this character alone.

* See Silliman's Journal, vol. 18, No. 2,—"On the red colour of flame," &c. &c.

a hydrate of magnesia, but upon a closer examination it appears to agree better with that variety of hydrate of allumine, called heuzenite by Cleaveland. It is just as likely however, to be one of the numerous family of clays, a bole, or lithomarge, for instance. It does not form a paste with water, and is not easily reduced to an impalpable powder.

A calcareous spar of the lustre of satin spar, and also sometimes of the same structure is found in thin veins in the rock. Its usual structure, however, is laminar, and the laminæ appear to be arranged diagonally as regards the sides of the vein, having their polished faces striated in narrow blue bands like the water lines on paper, parallel to the sides of the vein in which direction there are probably cleavages although none could be obtained.

A species of potstone or foliated soapstone is obtained under the same circumstances.

Hexagonal crystals of silver mica are found imbedded.

A beautiful enamel coating often fluted and of a purple, a green, or a reddish colour was seen upon the surface of some of the talcose schist forming the sides of the veins in which the supposed hydrate of allumine was obtained, also upon the satin spar. Advantage has been taken of the fall and of the rocky elevation on either side of it, to construct a dam and to establish a saw mill. On the left side of the saw mill and of the river, the serpentine rock is seen forming a perpendicular scarp. It is composed of the precious variety of serpentine, and appears to form a thick bed in the talcose schist. On the upper surface of this serpentine is seen in patches a thin white compact coating of a mineral, which bears some resemblance to the mineral before described, but it is found to effervesce and dissolve very

freely in muriatic acid and to form with sulphuric acid a thick curdy deposit of a white colour and perfectly tasteless. I am disposed to think it an incrustation of magnesian carbonate of lime, and the curdy matter an artificial gypsum.

The talcose schist lies between the serpentine and granite, which last mentioned rock rears it head in one perpendicular scarp above the others perhaps fifty feet. It is composed of felspar and quartz, with occasionally, black schorl, but no mica Such an aggregate is a frequent member among those rocks in this country which are called granite. It has been called a granite here for want of a better name, but as its constituents have been given, a name can lead to no erroneous conclusions. It is very much to be wished that geologists would oftener condescend to give the constituents, &c. of the rocks they describe. In the difficult science of geology, as yet in its infancy, conciseness is well sacrificed for a detail which shall render its facts intelligible.

I have described marble as forming the right bank of the river at and near the dam; it does not do so, however, exclusively, as talcose schist is also there, but in subordinate quantity, and a short distance back from the shores granite is, I believe, as on the opposite side, also found. This marble sometimes spotted by serpentine, forming a *verde antico*, at others almost of a pure and brilliant white, forms an extensive bed some distance below the Marble Falls, but it is near them that that beautiful variety, chequered by serpentine has been found; it also occurs in large nodules imbedded in the limestone, and again one part of a mass is white marble—the other serpentine. This serpentine is of the purest kind, being of a very vivid green colour and very translucent. The marble with which it is associated

is generally of a compactly laminar structure and white colour. It takes, I believe, an excellent polish, and when, as is frequently the case, the spots of serpentine are round, small and thickly distributed, no handsomer material of the kind can be found, nor one better adapted for many ornamental purposes. It is so easily worked that rings have been made of it. Blocks of almost any required size may, I believe, be obtained, but of this there is no positive certainty, because no quarries have yet been opened, although it is said that they are about to be.

But it is not the *verde antico* alone which demands notice. A good description of white marble is found also here in large quantities, and although I have seen none which would answer the purpose of sculpture, it is very probable that it may be found, if sought for. Its colour is tolerably uniform, but some of the marble contains small crystals of a brown mineral and occasionally parts are grey rather than white. Its structure, as has been said, is compactly laminar, the mass being composed of small laminæ with polished faces closely aggregated. It is harder than white marble usually is, but effervesces freely in muriatic acid.—It is deeply translucent on the edges. For building, and for almost every purpose to which limestone is applied, it would answer well, and judging from what I saw, it would appear that any quantity might be obtained. About one mile below the falls it is seen in greatest abundance, apparently overlying serpentine, and forming with that rock a perpendicular cliff about twenty or thirty feet high. In short there appears to be an immense marble quarry in this part of Canada, the limits of which have not been ascertained

The water retained by the dam at the marble rock is

about twenty-five feet above the St. Lawrence and six feet above its natural level. Above these falls as far as the "Furnace Falls," (about twenty-five or thirty miles* *by water* from the mouth of the Gannanoqui,) the river is so nearly upon a level that rafts will not descend with the stream unless they be assisted by a favorable wind. The shores of this river are generally low, and I should conceive that much the highest portion of the country, at least on the shores of the Gannanoqui, is on the summit of the granite aggregate, on the left bank of the river at the "Marble Falls."

It has been before said that the rock at the Furnace Falls is a granite composed of red felspar, bluish quartz and green hornblende. It forms on the Gannanoqui; here a cascade of about fourteen feet in height, which gives motion to a flourishing saw and grist mill. I saw close at hand a reddish crystalline marble with points of graphite disseminated, and I heard of large deposits of excellent sandstone and graphite slate in the neighbourhood, but being hurried, the principal object of the visit to these parts, viz. to see the deposits of iron ore, engrossed most of may attention.—One deposit only was seen, that which has been described, but the occurrence of others was mentioned, the localities of which from description were not of so favourable a nature as regards the transport of ore.

At my request Mr. Burrows, an intelligent overseer of works on the Rideau, lately sent me some notes and specimens of rocks found near or on the line of the Rideau Canal from the Cranberry Lake to Kingston Mills. I propose to condense these notes and combine with them my own observations.

* Only fourteen by land, so circuitous is the course of this river.

1st.—Between Cranberry Lake and the strait leading into Dog Lake, the old red sandstone, in nearly horizontal strata occurs. It is described as being in very thick beds, and to dip away in several directions as south-east, west, south of west and north-west at a variable angle of from 5° to 10°. It is red and white in bands parallel to the lines of stratification, and resembles very much a red sandstone, which is purchased in the United States for the use of the iron furnace at Marmora, for which purpose, I think it would answer, but experience must decide that. From the creeks or south-east outlet of Houghborough Lake, an inferior sandstone, apparently belonging to the same formation is procured, some of the sandstone from hence is a species of grey wacke.

