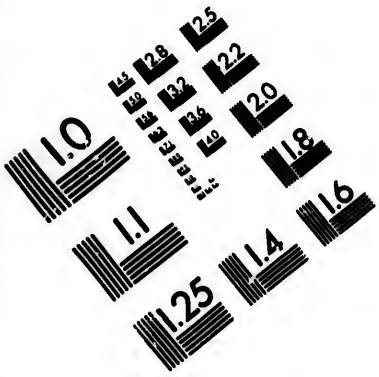

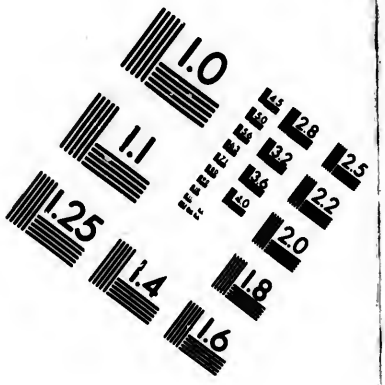

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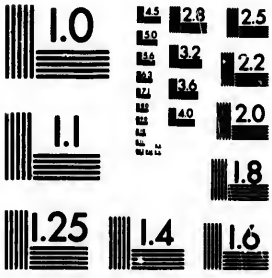

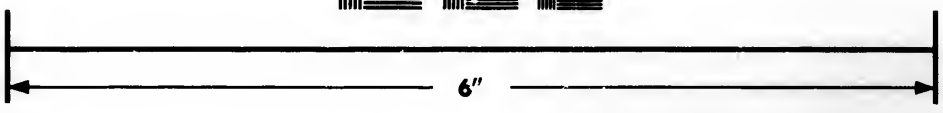

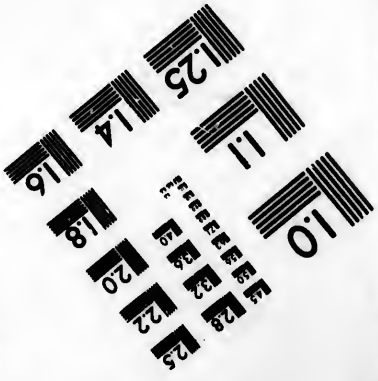

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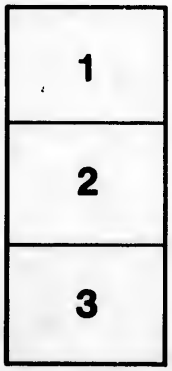

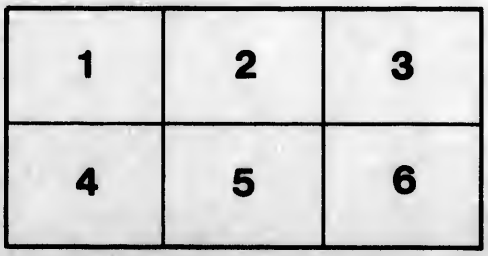

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RETURN

To an Address of the Legislative Assembly for a Copy of the Report of Count de Rottermund, of his Exploration of Lakes Superior and Huron.

Crown Lands' Office,
Toronto, 15th April, 1856.

Sir,—I have the honor to transmit to you herewith a copy of the Report of Count de Rottermund, of his exploration of Lakes Superior and Huron, and of the River St. Maurice, required by your letter of 1st April, instant.

I have the honor to be, Sir,
Your obedient servant,
JOSEPH CAUCHON.
Commissioner of Crown Lands.

Hon. G. E. Cartier,
Provincial Secretary.

To the Honorable
Joseph Cauchon,
Commissioner of Crown Lands.

Sir,—I have the honor to present to you my report of the examination and inspection of the Mines of a part of Canada West, in pursuance of instructions received from you, dated 12th June last. In conformity with those instructions, I proceeded to Chatham to meet Mr. Salter, deputy provincial surveyor, to make with him the arrangements relating to the exploration. Thence we proceeded to Sault St. Marie, by way of Detroit. In an excursion which we made to the rear of the small range of hills north of the River St. Marie, we ascended Root River as far as the great mountain-range, which is the continuation of Big Cape, on Lake Superior. From Sault Ste. Marie, we coasted, each in his canoe, along the north west side of Isle St. Joseph. to the Bruce Mines.

Having examined the Bruce and Wellington Mines, and part of the country adjacent, I found that there was both difficulty and danger to be apprehended from continuing the voyage in a bark canoe, on account of the winds, and I procured a boat with four hands and proceeded to Portlock Harbour

At the mouth of a river which is on the land granted as a location to Geo. Desbarats, Esquire, I met Mr. Salter with whom I returned to the Bruce Mines. There we parted our provisions and separated.

Having procured a tolerably strong boat, capable of bearing up against the the gales so frequently occurring on the large lakes, I proceeded at once to Lake Superior, as far as the Island of Michipicoten, coasting it on the east and north; I crossed over to the Island and examined it all round. From thence I returned by the same route, passing at other places to examine and observe the interior.

After this examination, I returned to Sault Ste. Marie, and finding the season too far advanced to continue the exploration advantageously or satisfactorily, on account of the frequent occurrence of gales of wind and storms at that season of the year, occasioning a great loss of time; I dismissed the hands and returned to Quebec, by Collingwood, Toronto and Montreal.

There the Honorable the Minister of Public Works acting in your absence, directed me to proceed to the River St. Maurice, where I remained till the first snow fell. The ground being now covered, all observation become impracticable and the road impassable, and I was compelled to suspend operations for the season. I then went to Toronto to classify and arrange the specimens of different minerals and stones collected in my journey of exploration, and to prepare the necessary materials, on which I was to found my report. My principal object was to visit the places, where works had been carried on, the next to discover those important points, where the labors of mineralogical exploration may be of general interest to the public. Being provided only with Bayfield's chart, which merely shows the position and the outline of the shores of the Lake, and unable to procure any which might have shewn at least the direction of a few rivers, except one, a sketch of the course of the River Michipicoten, for which I was indebted to the kindness of Mr. McDonald, Deputy Provincial surveyor. I found it impossible to penetrate to any distance into the interior, as I had no means of fixing with precision any place which I might visit, for want of the proper instruments.

In order to avoid a confusion of ideas, and the introduction of new systems, and a nomenclature not generally used in science, as well as to make my descriptions more intelligible, I have considered it expedient to copy the classification of earths by Mr. Roderick Impey Murchison, published in 1845, and that of Messrs. Dufresnoy and Elie de Beaumont, published in 1842, the latter being that which was used in making the Geological map of France.

Classification of Earths published by Mr. Roderick Impey Murchison, in 1845.

F. Tertiary.....Tertiary Deposits.. { Pliocene. Miocene. Eocene.

F. Secondary..... { Cretaceous. Jurassic. Triassic.

F. Palæozoïc..... { Permian. Carboniferous. Devonian. Silurian.

Azoïc..... Gneiss, penetrated by Granite.
Eruptive and Metamorphic rocks.