2d.—Is a black limestone of a very compact structure, and somewhat flinty aspect. It is transported from near Auley Mills to Jones' Falls, and burnt for the supply of lime for that place. No limestone having been discovered nearer; it is described as being situated on a high ridge.

3d.—Sandstone from a high ridge between the lakes at Brewer's upper mill, and the quarries described under No. 1. It is close to the line of the canal, horizontally stratified or nearly so, and superincumbent to a mass of very friable white and grey crystalline limestone. This sandstone is of a yellowish white colour.

4th.—Is the friable crystalline limestone alluded to above, and which, from the looseness of its laminar texture, friability and colour, resembles some calcareous spars. It was also alluded to in describing a similar aggregate at the mouth of the Gannanoqui. It is described as underlying a sandstone, which I venture to name the old red, simply from the fact that wherever it is found in this country, it

appears to be either in immediate contact with primary or transition rocks or if any rock containing organic remains is found above it, these remains always indicate an older formation than the red marl or *new* red sandstone—the only one it could be mistaken for. Admitting that it is the old red sandstone and that that rock is the last of the secondary, the one beneath it must be of the transition class, which its texture and structure corroborates, the former too loose for a primary rock and the latter too crystalline for a secondary, besides which a similar aggregate as has been described, is associated with graphite, a mineral seldom met with above the transition class. This limestone possesses one character that may be considered some what at variance with these views, viz. when struck it gives out a strong odour of sulphur.

5th.—In excavating a lock-pit at Brewer's mills, Mr. Burrows met with the following rocks in the order set down. He is not positive, however, that some of them were not boulders, but thinks that if they are they must be very large ones. The superincumbent rock forms a stratum of about one foot thick, adapting itself to the shape of the mass it rests upon. It is a crystalline aggregate composed of black hornblende, which predominates, mica, felspar and quartz. The rock it lies upon is a crystalline limestone, resembling No. 4, but not so loose in its texture. If these rocks are *in situ* and their relative position correctly given, the fact has very much the appearance of a secondary trap overlying transition limestone. Large rhomboidal crystals of felspar were also struck from a rock in place in this pit; the whole is crowned by nine or ten feet of very stiff clay.

6th.—On the west side of Cataraqui creek, immediately opposite Brewer's upper saw mill, very fine specimens of

large hexagonal mica, of a brown colour, and aggregated into masses, are taken from a rock which, judging from a hand specimen, appears to be a genuine granite, and is probably the oldest formation which shows itself in these parts. It is possible, however, that this mica is from a granite vein, traversing a younger rock.

7th.—From a quarry situated about five miles to the south of Brewer's upper mill, near the road to Kingston, and on the east side of Cataraqui creek, the main supply of stone for building the locks at Brewer's mills is obtained. The little stripping required in quarrying this stone, is the cause of its being brought a distance of from three to five miles. It does not appear to be by any means so good a material for building as No. 1, although it is probably of the same formation—it is of a yellowish colour. It is the different state of oxidizement in the iron which is present, that occasions the difference in the colour of that sandstone; when red, the iron is in the state of the red oxide; when yellow, it is the brown oxide of iron which affords the colouring principle.

8th.—The lock pits at Kingston mills had been sunk through a rock which may be either called a sienite or greenstone; so equally are the minerals necessary to constitute those rocks, mixed up with one another. The felspar is red and sometimes, I believe, predominating, while the hornblende is dark green, and more usually prevails. I have not observed either quartz or mica in it, but I believe they sometimes occur.

9th.—Is limestone from the east side of the creek at Kingston mills. It is dark and compact. It occurs in undulated strata of various thickness. Courses of twenty-eight inches have been procured at this quarry, for the

use of the works at Kingston mills. This ridge appears to Mr. Burrows to be a continuation of the limestone quarries at Point Henry. It crosses the Montreal road, and, he thinks, extends within a short distance of the sandstone, No. 7, where it suddenly terminates.

NOTE 6.

The St. Maurice iron works are situated on the right bank of the St. Maurice river, about eight miles upwards from its mouth. They are accessible both by land and water, but more readily by the former than by the latter. A strong current, occasional shallows, and one small rapid, rendering it necessary that in ascending the river, the oars should be laid aside, and the more tedious process of poling had recourse to. The strength of the current, however, is all in favour of descending, and with proper guides, bateaux of five tons transport cast metal, &c. &c. to Three Rivers, from whence they return to the works empty, once in the course of the day. All stores, &c. required for the establishment, are transported over land from Three Rivers, a distance of eight or nine miles, upon atolerably good and level road, across a country composed of a deep ferruginous sand, bottomed on clay, and consequently presenting a barren aspect.

From this bank of sand the visitor drops suddenly upon these iron works, which consist of one smelting furnace, two forges, one charcoal mill, one saw mill, and one grist mill, with minor workshops. The whole, including the domestic establishment of the resident, and the huts of the workmen, presenting the appearance of a small village.

By damming up a small stream running into the river from the west, ample conveniences for washing the ore are obtained, and power sufficient to drive the furnace bellows, which is moved by a wheel thirty-two feet in diameter. A grist mill, a forge for drawing bar iron, with a hammer weighing five hundred weight, a mill for grinding charcoal for the moulding room, a saw mill, and another forge, having also one hammer of five hundred weight. The supply of water is constant throughout the year.

The description of ore made use of is the bog ore, which is obtained from the neighbourhood of the works, not, however in the immediate vicinity, as that, although not entirely exhausted, is said to be scattered over the ground in such small deposits as not to be worth the expense and labour of making roads to them, while ore can be procured in great abundance, in other places though at a greater distance. The nearest point from which it is brought at present is six miles, and farthest nine.

This ore is of excellent quality, and occurs in patches of different sizes, varying in thickness from six to twelve inches. It is found from four inches to one foot below the surface.