Classification of Earths published by Messrs. Dufresnoy and Elie de Beaumont in 1842.

ORDER.	UNDER GROUPE OF FORMATION.	NAMES OF FORMATIONS.
Alluvion.	Man exists on the surface of the globe.	Alluvial Earths, Modern Volcanoes, extinct and in action; the great Volcanoes of the Andes were thrown up during this period.

ORDER.	UNDER GROUPE OF FORMATION.	NAMES OF FORMATIONS.
Tertiary Earths.	The Mammiferæ begin to appear in the lower section of this group, and become very abundant towards the middle.	*System of the principal chain of the Alps, direction 'E.* 16° *N.* Superior Tertiary formation; Subappenine group sands of the Landes, ancient alluvions of La Bresse. Tuff with bony remains of L'Auvergne. Eruptions of Trachytes and of Basalts, for the most part corresponding with this epoch. *System of Western Alps, direction 'N.* 26° *E. by S.* 26° *W.* Middle Tertiary Earths: Faluns of Touraine, Fresh water limestone with mill-stone, contains a great deal of lignites in the south of France, and in Germany, sandstone of Fontainebleau. *System of Islands of Corsica and Sardinia, direction N. S.* Inferior Tertiary Earths: Marl with gypsum, bones of Mammiferæ. Coarse limestone, Paris building stone. Plastic clay, lignites of the Soissonnais.
Earths.	Cretaceous Earths or Formations.	*System of the chain of the Pyrenees and that of the Appenines E.* 18° *S by W.* 18° *N.* Upper Chalk: Beds with Flints. Beds without Flints. *System of Monte Viso, direction N N. W. by S. S. E.* Lower Chalk: Gravelly Chalk (craie tuffeau.) Green sand. Ferruginous sandstone and sand formation. Nescomian formation, Wealden formation.
Secondary	Limestone. Earth of the Jura. (Considerable abundance of Saurians. Oolitic Limestone.)	*System of the Côte d'Or, direction E.* 40° *N. by W.* 40° *S.* Upper bed: Portland Limestone. Kimmeridge Clay. Honfleur Clay. Middle bed: Oxford Oolite, Limestone of Lisieux, Coralrag. Oxford Clay. Dive Clay. Lower bed: Corn-brash and Forest marble (*calcaire a polypiers*) great oolite (*calcaire de Caen*), Fuller's earth (*blanc bleu de Caen*) Lower oolite. Marls and Limestone of Célemnites, upper Marls of Lias, lignites in the Departments du Tarn et de la Lozère. Lias or griphite limestone: Lower Lias *Calcaire à gryphées arqnées.* Sandstone of Lias or infraliasic sandstone, Dolomite.

- **Tryas .....**
  - *System of Thuringerwald (the serpentines of the centre of France belong to this system,) direction W. 40° N. by E. 40° S.*
  - Saliferous and gypseous shales and sandstone (*Marnes irisées*) with masses of gypsum and salt. Working of lignites in Lorraine, Alsace, and la Haute Saone.
  - Muschelkalk.
  - Varigated sandstone (*Grès bigarré.*)
- *System of the Rhine, direction N. 21° E. by S. 21° W.*
- Sandstone of the Vosges (*Grès des Vosges.*)
- *System of Belgium and South Wales, direction E. 5 S. by W. 5 N.*
- Zechstein (Magnesian Limestone,) fish-schists of Mansfield, rich in copper, red sandstone, contains masses of porphyry and agate balls.

Transition Earths. This group is characterised by a great abundance of vascular cryptogams and by the almost total absence of the dicotyledon plants. The vertebrated animals are represented only by a few impresses of fishes.

- *System of the North of England, direction S. 5° E. by N. 5° W.*
- Coal measures.
  - Sandstone, schists with beds of coal and carbonate of Iron, carboniferous limestone or blue limestone with beds of coal.
- *System of the Ballons (Vosges) and of the hills of the Bocage de la Normandie, direction E. 15° S. by W. 15° N.*
- Upper transition Earths.
  - Old Red Sandstone (Devonian system.)
  - Anthracite of la Sarthe, and of the environs of Angers.
- Middle transition Earths.
  - Limestone of vicinity of Brest.
  - Dudley Limestone.
  - Schist (*Ardoises d'Angers.*)
  - Quartzite Sandstone Caradoc.
  - Sandstone of the English (Silurian system.)
- *System of Westmorland and Hundsruck, direction E. 25° N. by W. 25° S.*
- Lower transition Earths.
  - Compact Splintering Limestone.
  - Argillaceous Schist, (Cambrian system.)

Granitic formations...Granite forming the principal crust of the globe.

In my expedition, my aim was not so much to ascertain the epoch of the formation of earths, as to discover the presence and metallic wealth and nature of minerals, and the causes which may have occasioned the metallic deposit.

On this account, I shall divide them for the present into two distinct classes, namely, into palœozaic and azoic rocks, following in this Mr. Murchison. These terms are already in use among the learned of Europe. I shall arrange the palœozoic rocks, according to the fossils which I discovered in the different localities, whether of Lake Superior or Lake Huron. This classification demands great

attention, and very minute discrimination, to avoid the solecism of giving names according to individual fancy, not used in the scientific world. Such are the names applied to formations in Canada of Huronian, Sillery, Laurentine, Richelieu, peculiar to the localities which they indicate, substituted for Jurassic, Carboniferous, Cambrian, Devonian, &c., which are so well classified, defined and admitted throughout he scientific world. The azoic rocks will be classed according to their composition. brought with me the following collection and as nearly as I could observe in my apid journey specimens of the different localities, characterizing the nature of the mines and minerals, as well as of the different kinds of granitic rocks.

Feldspathic Rocks and derivatives,
Grauwacke of different kinds,
Sandstone of different kinds,
Molass,
Jasper of different kinds,
Dioritic rock,
Paddingstone.
Amygdaloids,
Breccia,
Limestone,
Serpentines,
Quartzose rocks of various qualities,
Sands,
Clays, (*Terres Glaises,*)
Cupriferous rocks,
Minerals, as copper of various kinds,
Iron,
Lead,
Silver,
Gold,
Zinc,
Cobalt,
Agates { Waved, Arborescent, Sardonyx, Calcedony, Cornelian, Chrysoprases, Onyx,
Zeolites of different kinds,
Chabasite,
Prehnite,
Heulandite,
Mesotype,
Chlorite,
Zircon,
Petrified vegetable substances,
Bones and different kinds of fossils, as
Limnea,
Terebratula,
Encrinites,
Orthoceras Lateralis,
Hyppurites,
Catenipora, &c., &c.

It is not possible to give the names of all the minerals and fossils which I possess in my collection, without previously ascertaining the designations of the former, by their chemical composition, and those of the latter by their form and nature. It is necessary to compare them with the tables published for the purpose. A most important fact is the discovery of fossils about Lake Superior. Here are the remarks of the Report of progress for the year 1846–7, page 36.