Those places which were exhausted of ore many years ago, are said to exhibit no appearance of a renewed supply. It is probable however, that those exhausted spots which have become filled subsequently with stagnant water, would, after continuing in that state for some time, afford some appearance of the kind. This species of renovation is common to bog ore, and where observed, it has been often supposed to be owing to the growth of the ore; the rationale however, appears to be this,—water combining

with the different acids and alkalis, which, decomposing animal and vegetable substances afford becomes capable of dissolving oxidulous iron, &c. When such waters become stagnant a precipitation ensues not only of those minerals, &c. which may have been held in mechanical suspension by the water, but also of most of those which are chemically combined with it. In this manner an argillaceous and phosphorized variety of iron ore is formed of a thickness proportioned to the time this reproducing power has been in action. Indicative of this natural process the interior of the cells of bog ore are sometimes lined with a blue phosphate of iron. In the south western parts of New Jersey, where bog ore occurs in great abundance, many spots previously exhausted are explored again successfully, after the lapse of about twenty years.

The iron is probably derived from the ferruginous sand banks which have been said to characterize this place, and from deposits of magnetic iron in the primary chain to the northward, the existence of which the profusion of magnetic sand which the waters of the St. Maurice throw upon its shores, renders almost certain.

It is worthy of remark that the ore is here said to be deposited on a *coarse white sand and never on clay*. The thin stratum of clay, which it would appear was necessary to retain the waters, holding the iron in solution sufficiently long in a stagnant state to allow of its precipitation, (a purpose coarse sand would scarcely answer,) has *perhaps* been converted into bog ore by a species of impregnation common to this substance, and often decidedly observed in roots of trees, &c., as it is probable that a similar formation has seldom been deposited originally on any other than a retentive sub soil.

In one instance a second layer of ore was found beneath the first, where there are alternating thin strata of clay, such an occurrence is not unlikely to exist.

As to the quantity of ore to be obtained, it is not possible without instituting an actual survey for the purpose, to obtain any other information than that of the most general description. The individuals best informed on the subject, believe it to be in considerable abundance, if not on the land leased by Government, on the adjoining seigniories of Cap de la Magdelaine, Champlain and Batiscan. The seigniory of Champlain belongs to one of the proprietors of the iron works, the Honble. Mathew Bell, but the other two either are or were the property of the Crown.—Hitherto when one deposit of bog ore has been exhausted another has been readily found by probing the ground with a short pointed piece of iron, when if ore be present it is ascertained by the gritty metallic sound returned. The nature of much of the land in these parts swampy, cold, barren and covered with soft wood, are signs of the probability of its frequent occurrence. Where hard wood prevails ore is not found; hemlock, spruce, sapin and cedar accompany it—white pine is not found in abundance where ore occurs.

The credulous workmen are said to be alarmed by the *ignis fatuus* which is sometimes seen floating over the bogs in this part of the country. The appearance of this meteor should rather be welcomed as a favorable omen than otherwise, as it certainly proves the presense of phosphoric acid, one agent, probably by which the iron ore was originally dissolved, and removed from in some cases remote situations to others, where under a new form it can be readily worked. The *ignis fatuus* is ascribed to a mixture of hydrogen

obtained from the decomposition of water with carbon and phosphorous, from animal and vegetable substances. The presence of phosphoric acid, however, does not improve the quality of the ore, as the bar iron made from it is said by writers on the subject to be often, in consequence, what is technically called "cold short," that is brittle when cold.

This ore is said to afford good pig and bar iron, the former at the rate of 45 per cent., it is probable, however, that this is rather overrated, as bog ore seldom yields more than 35 per cent. No plate iron, wire, nor steel, have been manufactured; for the two first, it may probably be too brittle owing to the presense of phosphoric acid, which is always found in metal obtained from this ore.

The articles of cast iron furnished by this establishment are stoves and hollow ware of all descriptions. The former are cast thick to resist the cold of the climate, and are found to be less liable to crack than those imported.

During the late war the lake service was supplied with trucks, shot and other castings by this establishment, and in the event of a future war, not only the marine branch of the service, but that of the ordnance also could be supplied with many articles which the nature of the service might require, such as gun carriages, shot, shells, &c. &c. the the price would of course depend upon the state of the trade.

The quantity of cast iron obtained averages about two and a quarter tons per day—the result of two drawings in twenty-four hours, or sixteen tons per week. From forty-five to fifty hundred weight of bar iron is manufactured each week for the supply of axes, horse shoes, ploughshares, &c. &c.

The growth of timber is, in the swamps, spruce, hemlock,

tamarac, cedar, sapin, (the pine which yields the Canada balsam.) On the higher elevations birch, maple and beech. The quantity is thought not to be sufficient for the smelting of all the ore. That prefered for making charcoal is beech, birch and maple. The proportion of coal to ore is six hundred and forty-eight bushels to three tons. The charcoal is made in winter and brought to the works a distance of from four to seven miles.

Some years ago a very fatal accident very nearly happened at these works. The first layer of coal had just been put upon the furnace and lighted, when one of the men seeing scoria sticking to the sides of the furnace, descended to remove it, and while standing on a ladder to do so he suddenly lost his senses and fell. Another man seeing the transaction descended likewise, and while putting a rope round the body of his inanimate comrade, a stupor came over him and he fell also. A third man now descended with a rope round his body and succeeded in getting one of the men out, but not before the gas had taken effect on himself as he was drawn out apparently lifeless. The man who first fell was the last who was taken out, yet he suffered least, and subsequently described his sensations previously to falling as very pleasurable, while those of the other two, both before and afterwards were said to be horrible. One man indeed, was very angry with the Doctor, I believe, for bringing him to life.

The river opposite the forges, as these works are called, is two hundred and eighty-eight yards wide. At the mouth of the river where the ferry is established its width is according to the ferryman about four hundred and eighty yards. This river continues navigable for six miles above the forges, but the current is in some places very rapid—

at least four miles an hour. Where the river ceases to be navigable, a fall called the Falls of the Greys, occurs and it is not far from the foot of these falls on the right bank of the river that the sandstone for building the hearths and furnace and the limestone as a flux for the ore are procured. I walked to these quarries by the shore of the river, and shall attempt to give a geological section of the country passed through.

No rock appears on the banks of the river for three or four miles; its place is supplied by a stiff clay, through sections in which streams and small torrents descend, the colour of whose waters often indicate the presence of iron in solution; it is less equivocal when, as is also often the case, a crust of the red oxide of iron is found covering the rounded stones and pebbles at the mouths of these streams. About one mile or thereabouts, from the works, a sulphuretted spring is met with, rising in the river, and forming a small *jeu d'eau* above it. The smell of sulphuretted hydrogen is so powerful that it is impossible to pass the place without noticing it. On the dry bank opposite, down which a small stream is trickling, a white curdy mineral is observed coating the sides of the bank, and evidently deposited by the water, which is also sulphuretted. It was supposed to be either a carbonate of iron, or a sulphate of lime, but no examination of it was made, to determine that question. The same appearance is observed at St. Paul's Bay, where also chalybeate waters mix with those which are sulphuretted.

The first rock which was met with, is a fetid shell limestone. Suddenly cropping out of the ground—the same as that in which the quarries are worked, and which are situated near the falls, about two hundred yards from

the river, and perhaps fifty feet above its level. The sandstone which is next met with on the shore, about one mile and a quarter below the falls, is, as I conceive, of the old red sandstone formation, although its colour is rather white than red. It forms a low bank, running parallel to the river, at the distance of about one hundred feet. It dips with the river, but faster, in consequence of which it is soon lost in that direction. Its total depth is about twenty feet, one half of which is below the surface of the ground at the base of the section, and about one-third is below that of the river. It is divided into strata, varying from a few inches to nearly two feet in thickness. The upper strata are rubbly, often friable, and of a reddish colour externally, but the lower turn out some excellent blocks, and haslars from five to six feet in length, may be obtained, although not easily. On account of the whiteness of its colour, the fineness of its texture, but above all, on account of the obstinacy with which it endures the greatest heat of the furnace, this stone has acquired a kind of notoriety, and in consequence, I was sent a few years ago, by order of His Excellency Lord Dalhousie, to report upon it, with the view, that if found to be of a favourable description for building, permission might be obtained from the proprietor to remove a sufficient quantity of it to erect a monument to Wolfe and Montcalm, a work at that time in contemplation. The report was unfavourable, partly on account of the expense of quarrying the good material, but more because the best of it was not considered by any means so well calculated to resist the disintegrating action of the atmosphere, as the stone (a grey wacke from Cap Rouge) of which the monument was ultimately built. It does not follow, because a stone stands the furnace well, that it should

resist the weather equally well, or *vice versa*, as there is a great difference in the *modus operandi* of these different causes. Much depends upon the nature, particularly as regards the structure of the stones, for instance, compact stones usually resist the weather well, but will fly immediately in the fire as flint, quartz rock, &c. On the contrary, rocks and stones of a granular and slaty structure will often crumble away in the air, but which would resist heat remarkably well. But it is ridiculous to dwell upon so obvious a truth, which would not have been done if an opinion were not prevalent that any stone which will endure heat, will also endure what is so very different, the capricious changes of the atmosphere at all times,—the combined action of heat and moisture, in the summer, and the still more powerful combination of cold and moisture in the winter.

In corroboration of what I have been saying, the sandstone in question is by no means extraordinary as a building stone, but for the particular purposes of constructing the furnaces and hearths stone, it is not easy to conceive a better material. Upon examining the sandstone with a microscope, it appears to be composed of grey grains of quartz, and a somewhat powdery mineral of a white colour, which appears to be decomposed felspar. All parts of it are infusible under the blow-pipe.

Above this sandstone lies in conformable, that is parallel order, and close contact, a dark grey wacke, averaging twelve feet in thickness, immediately above which rises, at an angle of about 45° to the height of nearly one hundred feet, a mass of sandy alluvium. There is not the least doubt that the limestone before mentioned overlies the grey wacke; but whether other intervening strata may not occur is a question I cannot decide.

About one mile and a half higher up the river, and about one quarter of a mile above the falls, another section of this sandstone is seen,—here the French formerly quarried. From the circumstance of the strata of sandstone in the first quarry dipping, as has been described, faster than the river, I was induced to think that this section would be deeper than the other, and upon proceeding to the spot, this was found to be the case. The sandstone here forms a bank about twenty feet high, and its summit is perhaps fifty feet above the river; immediately at its base, a coarse conglomerate, composed of large rounded pebbles of quartz in a paste, apparently of indurated clay, was noticed. I was not able to ascertain what rock holds its position between this conglomerate and the sienitic rock below, which forms the falls of the greys, and much of the shore at its foot; but I think it is a recurrence of the same sandstone. An interesting geological fact was noticed here, similar to what has been observed in other places in Canada, viz. that the primary rock beneath appears to have thrown up the sandstone, and occasioned an opposite dip; thus the sandstone below the falls dips down the river, while that above is inclined the other way.

The profusion of magnetic sand on the shores of this river in this place has been already mentioned, as well as the cementing power it exerts.

The sand, or rather loam, which is used in the "moulding room" for the finer impressions, is procured from England, as it is said that an article proper for the purpose has not been met with in the country; they, however, both at Marmora and Kingston use a sand for casting stove plates, procured in the neighbourhood of those places. Sand of the best description must be of rare occurrence, as we are

told that there are only three places in England, in which it has been found, viz. Highgate, Woolwich and Liverpool, from the last of which places it is obtained for the moulding rooms in Scotland.

The following characters appear to be necessary to constitute a good moulding sand, viz :—

1st.—Great fineness in the particles.

2d.—A freedom from any which soil the fingers.

3d.—Infusibility and incombustibility at the temperature of melted iron.

4th.—Sufficient adhesiveness to prevent the liquid iron from washing any of the particles away.

5th.—Porosity to allow the escape of the gas, (hydrogen,) which is generated when the fused metal decomposes the slight degree of moisture necessarily present in the sand, and which gas is observed to burn away with a blue flame on the surface of the mould. A mixture of silex and alumine, the former predominating, and both in a state of considerable fineness, would afford an article which, judging *a priori*, would be likely to answer. The presense of the red or yellow oxide of iron in an ochrey state would not probably injure its qualities, but all sand containing carbonate of lime or vegetable substances should be rejected, as the former, when in contact with the liquid metal, would act as a flux upon the other minerals, while the latter would burn away, leaving vacuities, both of which circumstances would injure the impression ; much of this, it must be confessed, is conjecture, unsupported by any experiment with which I am acquainted.

At Three Rivers there is a small establishment for recasting old iron and pigs brought from the forges of St. Maurice, which the occurrence of the Sabbath prevented

from being cast in moulds. It consists of two cupola furnaces. The mixture of the old and new iron is found to improve the quality of the recast metal. Here, besides sugar and pot ash kettles, &c. &c. iron gear for steam boats is manufactured.