" The age of the volcanic formations of Lake Superior is a question that has " not yet been finally settled, and the doubt concerning them seems to be whether " they are older or newer than the Potzdam sandstone of New York. The diffi- " culty arises from the absence of fossils, none of a satisfactory kind, that I am " aware of, having been obtained, from any beds whose relation to the volcanic " rocks is undoubted, either on the north or south side of the lake."

In the Report of Progress of 1849, the opinion founded upon the absence of fossils is confirmed, page 21 : " In the position assigned to them by Dr. Hough- " ton, late Geologist to the State of Michigan, as being below the lowest known " fossiliferous deposits, a position which, as may be seen in the Report of pro- " gress which I had the honor submit to Your Excellency in 1846."

The discovery of fossils on the Canadian shore, north of Lake Superior, and that made by David Owen, Geologist to the United States, published in 1852, might tend to alter the opinion adopted on account of the absence of these fossils.

The rocks and minerals will be arranged, not only in mineralogical order, but according to the places in which they were collected.

As the two Lakes are of two different characters and very distinct from each other, in respect of the copper ores, as also of the rocks, I shall divide them into distinct categories, that of native copper, and that of copper pyrites. I shall then proceed to some general remarks relating to the interests of the mines which I have visited.

To this day, the nature of the native copper, on the Canadian side of Lake Superior, has not been described nor established, but only that of the copper of the United States, (see the well known and highly esteemed work of Mr. Witney, published in Philadelphia in 1854, in which are some details of the mines of Lakes Superior and Huron, in the Canadian territory,) while copper in the metallic state abounds no less on our side, and seems to be the predominant characteristic of certain localities. This seems, moreover, to afford one great advantage, namely, that the rocks in which zeolitic metallic copper is found, are worked at much less expense than those which are described as existing on the south side.

The Island of Michipicoten and the east side of Lake Superior yield, for the most part, nothing but the native mineral. The oxides and the sulphurets are more rare and secondary. I found several veins of the sulphuret at the extreme north of the lake, and also at the north-east. Native copper is found in two different states, one, that of a thread or vein, the other, arborescent or rather zeolitic in a rock of greywacke This distinction in the nature and position of the mineral is very important, as it may throw light on the mode in which it was formed, constituting as it does the principal wealth of the district of the lake.

As sandstone and greywacke act a very important part, I consider it right to give the synonymes of those terms, to avoid the mistakes which might arise from diversity of nomenclature.

Here is the description given by Messrs. Dufresnoy and Elie de Beaumont :—

" Greywacke,—This is the arenaceous rock of transition earths. It is " formed by the union of old rocks and a greyish cement, composed sometimes " of argillaceous schist, sometimes of clay. In some particular circumstances, " this cement consists of micaceous schist, talcose schist, and even of a compact " rock analogous to feldspar."

" In this case, the greywacke has been subjected to causes which have altered " it, and communicated to it a crystalline texture. The fragments contained in " the greywacke are usually quartz, granite, porphyry and argillaceous schist, " &c. Sometimes the fragments or pebbles (*galets*) are large and form by their " union a pudding stone; most usually they are very small and the grey- " wacke is then termed fine-grained. Frequently, the fragments of mica pre- " dominate, and as these fragments are always in small plates, they rest on the " flat face and produce little layers of mica which give a schistose structure to " the rock. It is then distinguished by the name of schistose greywacke.

" This rock is included among the psammites of Mr. Brongniart.

" Schistose greywacke passes insensibly into argillaceous schists, which are " likewise the effect of a sedimentary deposit.

" Greywacke is generally grey, a circumstance from which it derives its " name; sometimes, however, it is red, as in the transition earths of England. " The Geologists of that country have even used the term old red sandstone to " designate these greywackes, in contradistinction to the new red sandstone, " which is cœval with the red-and-white sandstone (*grès bigarré.*)

" There are in the Alps, rocks having all the external character of grey- " wacke; they have been till now so described and designated, but as they belong " to earths of later date they are not to be confounded with those rocks which " belong exclusively to transition earths.

" Coal-sandstone,—This is formed out of the debris of old rock, and con- " tains a great number of silicious pebbles combined by an argillaceous cement, " often very micaceous. In certain localities coal-sandstone is composed for the " greater part, of fragments of granite, and on this account it has been termed re- " composed granite, (*du granit recomposé*). It contains a great deal of mica, " which is deposited in layers, and gives it a schistose structure. It then resem- " bles certain micaceous schists, but the mica glitters only on the lamellæ of " stratification, whereas, in micaceous schists the lamellæ of mica are disposed " in various directions. This characteristic suffices to distinguish the arenaceous " rock from schists of old earths.

" The coal-sandstone is akin to greywacke; only it is composed of coarse " pebbles, and the cementing matter is always earthy. The schistose coal-sand- " stone passes by imperceptible gradations into schistose clay and bituminous " schists. The schists and clays (*argiles*) of the coal-fields consist of sandstone " of which the particles are extremely fine.

" Red sandstone,—This is composed of an argillaceous and sandy cement " embedding pebbles of hyalin quartz, lydian quartz, argillaceous schisits, por- " phyry, granite, &c. Calcareous breccias, besides the different arenaceous " rocks which we have enumerated, we frequently find calcareous breccias. " These exist throughout all the formations, from the transition earths to the tertiary earths.

We find by this description of Messrs Dufresnoy and Elie de Beaumont that sandstone and greywacke are a species of rock, formed of detritus of different kinds, and this is the reason why we have several kinds of sandstone, their nature depending partly on the materials, partly on their molecular condition and structure. We find, moreover, that the common designations (*synonymes*) of sandstone and greywacke must indicate an epoch more recent than that of the earliest appearance of solidified rocks, more especially, if, as some are fond of supposing, they were ever in a fluid state.

In order to the formation of sandstone, that is to say to the cementation of the molecules or particles of rock, the rock must have passed from the solid to the loosely molecular state; the several kinds of sandstone cannot therefore be classed among the most ancient formations. It is true that the presence of fossils

renders classtfication very easy, but their absence ought not therefore to cause the formation in what it occurs to be assigned to the most remote periods; for I have many specimens which prove the partial or complete destruction of fossils in different rocks, not by volcanic media nor by chemical solvents, but by the very distinctly apparent influence of electro magnetic power.

Looking at the characteristics presented by Lake Superior, it is no work of the imagination to maintain, at least, with reference to that part of the country, the theory of injections by the agency of volcanic fire. I would ask those who still endeavour, in despite of the progress of the science of chemistry and of the knowledge of physics made in the present century, to maintain the theory by which every fact is explained by the agency of volcanic fires or polar cold, how it happens that certain regions are exclusively in possession of gold and silver, while others have nothing but copper or iron, or even lead, zinc, or any other metal; how it happens, moreover, that the various kinds of metals found in the same formation are never in the same state of combination? How will they explain the fact, that one country abounds more with one description of minerals than it does with another, although they are found in the same silurian formation (or any other formation) that is to say, that they belong to the same epoch of formation or revolution of the globe?