The establishment at St. Maurice was commenced by the French Government about the year 1737, and a foundary for cannon is said to have had existed here, but no vestiges of any operations of the latter description remain.

I will close this report with a short account of the Batiscan works, &c.

The river Batiscan enters the St. Lawrence from the northward about twenty miles below Three Rivers. It is navigable in the spring for schooners, at other times for boats, nine miles above its mouth, where are the ruins of an iron foundary established there about the year 1798.

This establishment consisted of a blast and air furnace, two forges, a saw and grist mill, besides other necessary work shops and dwelling houses. Both ore and wood are to be procured here more readily than at the forges of St. Maurice.

The cause of its failure appears to have been the want of capital and good management.

The land either is or was, until very lately, the property of the Crown.

For most of the information, which is matter of fact contained in this note, I am indebted to Mr. Greaves and to Mr. M'Cauley, who through the politeness of Mr. Bell, had been requested to afford me all the information I might require, which they readily did in the kindest manner when I visited the St. Maurice works.

NOTE 7.

This mineral is turned up by the plough, and is found in the water courses of a field, (composed of a stiff clay,) in rear of Dr. Mill's house at Sillery, in the neighbourhood of Quebec.

It occurs under all of the following forms, botryoidal, reniform and mamillary, and varies from the size of a nut to that of a large potatoe. These are incrusted on the outside by a yellowish white coating. Internally it is bluish black, though not uniformly so exhibiting when broken red and yellow parts. Its structure is earthy and it is extremely friable—very adhesive to the tongue and gives out a strong argillaceous odour. Its specific gravity is low, but it absorbs water so rapidly and abundantly, as to hiss, bubble and have its weight considerably increased after a short immersion; it does not, however, fall to pieces in water. It yields to the nail and receives a polish from it. It is not magnetic until exposed to a read heat with grease, and then only slightly. Before the blow-pipe it becomes glazed and rounded. *With borax it forms a glass globule of the colour of the amethyst,* but the greater part of the essay remains suspended in the flux. If too much heat be applied, or if continued long, the colour of the globule is yellow, afterwards it becomes colourless.

I may be mistaken in calling this "wad" but it is certainly a combination of manganese and iron.

NOTE 8.

Talc and mica, (the silver varieties,) have often been mistaken for silver. Some years ago, I was invited by the

Honble. Judge Taschereau, to visit his seigniory of St. Mary's, L. C. At that period it was reported that one of his tenants had deserted his family and home, and had taken up his residence in the woods, where he was working by his own solitary manual labour, which he conceived to be a silver mine. We visited the scene of his operations and found an excavation about ten feet every way in—talcose schist. A letter was written to the Priest of the parish to endeavour to withdraw the poor enthusiast from so ruinous an occupation.

NOTE 9.

The reader has been referred to Silliman's Journal, for information respecting the gold mines in North Carolina. It is proposed here to give two extracts from other sources on the same subject.

"The extent and value of the gold mines are becoming every day more apparent,—of course some mines are larger than others. The one at Chisholm's has been found to be rich for a quarter of a mile up the branch (of the Yadkin river?) and on each side from ten to twenty yards. There are many spots of from ten, twenty, to one hundred acres, on which gold can be found, averaging from half a grain to two grains of gold per bushel of earth. In most of these cases it is not gold but water that is scarce. Gold has been found in the neighbourhood of Charlotte; those mines are rich, but their extent is not yet known. The gold found there is in very fine particles, embedded in ferruginous clay, running in veins. This is taken out, made fine, then washed down, and the gold amalgamated. Chisholm's gold mine is situated two miles above the narrows of the

Yadkin river, on Beaver-dam creek, almost one mile from its mouth. It is on this side we are erecting our steam engines. If the machinery for working answers, we cannot fail to do a good business. The gold is there—all that we want in order to obtain it is labour-saving machinery." —*New York Commercial Advertiser.*

"In the United States—in North Carolina, in Cabarras county, on Meadow creek, &c. the gold occurs in grains or small masses in alluvial earths, and chiefly in the gravelly beds of brooks in the dry season.—(Gibbs.) According to Mr. Ayres, one mass weighing twenty-eight pounds has been discovered. The gold of Cabarras is alloyed with silver, and a little copper. When purest it is twenty-three carats fine, and is superior in quality to the gold coins of England and the United States. In 1810, upwards of one thousand three hundred and forty-one ounces of this gold, equal in value to twenty-four thousand six hundred and eighty-nine dollars, had been received at the mint of the United states.(Bruce's Min Jour. vol. 1.) It is said also to have been found on the upper branches of James' river, and on the Catabaw, in South Carolina.

"It appears that most of the gold of commerce is obtained from auriferous sands. When thus found, it is extracted by the simple process of washing the sand. When enveloped in other minerals, it is extracted by amalgamation with Mercury."—Cleaveland.

The geological associations and position of the gold of the Carolinas, has become a subject of controversy in Silliman's Journal. The competitors are the Professors Olmsted, Mitchell, Eaton, and Mr. Rothe.

Professor Olmsted considers the gold to occur entirely in a deluvial formation.

Professor Mitchell considers it to occur as follows:—

1st.—In veins of quartz, traversing the ancient primitive rocks, in very small quantity.

2nd—In veins of quartz, traversing more recent primitive rocks, in considerable quantity.

3d.—In veins of quartz, traversing transition rocks, and also disseminated in considerable quantity.

4th.—In soil produced by the decomposition of these three kinds of rocks.

5th.—In the sand of a stream running over old red limestone, in very minute quantity.

Professor Mitchell is therefore of opinion that the gold is found almost entirely *in situ*.

Professor Eaton appears to be of the same opinion, and further that it occurs in quartz veins traversing talcose schist; whereas Mitchell considers the rocky matrix to be an argillate.*

Mr. Roothe is of opinion that the gold occurs both *in situ* and alluvium—in the first instance in quartz veins traversing secondary greenstone and greenstone slate.

The papers containing this controversy are to be found in the 9th, 13th, 16th and 18th vol. of Silliman's Journal.

NOTE 10.

"There is a rich lead mine in the township of Potton, adjoining the boundary line between Canada and Vermont. In early times the Indians are reported to have got loose masses of this lead. It is situated at the base of a bold

* Such was formerly Professor Olmsted's opinion.

conical mountain plainly visible from Lake Memphremagog. On the top of the mountain which is small but flat there is a pond from fifteen to twenty rods in diameter.

In the neighbourhood there is a hill with a precipitous descent, from the summit of which a column of dense smoke is frequently seen to issue, about one foot in diameter.—One man got a few years ago, between thirty and forty pounds of pure lead, (sulphuret of lead,) in one morning from the mine described."—Wilcox.

" On an estate belonging to the Seminary of Quebec in the Bay of St. Paul, a lead mine was discovered some years ago. The veins which have been traced are slight, but two Germans who were brought over to the country on account of like discoveries in the upper country, examined this and thought it worth the working."—Gen. Murray's Report.

I have seen this lead; it is an argentiferous galena, I believe, and occurs in veins traversing a white marble, associated with chlorophane of a beautiful green colour. Large masses of this marble detached, but of an angular form, are found lying at the foot of the primary range, on the right bank of the Gouffre river at St. Paul's Bay.—These masses leave specks of galena disseminated in small quantity, and are traversed by hair veins of the same. The chlorophane appears to be embedded in the marble in large distinct masses. We ascended the hill in search of the vein or bed, but found nothing but bare and whitened surfaces of primary rocks.—(See page 82, 2d vol. of the Society's Transactions.)

NOTE 11.

Mineralogical characters of the sulphuret of zinc found in the transition limestone of Kingston.

Two varieties are found, the yellow, the lustre of which is resinous and the lead coloured, which bears a resemblance to galena. The structure of the latter to which, I at present confine myself, is perfectly laminar, and the faces of the laminæ exhibit the splendent metallic lustre, which, however, although it does not entirely vanish on being scraped, is then only glimmering metallic. It is brittle and easily scraped by the knife, and the powder thus obtained is of a light grey colour. Its spacific gravity 4-1. In the mattrass it decrepitates violently. In the interior flame of the blow-pipe it becomes first yellowish and by continuing the heat blackish, during which period a sulphurous odour is exhaled, and a powder of a lemon colour, (sulphur,) is deposited upon the charcoal. But its most distinguishing character is the unpleasant smell of sulphuretted hydrogen which it exhates when its powder is digested in acid.

NOTE 12.

"I have found a black and garnet coloured sand in great abundance on the shores of the Lakes Erie and Michigan. This is a sulphuret of mercury, and yields about 60 per cent. It is so easy to be obtained and in so convenient a form for distillation, that it must become an important article of commerce."—Stickney in Silliman's Journal, vol. 1.

Garnet coloured sands are very common in Canada, but they are composed of a mixture of maxnetic iron and garnet.

NOTE 13.

If the townships and allotments of land in these Provinces have been laid down by compass, they cannot possibly be correct, for with all the care an experienced surveyor could bestow, he would not have been able to make the proper allowance for the degree of *local* magnetic attraction, the comparative intensity of which, at different places is so various and uncertain. We shall be told that the surveyor, in running an allotment or township, first commenced his operations from some plain or bank of a river, far removed from hills or mountains, (the more frequent depository of magnetic iron,) and out of the reach of local magnetic influence; and that having there laid down a magnetic meridian he no longer used the compass, but produced his lines by covering vertical pickets.

This method is perhaps the best that can be adopted in the absence of all instruments except the compass, but after all it is very liable to error, for, not to mention the impossibility of always finding a spot free from mountain or hill, if a plain or bank of a river so situated, be found, who can be sure that local magnetic attraction does not extend to it; who can be sure that it is not itself the seat of that attraction—may not the very sand at your feet or the boulders on which you are seated be magnetic.

Where primary rocks occur in this country, the presense of magnetic iron may be suspected. Some of the secondary trap division are also magnetic. But local attraction is sometimes so little indicated by external appearances that the most experienced may be deceived. Mr. Watts of Cape Diamond, and Mr. Saxe of the Surveyor General's Department of Lower Canada, both agree in stating that the neighbourhood of L'Acadie is remarkable for the local

magnetic attraction which exists there. I believe no geologist would suspect its operation upon passing his eye over the country. As far as I am acquainted with it, the soil is alluvial, with a topping of vegetable earth and no rocks or mountains near enough to effect the compass in so remarkable a manner. The following quotation from Guillemard is descriptive of the soil in this portion of the Province : " La rivière Sorel après avoir quittè le bassin de Chambly, mouille le pied d'une montagne appellée Belœil. Entre cette rivière et le fleuve St. Laurent, est une plaine immense, sur cette plaine entirement uni, il ne se trouve point de roche et presqu'aucune pierre. En creusant on trouve jusqu'a une profondeur considerable, des sol des differentes espèces, du sable, de l'argille, de la terre bégélale, et dans beaucoup d'endroits, une mitre matière bégélal noir, ressemblant beaucoup à une espéce de tourbe appellée peat," he adds the summit of the Belœil mountain is a deep grey and large grained granite ; it contains little mica, but a considerable quantity of black schorl ; the sides of the summit are principally composed of a greyish black schistus, very compact, some parts of which resemble basalt in form and grain. In descending the Sorel, rocks are no where seen, at Sorel the banks are of a fine clay, full of mica.

Is it not possible that M. Guillemard may have mistaken that for granite, which is a trap rock of the same age and character as the Montreal mountain? Black crystallized hornblende often much resembles black schorl; basaltic hornblende is associated with the former in the Montreal mountain. I have hazarded this conjecture without having seen either a specimen of the Belœil mountain, or any other account of it than M. Guillemard's, because if correct, it

renders more probable the following explanation of the cause of the magnetic attraction in the neighbourhood of L'Acadie, viz. that it is owing to the reappearance of the same trap on the surface of the ground which, as in the instance of the Montreal mountain, is known to be very magnetic.

This mountain has a remarkable action upon the magnetic needle. While surveying on its summit some years ago, I observed a variation of 4° in a distance of one hundred and seventy feet. At first some error was suspected in the operation, but by frequent trials and with different instruments, the existence of this phenomenon was placed beyond all doubt.