If minerals owe their existence to volcanic injections, coming from the centre of the earth, they should be all alike; yet experience shews vast differences, in respect both to their nature and to their formation and mode of combination. The iron of Sweden for instance, exists nowhere else on the continent of Europe, although there are formations of the same epoch; the native copper, found on Lake Superior, has not yet been discovered in any other place, although the same formation must exist in other localities possessing minerals. I conclude then, that those who generalize the idea of the existence of minerals being the effect of volcanic injections, maintain a theory which is completely refuted by observation and experience. If minerals owe their existence to volcanic action, volcanoes must have been of various characters (*natures différentes*) at each epoch of general eruption. This must necessarily lead to a general classification of the different kinds and qualities of minerals, according to the order of the different epochs and characters of the volcanic eruptions, as geologists classify fossils; but it is impossible to tell whether the volcanic emanations of lead are of earlier or later origin than those of copper, iron, gold, or other metals; inasmuch as almost all the metals are found in all the formations, from the oldest to the most recent, classed according to the fossils.

Taking into consideration the labours of Messrs. Dufresnoy and Elie de Beaumont, who classify formations, and arrange their system according to magnetic direction, together with the labours of Mr. Hopkins and several others; looking closely into discoveries attended by so many well established proofs, chemical and physical; I fearlessly adopt as my guide, in judging of the formation of minerals, particularly those of Lake Superior, the electro-magnetic theory. This, although still imperfect, in regard to our knowledge of the immense variety found in different rocks, has nevertheless become too undeniably evident by means of various experiments, to admit of our having faith in the currents of terrestial fluids. On this head it may perhaps be useful to cite the opinion of Mr. Jackson before giving my own: "were the metallic veins filled by igneous "injection by sublimation, or by watery or galvanic deposit. This is a question "of great practical and scientific interest concerning which geologists and miners "are far from being agreed.

"The objections to be alleged against the hypothesis of an igneous origin "are, 1. That the copper has received the impress of the crystals of prehnite "which have not been rendered anhydrous by the melted copper; 2. That if the

"copper ever were in a fluid state, its point of fusibility being much higher "than that of silver, the latter metal would have become combined with it, "whereas it contains none of it, although the veins of silver are most intimately "mixed with the metallic copper. These objections apply equally to the hypo- "theses of the sublimation of copper and silver, for silver is not volatile at the "temperature of our furnaces.

"Taking the hypothesis of a watery deposit, we must assume a chemical "solution of copper, and a reacting influence, by which the copper may be "precipitated, and then the result of the decomposition ought to be found in the "vein which is the product; moreover, we must suppose a solution of "metallic copper, one to three inches in depth, completely filling the crevices of "the rock in which it is found.

"It has been supposed that a galvanic separation might explain the origin "of those veins of copper, but from what matters has the copper been separated? "Galvanism could never have separated copper from rocks of traps or sandstone; "and it would be difficult to form an idea of the position of the poles of a "voltaic pile of sufficient force to effect the deposit of masses of copper so "considerable. Traps are known to be magnetic and polar; this has been "satisfactorily demonstrated by Dr. Locke and other observers of the rocks of "Lake Superior; this property is the result of the action by induction of terres- "trial magnetism, on the vast abundance of magnetic iron ore contained in the "trap. I have ascertained in fact, that a specimen of trap assayed in the "furnace, yielded about 12 per cent of metallic iron. The magnetic needle "gives us no assistance to ascertain whether electric currents exist, because its "variation is produced by the influence of polar magnetism in the trap.

The presence of crystals of native copper among those of prehnite datholite, carbonate of lime and quartz, clearly indicates the simultaneous formation of the copper and the minerals containing it. If the igneous formation by injection or by sublimation of the zeoliths and carbonate of lime be admitted, how shall we explain the circumstance that Jacksonite and anhydrous prehnite are the only minerals which are not hydrates?

"It is a matter of inquiry, whether the native copper in the amygdaloids "was originally diffused throughout the sandstone, or has been mechanically "introduced by the agency of the trap? It has been alleged that the sandstone "being formed of the detritus of older rocks, might contain copper ore of the "same date of deposit as itself, afterwards reduced to the metallic state by the "agency of the trap; and this assertion would be admissible if it could be "proved that in the neighborhood of traps, sandstone contains copper in sufficient "quantity to yield the amount of that metal found in the amygdaloids. But this "is not the case. It has been asserted likewise, that the deposit of ore might "have taken place in certain parts of the sandstone, in which it had been "subsequently reduced by the trap This we confess supposes a remarkable "degree of intelligence in the trap, which must in some way, have been able to "hit upon the places in which the mineral was deposited.

But wherefore should this faculty exclusively belong to volcanoes, since they inject at one time lead, at another zinc, or gold, or copper? It seems that they are mindful, not only of the direction of the fissures, but even of electro-chemical affinities, as in the injection of sulphur, gold, arsenic, copper, &c. May not trap, which they say owes its existence to volcanoes have inherited some degree of intelligence, at least in regard to copper?

"In the conglomerate there are veins of carbonate of spathic lime, contain- "ing crystals of copper weighing sometimes half a pound, and generally in "shape rhomboidal dodecahedrons; in the veins of carbonate of lime, at Agate "Harbour mine, there are masses of copper weighing several hundred pounds.

" M. Teschemachet found in the mass of the black oxide at Copper " Harbour, nine regular cubic crystals of that oxide. Those crystals shew that " the ore is not metallic, copper stained by earthy matters as it had been " supposed. A specimen of this ore in a state of purity, being analysed in my " laboratory, gave 79.86 of copper."

Caloric is known to be a species of fluid which in certain bodies generates electricity, and the smallest friction produces heat, and therefore generates electricity. Electricity produces magnetism. Metals are distributed in the direction of the electric and magnetic currents as they assume a position in relation to each other depending on their specific gravity, their bulk and the force to which they are subjected being the same.

As the terrestrial globe turns from west to east, and the sun's rays therefore travel from east to west, the friction of the atmospheric air the production of electricity, and the generation of the magnetic fluid towards the north and south poles, cause minerals to assume a direction consentaneous to the influence of these several forces. Taking for granted the earliest epoch of the globe, when its nature must have been homogeneous, all mineral matters must necessarily, after certain periods of electro magnetic action, assume a position which is the result of the perpetual action of these two forces; and in those periods the globe must have undergone a decomposition more or less homogeneous according to the intensity of these forces, when once the different kinds of matter have found their relative positions according to their power of attraction or repulsion under the influence of the electro-chemical, magnetic and other fluids.

The body of the globe has therefore undergone a change in its mode of resistance in certain directions, and it is probable that mountains must have been formed either by the force of expansion in gases produced by internal heat, occasioned by the action of electricity and evolved during the combination and decomposition of bodies, or in other places by the action of depressing causes, sometimes even by their own weight, owing at one time to the disappearance of certain bodies, at another to a certain condition of atomic separation, previously incident to rocks; and the formation of mountains must therefore have their greatest dimension of length in the same direction; nothing could turn them aside; for the matters which offered the greatest power of resistance must have also been the most homogeneous possible, at the period when the revolution of the terrestrial globe on its axis was first established.

The displacement of bodies, depending on their adaptation to the action of fluids (*la nature qu'ils possèdent pour l'action des fluides*) must have produced some effect in changing the centre of gravitation in the globe. This being changed, the direction of the poles must also have been altered; but in its constant rotation the rays of the sun communicating to the terrestrial globe the generative action of the fluids; the metals must have undergone a new arrangement differing from that of the first era, but ever conformable to the combined result of the forces, *viz*: from east to west, from north to south and occasionally from pole to pole (*celle des polanisation's.*) But the fluids meeting in their transit bodies endowed with various degrees of fitness as conductors, the direction of the aggregate power of the active forces, to effect the combination and decomposition of bodies, must necessarily have undergone modification, and have effected combinations, greatly varying in their nature.

As an effect of the various revolutions which the territorial globe has undergone, whether by the alteration of the centre of gravitation and the formation of mountains, by earthquakes, the result of an accumulation of fluids arrested in their transit by an obstruction (*digue*) composed of bodies of various degrees of fitness as conductors, or finally, by the partial action of volcanoes, or by an inundation of greater or less duration contemporaneous with the primitive forma-

tion, the decomposition of terrestrial matter must have proceeded irregularly (*a dû subir des lignes brisées*) and the terrestrial globe must therefore in subsequent revolutions have become less and less homogeneous, in regard both to the nature of its component parts, to their power of resisting expansive forces and to the depression produced by the weight of masses. The mountainous formations must have been greatly shortened and of unequal height, and metals must, during subsequent changes have been subjected to many various influences, and have performed an almost exceptional part among the more direct and general operations, acting on the great mass of the terrestrial globe.

In the present day, after the lapse of many periods characterised by various formations, there is great difficulty in anticipating the true position, direction and circumstances of combination in which we may expect to find minerals. In order to form a just conclusion, sufficient leisure is necessary to enable the geologist to observe the locality with accuracy, and to study the different action and effect of bodies on each other, in the peculiar circumstances in which they exist. For at different periods, metals must have been arrested by the direct and intense action of certain fluids, and by the proximity of large masses of other substances; and the progress of combination on decomposition in the several stages of varying activity may have impelled them to take a direction more or less partial, or altogether exceptional.

I regret exceedingly my inability, through the want of means, to present to you such a description as I myself could have desired to produce of the different specimens which I possess; for I will not enumerate them, until I shall have been able to make a chemical examination of the substances of which they consist. I am well aware of the importance and the utility of such a work, to the welfare of the mining region, and of the advantages which, apart from the interests of science, persons concerned in the working of the mines may derive from them. But I would publish nothing at random, nothing of the truth of which I had not the fullest conviction. Such publication may often have pernicious effects, either by inducing too strong a confidence on the one hand, or exaggerated fears on the other; and at a later day we are compelled to be at variance with ourselves.

Wherever in the regions about Lake Superior the amygdaloid greywacke is met with, we find abundance of metallic copper, and where the rock assumes a crystalline character, it appears to be less rich; the copper disappears, or assumes a different form: it is still found, but in the form of sulphurets, oxides of different kinds, or it exists in the shape of salts, as carbonates, &c.

The Island of Michipicoten, Gargantua and Mica Bay, appear to me to be the centres of observation. On the Island of Michipicoten fossils are found in a state of partial decomposition. This decomposition is often almost complete.

The presence of certain kinds of fossils, at one point must have produced the action of an electro-chemical current. On this Island has been found the finest bed of agates of all kinds, in mass, in nodules, in veins, and in small pebbles. These agates are also in different stages of decomposition, from a state of the most perfect purity to complete disorganization. On this Island too, we find the most beautiful specimens of zeolith as well as of the minerals, chabasie, mesotypes, heulandits, &c., &c., and the rocks contain native copper in the zeolitic state; several veins of barytine of varying richness, besides jasper of various kinds and colours.

Native copper is found at Mamains, but I have noticed that the native copper of Mamains is now in veins, and no longer in the zeolitic state.

At Gargantua we find some rocks in which there are agates in process of decomposition. The want of time did not permit me to ascertain the presence of copper, in quantity for mining, but I found native copper, in small pieces, and I

doubt not that a more particular examination would ascertain its presence in veins sufficient to be worked.

The sulphurets are found north and north-east from the lake. I discovered old red-sandstone of copper in a native state. In coming down Lake Huron, between Batcheewauanong and Goulais Bay, we find a new red-sandstone and variegated sandstone. I should not feel surprised, if on minute search we should find coal in rear of Gros Cap, above Sault Ste. Marie. I discovered no evidence characteristic of the current of polarization; that is to say, of that current, which, passing through the centre of the earth to the zenith ensures the existence of deep veins, and I should therefore be slow to affirm that the veins of copper extend to a ry great depth. But such being the case, they must lie in the direction of the island of Michipicoten and that of Mamains; for to the northward, above Mica Bay, the currents appeared to be horizontal, similar to those of the Bruce Mines; in which the action appears to have been strongest near the surface. Lake Superior is likewise interesting, in respect of the azoic formations.

At the point in Mica Bay there is a phenomenon, most interesting to science. Within the space of one hundred square feet we find several varieties of rock: granites, syenites, porphyry, amygdaloid, greywacke, zeoliths, agates in veins, and nodules, and silicious rocks of schistose structure, lying one over the other in masses which occasionally assume the character of veins, but so indistinctly that it is impossible to discern which is interrupted by another, and which was the primitive formation. On account of the smallness of the space, it is impossible to admit any volcanic action as a cause of this derangement, or any other revolution of nature, except the electro-magnetic action affecting in this case, not an extended field, but one isolated point, perhaps by an earthquake or some other accident occurring to divert the ordinary current for a longer or a shorter interval: the residue or remains of the different matters interrupted, subsequently undergoing changes depending on their various modes of combination.

Above this point both north and south, and at the falls of the River Montreal, there is a similar phenomenon, but less complicated and of a smaller extent. On Lake Superior the mica seems to exist in a state of complete decomposition, among porphyric and silicious matters.

In this place we meet with, not veins, but mountains of the purest quartz, 250 or 300 feet in height, intersected by a vein of trapp or rather black trappoidal jasper: that is to say, right prisms, forming regular steps.

I noticed also the presence of the *schorls* so well described in the Memoirs of the mines of Sweden and Norway. Nowhere throughout the whole eastern part of Lake Superior did I find any trace of schists, except in the neighbourhood of Goulais Bay. I found only granite, syenites, porphyry, greywacke, quartzose rocks, quartz nearly pure, ialin, sandstone, and jasper.