It was a somewhat singular coincidence, that while employed ascertaining the fact, Mr. Shand, the overseer of works in the Engineer Department, who had been employed running a line by compass on a another part of the mountain, joined me to report a much greater deviation of the compass in his case than in mine, we were afterwards obliged to work without any reference to a compass, which is unquestionably the best plan at all times.

Lieut. Luxmoore, R. E. while measuring a base on the ice opposite Montreal, a few winters ago, found a variation of 1° in about two thousand five hundred yards, probably the effect of the same cause, though weakened by distance.

It is the character of the trap rocks, like the Montreal mountain, to effect the compass. The basaltic range in Ireland, called the "Giant's Causeway," does so in a remarkable degree. This phenomenon is not owing to these rocks containing beds or veins of magnetic iron, but to the iron entering into the composition of the rock, being magnetic; and as those rocks in many cases are decidedly

secondary or overlying their supposed igneous origin, appears to receive additional support from the fact, that magnetic iron, a mineral so rare among the secondary class in general should even be characteristic of the trap species, and which the purifying nature of the heat these rocks are supposed to have been subjected to, may account for.

The neighbourhood of Kingston is remarkable for local attraction, but I believe it is principally confined to the Point Henry side of the river, where the occurrence of amphibolic rocks may occasion it. Mr. M'Donald, in running the boundary line of the military reserve experienced it frequently. Lieutenant Wulf, R.E. noticed a variation of 10° in a distance of about six hundred feet; and Mr. Markland, in a general report on Kingston, writes—"No mines have as yet been discovered but from the difficulties which surveyors have met with, in running parallel lines, owing to the variations of the needle, there can be no doubt of the existence of iron mines."

An opinion is too generally entertained that in places where the compass is locally effected, mines of iron may be expected to occur, and that where no such phenomenon exhibits itself, it is useless to seek iron ore. In by far the generality of instances, in which the needle indicates the vicinity of some magnetic body, that body will be found to be a barren rock, containing iron it is true, but in an unavailing quantity, disseminated through the rock in small particles; to obtain which, in a state of pure iron, the rock itself must be smelted. In the generality of instances also, in which mines occur, they exercise no influence upon the compass whatever.

Among the many species of iron ore, there are only two,

or at most three, which would be likely to move the needle upon approaching it. One of these enters as a constituent among many rocks, particularly those of a dark green colour, or those of a black which are not limestone. It also much more rarely forms solid beds of magnetic ore, such as have been described in this essay. To the former cause I attribute the local attraction near Kingston, in the neighbourhood of which place many rocks occur, both fixed and detached, which would be liable to attract the needle.

Whatever may be the cause, however, of attraction in any particular case, all authorities agree in stating that local attraction is very common in Canada; and this fact should be particularly borne in remembrance by those who use the compass, either for surveying or for the more general purpose of security in the woods. It shews that too much confidence may be placed in this instrument, and that an implicit reliance upon it for security, while traversing the forest in this country, might prove the destruction of the traveller.

Besides a natural local attraction, or a local attraction resulting from natural causes, instruments are sometimes liable to a similar influence from artificial ones, as appears from Mr. Amos Eaton's observations in Silliman's Journal for March, 1827, p. 14. With the aid of a microscope, he detected very minute steel scales attached to the limbs of the instrument, and left there in the manufacture of it.

The theodolite and the sextant are the only instruments which should be used by surveyors in this country, without any reference to the compass of the former, but starting from a *true* meridian.

NOTE 14.

In several places along the northern shore of the St. Lawrence, below Mal Bay, veins of magnetic iron are found in the rocks, and they are said in consequence, to exert an influence upon the ship's compass, in passing up and down the river. Captain Bayfield, however, never noticed any thing of the sort, but attributes the observed difference in the compasses of vessels from the bearings laid down in correct charts, to the *local attraction* of the vessels themselves. This local attraction, which varies in different vessels according to the quantity and distribution of iron in the construction, equipment, and cargo of the vessel, and also according to the situation in which the compass is placed with respect to the focus of attraction, is called the *deviation*. The deviation has but lately been taken into account, and allowed for in His Majesty's ships, and is in general entirely overlooked in merchant vessels. The error, from this cause, in those latitudes frequently exceeds a point of the compass.

NOTE 15.

A Mr. Mason appears to have examined the country in the neighbourhood of Charlotteville with a view to ascertain the quantity of bog ore in it. He says—"The bog ore is scattered over the whole of the country; but I do not know any one bed of ore that will exceed one hundred and twenty-six tons. I spent three months in examining the country for ore, and I calculate that it will take all the ore I found within twenty miles of this place, to supply a small furnace for seven years; but I believe considerable

quantities, within that space, are not yet found. No rock ore has yet been found in this part of the province." And Mr. M. thinks it not likely that there will be.--(See additional note commencing in the next page.)

NOTE 16.

In the township of Yonge, some years ago. an explosion took place in a vein of iron pyrites, of which the following is an account, from the pen of Dr. Bigsby :—

" This explosion took place sixteen years ago (1809) in the township of Yonge, near the Lake of a Thousand Islands, in the St. Lawrence. At the time, a man was seeking his cow in the woods, within a short distance of the spot. On a sudden he was startled by a tremendous explosion, attended by volumes of smoke and sulphurous odours.— Three years since, upon being informed of these particulars, I visited the place. It is half a mile within the woods, north of the road from Brockville to Kingston, near the easternmost of two creeks, and about ten miles from Brockville. I found on the summit of a quartzose mound from thirty to forty feet high, a round cavity twelve feet deep, twelve feet long, and nine feet broad. Its sides consisted of very shattered quartz, spotted brown by oxide of iron, and covered profusely with acicular yellow and white crystals of sulphur. The lower parts of the cavity were studded with masses of iron pyrites, of which there is a vein at the bottom of the cavity. It is a foot and a half thick, and disseminates itself into the surrounding quartz. This vein may be seen running east, with a very high dip, to the distance of a yard and a half."

Similar phenomena have been noticed in a mountain in Vermont.—(See Sillimun's Journal for February, 1821.)

Also in the country towards tho head of the Missouri.—(See Travels of Captains Lewis and Clarke.—Geological Transactions.)

It is remarkable that pseudo volcanic substances, such as pseudo volcanic carbonate of iron, pseudo volcanic quartz, formerly having cubic pyrites disseminated throughout, the impressions of which still remain, are said to occur in the township of Yonge.