At the north-eastern extremity, in the neighbourhood of the River Michipicoten the rocks assume the schistose character, without, however, becoming schist, properly so called. On the left bank, at the mouth of the river, there is a brook issuing from a small lake, and appearing nearly parallel with the River Michipicoten. At this place I found schist, running in a north-easterly and south-westerly direction, from the foot of the mountain where it commences. This schist cuts across the brook. I also noticed bands or veins of schist, altogether to the north of the lake, on one of the mountains, to the right of the River Dorée. From the River Michipicoten to the River à la Chienne, that is to say, on the north side of the lake, it assumes the structure, rather than the character and nature, of that genuine formation which is known as argillaceous schist, and which is found in the townships of Lower Canada, in Belgium, and in some parts of the north of France.

I have now only to remark, in speaking of mineral formations, that the differ

ent characters which are found in the mines of Sweden are apparently repeated here; that is to say, wherever mica least abounds, we find copper in greatest abundance.

Quartzes exercise a repellent action particularly upon iron pyrites and upon some other matters, whilst chlorytose matters exercise an attractive influence.

Upon examination of Michipicoten Island, which may serve to illustrate all the north and north-east section of Lake Superior, it is found to be composed of greywackes, jaspers of different kinds, of agatiferous rock, of old red sandstone, of rock of a porphyric nature, and of schorl, with a total absence of mica.

Copper ore and ores of all other descriptions are the results of the decomposition of primitive rocks, but on Lake Superior the copper, in its native state is due to the deposit of certain species of organic matters which have a tendency to increase the electro chemical action, and which decompose the sulphurets, oxides, &c., which the abundant deposit of matter containing traces of tale serpentine and chlorites, has brought together or concentrated in a certain limited space. For nearly all the rocks contain in the crystalline cleavage, and also in the veins these matters which appear sometimes to be a sort of cementation, if, indeed, it be not the state of combination of detritus, of desintegration of primitive rocks which have arrived at the state of sandstone and greywacke. Amygdaloidal and zeolitic rock are to be found only at the western extremity of Lake Huron, which I have visited. For although the rocks in this region are cupriferous, they are of a totally different nature.

The existence and the richness of the mines of native copper in the formations of Lake Superior, in my opinion, is due, first to the decomposition of primitive rocks, secondly to the formation of schorl which has retained the accumulation of cupriferous matters, and, lastly, to the presence of zeolites. These zeolites appear to have come into existence at the period at which the metallic matters were deposited in the rocks in which the greater part of the silicates had been already crystallized.

The formation of agates under the influence of organic animal matter, must also have contributed to the reduction of the ore to the native state. If we attentively examine not only the state of chemical combination, but also the molecular state, we should be astonished to observe to what extent the almost invariable progress, not only of the deposit, but also of the form and direction taken by the metals with respect to the rocks may be traced. Thus we find the rock impregnated with matter in an invisible molecular state, and sometimes in such a state of combination that it is scarcely appreciable; afterwards may be seen more and more distinctly, sometimes a small globule, sometimes a sort of pointed spar, gradually increasing in volume, sometimes a sort of rock in which the metallic copper seems to act the same part as the fragments of the rocks, that is to say, that the rock might be looked upon as a sort of puddingstone, but instead of pieces of granite rock, of prophyry, quartzites, &c., the fragment of copper is seen which appears to be embedded in a cement. Again we observe the piece of conglomerate copper forming a species of misshapen boulders, sometimes retaining its crystalline condition, and more particularly the dodecahedral form; it then forms itself into distinct veins as it exists at Mamains. The existence of native copper in the crystalline form, or in a compact or diffused condition, is due to the differences in the action of the electric current; for it is well known that the form, size, and purity of the crystallization of matter, depend upon the force more or less powerful brought to bear upon them by the electric currents. These different conditions in which the metallic copper is found, from its state of dissemination in the rock in the form of little spars or grains in crystals, up to the period of its assuming the form of veins, in which the matter appears to have been in a general and constant state of activity afford visible and palpable proof of the action of the electro chemical and magnetic fluid. I should be glad if any one who supports the

theory of volcanic action would demonstrate the direction and the cause to which the condensation of copper vapors is to be attributed. But inasmuch as volcanoes exert not only a chemical and physical power, but also a mechanical power which may be represented in figures and geometrical forms, that is to say, admitting any force whatever exerting a vertical action upon matters of different degrees of resistance and of different forms and contours already laid down by the geological charts, it appears to me that it would be easy to assign beforehand the direction of the rupture of the line of dislocation and of passage for the vapors. But upon examination of the formations and admitting the action of volcanic power acting from below as the centre, it would be seen that the decomposition of the forces has followed the most capricious directions, in opposition to all existing laws; that lines might be seen traversing with the same force masses of the hardest formation as well as those offering the most feeble resistance; that matters of different degrees of density have assumed a position at variance with all natural laws; and if there are so many visible and palpable proofs, I see no reason why it should be sought to stop the progress of mineralogical science by generalizing, on every occasion, volcanic action on the mine: for the action of electro chemical fluids produces a most intense heat, such as no volcano in eruption can possibly produce.

This heat may be of different degrees according to the force of the current of the fluids, and according to the nature of the matters upon which it acts. Its action may be brought to bear either upon the smallest possible point or over the greatest possible extent, and the direction of this action is not deranged by any mechanical resistance. It is force which engenders the combination and decomposition of all bodies, whilst volcanic action is only the force of expansion. It is then impossible to prove that to volcanic action is to be ascribed all the formations in rocks, such as granite, porphyry, &c., or of metals, such as copper, silver, lead, &c. Under such a system, prospecting for minerals will always be made at random and will always result in the ruin of capitalists.

In giving a general description of the mines on these lakes, I consider it my duty to draw your attention to matters affecting the general interests of these mines, and the future of these localities; to matters depending upon the decision of the Government, and the protection which they would be prepared to afford, matters which are not in the power of individuals or of private companies to control.

The mines on Lake Superior have many struggles to maintain, particularly with the active zeal and enterprise of the neighboring state. There, geological charts have been published every year, which are attainable by everybody, from the very outset of the work of exploration extending over a period of ten years in each state, besides scientific works by the *savants* of the country, containing their researches and remarks, and more particularly such as might prove of advantage and interest as regards the mines in the country. These works are republished in different languages both by travellers and men of science; as an example, I will cite the work of Mr. C. Lyell, entitled *Travels in North America*, published in 1845, and also other scientific and industrial treatises such as the Report of Messrs. C. Lyell and J. Hall, on the geological section of the New York Exhibition which was published in Paris in 1854, Geological Remarks on the Metalliferous Districts of Lake Superior, published in Paris by Mr. Dellesse, in 1850.

In none of these works do we find any description or mention of the names on Lake Superior, in Canada, but on reference to a work widely published and of great repute, not only in America but in Europe and which is cited by all the learned men who have paid attention to the mines in America, a work in which all the mines in the whole world are described and compared, both as regards their richness, their nature, and future prospects, it will be seen in what light the mines on the Canada side of Lake Superior are represented. Read the following on the page of the book

entitled, *The Metallic Wealth of the United States described and compared with that of other Countries*, by D. J. Whitney :—

"A number of localities were formerly explored and worked to some extent "on Michipicoten Island and on the north-eastern side of the lake, but they are now "abandoned.

"The *Quebec and Lake Superior Mining Association* commenced operations in '1846 at 'Pointe aux Mines,' Mica Bay, on a vein said to be two feet wide and "rich in grey sulphuret of copper.

"An adit was driven 200 feet, three shafts sunk, and the ten fathoms level "commenced, and after £30,000 had been expended, it seems to have been dis- "covered that there was no ore to smelt, and the works were abandoned.' "

It may be seen by these quotations that this author has been anxious not to pass over in silence the mines in Canada, and that he wished to do justice by giving a true description of what he saw.

How painful it is to find that the author of the work in question has only been able to bear witness as regards the Canadian mines, to that abuse of confidence by dishonest persons who have been the principal cause of the great losses which our Companies have sustained. It is also annoying to find that this author was unable to obtain any information whatever as to the existence of native copper, not only in veins but in different rocks of greywacke, red sandstone, &c., with characteristics, not adventitious but proving the genuine richness and the formation of the native copper, &c.

To what then are we to attribute this complete ignorance as to the state, position, and importance of the mines on the Canadian side? For more than ten years have associations been in existence, and their capital employed for the purpose of opening out the riches of the country. Any one might with justice assert that this is one of the greatest proofs of the mineral poverty of the soil. How then happens it, that at all the World's Exhibitions, we receive such high praise for the specimens of every sort of metal, and that there are few countries which can present such abundant collections, so diversified in their species and nature? Up to the present time we can show no complete work upon the position, direction, or importance of the mines, nothing approaching the kind of description published, not only in France, in England, or in any of the old nations, but even among our neighbours, who are in possession of full details respecting their mines, even in cases where their discovery dates long after ours.

I think that it is the duty of the Government, for the interest of the country and of science, so soon as mines are discovered, to cause charts to be published, shewing the nature of the soil, and the character of the metalliferous strata, and giving all possible information with respect to the localities, so that in after years after more minute investigation, there may be at least incontestable proof of the progress of these researches, and the existence of the mines may be generally known. By the adoption of these means the public credit might be husbanded, and the interests of the country protected.

With respect to the interests of the mines on Lake Superior, I cannot omit to mention the fact that neither the Companies nor individuals have any protection whatever, they have no legal means of protecting their interests. Very often the Director of a Company after having made arrangements with workmen for a certain description of labor, after immense sacrifices, is abandoned by his men at the commencement of the work; and, in order to procure others, he is subjected to the same sacrifices, and liable to see his workmen again abandon him.

Permit me to append to this report, letters from different persons whom I met at the mines, they will give you more detailed information.

Since the completion of the Canal on the American side, between Lake Superior and Lake Huron, the town of Sault St. Marie has made rapid progress. The

Americans have organized a Court of Justice and a military post with barracks.

On the Canadian side, to the north there is only the Dépot of the Hudson Bay Company. There are several Canadian families among the Indians, these families depend for subsistence solely upon the American towns.

There is only one Justice of the Peace, who possesses no means whatever of enforcing the law, and thus mining companies or associations are deprived of all protection, and exposed to great injustice on the part of people who have nothing to fear from the commission of crime; this has the effect of causing all the manual labor to be procured from the American side, thus impeding the progress of Companies on the Canada side.

With reference to the general interests of the mines, I have now only to point out to you the places so important in navigation, at which vessels loaded with the produce of the lakes may find a shelter. Between Lake Huron and the Otter Head Islands there are only two, and they have been given up to the Indians by the Government; one is in the Indian territory, No. 15, and the other in No. 2. Michipicoten Island has but one safe harbour, situated on the south side, in the 86th degree of longitude, west from Greenwich.

The possession of territory No. 15, appears to me of the very highest importance for the protection of the fisheries, which of themselves almost equal the mines in value and importance, and which would under any circumstances be of immense assistance in the support of the increasing population in these latitudes, deprived as they are of agricultural produce.

The antiquity of the mines to the north east of Lake Superior is evidenced by visible proof. Works may be seen at Mamains which must date back to the period in which gunpowder and iron tools were completely unknown to the natives.

The Indians made use of a metallic amphibolic rock which is excessively hard, and of great weight, to break the rocks in order to the extraction of the native copper which was found in small pieces or in veins. I have in my possession a very interesting little collection, which proves not only the search for copper ore, but also its use by the savages of the place at a very remote period. It consists of a stone hammer which was found on the spot where it had been used, and of various weapons of more recent date. I have in my possession locks of hair enveloped in copper, which the natives carried about them as marks of their bravery. Whenever they killed their enemy they used to cut off a lock of hair and carry it about them as a species of decoration. In places where there is no copper they cut off with the hair a small portion of the skin, which is called the scalp.

The mouth of the river Michipicoten to the north-east of the Lake is exposed to various changes caused by the waves of Lake Superior under the influence of strong gales from the south and south-west, and which form as it were channels in the sand. By this means the river on one occasion completely changed its course by forcing a passage through one of these channels, and in so doing exposed some human bones, the remains of which Mr. MacKenzie the governor of the Hudson's Bay Company's fort caused to be collected and interred elsewhere, not daring to take any part away on account of the well known superstition held alike by all the Indian tribes of America with respect to the displacement or removal of the mortal remains of their ancestors. Another traveller, however, who was acquainted with the fact of this discovery, and who did not reside at the place, found a means of deceiving the vigilance of the Indians, carried off these remains and sent them to Mr. J. Wilson, together with other booty. To his kindness I am indebted for the possession of a lower jawbone, a weapon of iron (a sort of lance,) a crooked knife, used by the Indians in the preparation of skins, an instrument made of horn and several locks of hair enveloped in copper. The knife and the lance are more than half eaten away by rust, the copper which encloses the locks of hair is completely

changed into carbonate and other salts, and only exhibits very slight traces of pure metallic copper. Some of these locks of hair still retain at their extremities small pieces of leather which seem to have been used to suspend them. Mr. Mackenzie has taken great pains to obtain information with respect to these bones which are supposed to be the remains of some great chief, but the oldest among the Indians have been unable to give any information on the subject. It would even appear that no tradition has been preserved respecting this man whose remains evidently denote a renowned warrior.

This incident, together with the changes in metallic substances and in the tools, strengthens the supposition that the mines of native copper to the north east of Lake Superior must be of very ancient date, and that the difficulties of transport in these latitudes have prevented their being worked by settlers or immigrants.