The following additional note, giving an account of the iron works on Lake Erie, has been drawn up by my friend Captain Bayfield, R. N. who, in my absence from Quebec, has kindly superintended the printing of my paper.

ADDITIONAL NOTE.

The substance of the following information respecting the iron works in the London District of Upper Canada has been communicated by Mr. J. Harris, R. N., a corresponding member of the Literary and Historical Society, who resides on the shores of Lake Erie near the principal known deposits of the iron ore which is the subject of this note.

The locality of this ore has not, to my knowledge, been visited by any person possessing the geological and mineralogical knowledge which would be requisite to enable any one to give a complete account of the nature, situation, and associations of these deposits of bog ore, or a mineralogical description, founded on analysis, from which might be inferred its value, either in regard to its productiveness of metal or the more or less facility with which it might be reduced.

In the absence of a more perfect account, the following, which I have drawn from the information furnished by my

friend Mr. Harris, may not be deemed altogether uninteresting, particularly as I believe, that it is the first notice which has been taken of deposits of ore, which from their advantageous situation, on the immediate shore of Lake Erie, may hereafter prove of much importance.

The first attempt to establish iron works for the purpose of working this bog iron ore was made at the mouth of Potter's Creek, a small river which enters the bay of Long Point, in the township of Charlotteville, London District, Upper Canada. Mr. John Mason, an Englishman, had the merit of this first attempt. In the year 1817, he erected a blast furnace, of a rude and primitive description, entirely by the labour of his own hands, with the exception of the machinery for the blast. The bellows were formed out of two hollow white-wood trees. It is thus that the spirit of enterprise and necessity, which has so truly been called the mother of invention, enables an individual, in this young country, to overcome difficulties, which in other situations would be considered insurmountable. Mr. Mason, however, did not live to complete his undertaking—he died, after setting an useful example and collecting a few tons of ore.

In the year 1820, six young and enterprising Americans came to the country, and under the firm of Capron & Co. purchased the place from Mr. Mason's widow :—proceeding in their labours with united perseverance and industry they soon had a furnace in operation. They commenced by casting stoves, hollow ware, and other small articles :—also some potash kettles and mill castings, but are said to have generally failed in producing good work.

Their machinery for producing the blast was very defective, and they also found their works to be too con-

tracted to supply the great and growing demand for their manufactures.

In 1830 the establishment was burnt by accident, but was rebuilt almost immediately upon an extended scale capable of doing more than double the work of the former. In August, 1830, these works were again in full operation under the firm of Messrs. Joseph and Benjamen Vannorman. Mr. J. Vannorman by a simple and ingenious contrivance has much improved the machinery of the blast, which now consists of an overshot wheel, moving two pistons by a single crank—the pistons being at right angles to each other. But still this improvement does not, it is said, produce that regularity of blast which is requisite to extract all the metal and turn out good work, So sensible are they of this defect, that they save the slag to remelt, although they have not yet done so, and probably will not, unless the ore beds in the vicinity should fail, a circumstance which is not likely to occur for some years, although Mr. Harris says he is far from considering them as inexhaustible.

Mr. J. Vannorman has so improved these works, that besides the articles previously mentioned, he has lately succeeded in making some excellent mill castings of large dimentions.

Besides the furnace which I have mentioned, the same firm has a forge in Woodhouse for making bar iron—not of a very good quality. Mr. Harris writes thus: "the best character I can give it is, an inferior *cold short*, but I consider this inferiority to arise in great measure from the defective mode of reducing the ore. The bar is not made from pig iron, but from the ore, which is neither washed or roasted, consequently good iron can hardly be expected.

There are two other forges, one in Woodhouse, the other in Dereham, the latter is not doing much."

The ore which is used at these works, is bog iron ore, said to be of a superior quality. It is found in the swamps of Charlotteville, Middleton, and Windham. Houghton, Norwich, Dereham, and other parts of the London District of Upper Canada contain ore also, but these deposits have not been worked. No rock iron ore is known to exist in this part of the country, but the deposits of bog iron ore are said to be derived from water, which oosing from the soil remains stagnant in the swamps depositing the bog iron therein. Mr. Harris is of opinion that the clearing of the country from wood will be likely to check the accumulation of the ore.

The soil contains a very considerable quantity of magnetic iron, disseminated in grains. Mr. Harris has extracted (he does not say by what means, but I suppose by a magnet,) thirty or forty grains of ore from one pound of the soil, in Charlotteville, previously dried. The whole district is said to contain more or less of ore, particularly the sandy parts.

Those beds that have been worked have yielded from thirty to thirty-three per cent. of very soft iron. It may be presumed that they do not obtain all the metal, as they neither wash or roast the ore to rid it of its impurities.—They do not use any flux, it is probable therefore, that the particles of soil brought in with, and adhering to the ore, renders any other flux in some measure unnecessary.—Much metal is said to be lost by its entering into combination with the silecious and other impurities thus placed with it in the furnace. The furnace produces from eighteen to twenty tons of iron per week.

They at first tried the fire-stone from Dumfries, but it failed, so far, that it would only answer for lining. They now obtain their fire-stone from the State of Ohio, of a good quality.

Moulding sand is obtained on the site of the furnace, and it is considered good by several English moulders.

Secondary limestone abounds in the neighbourhood containing organic remains, and burning easily into excellent lime. Fetid limestone is also met with. These limestones, I am inclined to believe, support the beds of sand, clay, and boulders, in which the iron is disseminated, from which the bog iron ore is derived.

Mr. Harris says, that boulders abound all over the London District, but that primary rocks have not been observed in *situ*.

Timber for charcoal is abundant and in great variety—the hard maple is preferred.

With respect to water, they have great advantages.—Potter's Creek, although not a large, is a never-failing stream. The works are situated at its entrance, immediately on the shore of Lake Erie. Hence the great convenience of sending off their weighty manufactured articles, or of receiving any supplies which they may require, without the expense of land carriage.

Mr. Harris closes his information by the following facts, which may be interesting to future travellers.—"There is a petroleum spring at Lobo, on the river Thames; and there is a remarkable spring, in my creek, in Charlotteville, near where I reside. I have frequently smelt the vapours from this spring, at the distance of full half a mile; it deposits sulphur on the leaves, sticks, and stones, in the stream."