The Bruce Mines.

The Bruce mines are situated on Lake Huron 84 west longitude and 46° 19′ north latitude.

Upon arriving at the mines, one is struck by the beautiful *coup d'œil* presented by the little village of Bruce Mines. It is built upon the bare rocks in which are *strata* of different kinds of copper ore, having opposite to it the Island of St Joseph the future granary of the two Lakes.

The town of Bruce Mines already contains about one hundred houses, all occupied by the families of the workmen employed at the mines, the south eastern extremity is devoted to the buildings in which are placed all the apparatus employed in the preparation of ore, to be thence transported to their different destinations, also the Superintendent's office and the Post Office.

The company has also erected wharves to facilitate the arrival of steamboats and other vessels.

In the middle of the formations which are now being worked, is a blacksmiths' shop, and on a small elevation from which there is a view of all the works, is the dwelling of the captain and that of the Superintendent General of the mines.

At the period of my arrival a new apparatus for washing the ore was in course of construction. It is an American invention; by it the ore is first reduced to powder as fine and as uniform as possible; this powder is then placed upon sieves of different numbers, which have a continual horizontal motion with a slight concussion. By means of this "rocker" the copper ore is separated from the ordinary stone, the action of the machine being based upon the well known principle,—that all matters being reduced to the same volume, if they are of different weights, and are equally exposed to the same action of displacement, range themselves in the order of their respective weights.

As this apparatus is on the point of being put into operation, and may indeed be so at this moment I shall abstain from any remarks as to its utility. I will add however that it would be of the greatest advantage to Lake Superior where the native copper is found, in rocks similar to those in No.

Having visited all the mines which are now being worked I can with confidence state my opinion that the copper formations of Lake Huron are not of a nature to possess vertical veins as has been heretofore supposed, because the calcareous rocks of St. Joseph Island or of Eagle point, would have heaved up the dioritic rocks, and the topographic formation of the locality plainly shews the impossibility of this movement, solely because the nature of this locality has not permitted the metallic veins to be formed under the influence of vertical currents of polarisation, but rather caused them to extend themselves in a horizontal direction by the movement of the electro magnetic current.

Upon attentive examination of the rocks not in the adits of the mine only, but generally, it is evident that as the rocks extend below the surface their formation

undergoes a change not only of a chemical nature but also with respect to their molecular crystallization.

Although the Bruce mines do not appear to possess ore to any great depth they are not without considerable importance.

The ore which is obtained in these locations presents all the appearances of richness. The works however must be carried on with the prudence required by the circumstances presented by a country entirely new and almost as wild as it was when originally settled.

It is hardly necessary for me to express my opinion as to the mode of proceeding which ought to be adopted, for Mr. Baron the superintendent, on the spot, appeared to me not only to understand works of this character, but has even invented and put in operation a mode of extracting the metal which seems to me to work most advantageously for the interest of the stockholders and the prosperity of the mines.

I shall refrain from attempting to make any valuation in figures of the products of the mines. 1st. because my time there was too limited; 2ndly. because such calculations would only be an imaginary estimate which might be prejudical to the shareholders and also to the value of the locality. It is a very easy matter to lay down as a rule, "so much per cent of ore, so much profit" but apart from the intrinsic richness of the localities in which mining operations are carried on, there are other circumstances to be considered, when an opinion is to be given as to the advantages offered by such and such localities, such as the great distance from inhabited districts, and the current prices of all those things which are required besides manual labor. The mines on Lake Huron like those on Lake Superior have a powerful adversary to struggle with; for in the United States the working of mines s carried on with all possible energy and perseverance, protected by laws specially enacted for that purpose, by means of partial operations among workmen independently of the associations of capitalists; all this renders the first efforts at the working of mines in Canada very difficult to sustain, and neither the richness of the mines nor the best administration can prevent partial or momentary delusion, before affairs assume a permanent routine, under the influence of intelligence unaffected by the urgent and ever varying necessities, constantly arising in a yet virgin country.

As far as I have been able to judge after a cursory examination of the western shores of the Lake, the Bruce mines appear to me to be the richest in this vicinity. The copper mines appear to yield the most abundantly, but I do not think they are in the richest formation. Mines must exist in their rear which would be much more important or m,ore regular in their formations and more homogeneous, from the fact that the rocks although they contain ore in very great abundance at the surface, contain none at any depth and that the same rocks as they entered below the surface present a different crystalline composition.

I would decline fixing at present the exact date of the formation, for the few fossils which I found appeared to be at variance with that hitherto assigned to that locality. I would rather first obtain more reliable data; but I am almost positive that the very abundance of the veins dispersed on every side proves that the cupriferous region on Lake Huron is of the very greatest value, 1st. because it is situated near a country abounding with all agricultural resources, and will consequently be approached more nearly every year by an increasing population. 2ndly, the climate is more favorable to the working of mines, and the Navigation less difficult; as the Islands of St. Joseph, Drummond, and Manitoulin afford shelter from the storms which are very disastrous, and those vessels which take the United States side are very often exposed to disasters which unfortunately are very numerous. Ready communication with the Atlantic by Lake Nippissing, and the easy access from the different harbours, which form the termini of the railroads con-

necting all the important points, are considerations which deserve the favour and encouragement of the Government of the country to promote to as great an extent as possible the interests of the mines in this part of the country.

It would be impossible for me, without committing very serious errors, to state exactly the respective positions of the formations according to the classification generally used by celebrated and learned naturalists in Europe, for I was unable on account of the limited time at my disposal to make investigations as complete and detailed as the circumstances of the case required.

If the Government were anxious to have positive information as to the richness of these locations, they should allow a sufficient period of time, not only to make a report of the nature of the encasing rocks, but also of the correct position of the veins with respect to their true direction, their power, the number of principal and secondary veins, also to analyse the composition of the ore and that of the rocks. Without this, any person desirous of making an exact and detailed report, would, unless he confined himself to a general description, be often forced to contradict himself to the prejudice, without his wishing it, of the general interests of the mines of the country as well as those of capitalists.

The copper of the Bruce mines is generally a sulphuret in compact dioritic rock. I also remarked that there was a formation of amygdaloid quartzite. It would be of the highest importance to shew what control or rather what influence this rock and the absence of schorl exert in the formation of copper ore. As I remained there but a short time, I shall abstain from giving a decisive opinion. If I enter into more details respecting the mines of Lake Superior than those of Lake Huron, my reason for so doing is because I have had more time to observe the nature of the formations, and have been able to form a more correct opinion of the richness and nature of the mines, having had a greater field for my observations.

Near the Bruce mines is the Wellington location, a tributary of the Bruce mines, where a great deal of work has been done. During the short time I remained there I was unable to note the character of one of the best localities.

Copper is found in Copper Harbour, not far from the Wellington mines. This vein comes out of the lake, and extends several feet on terra firma, but is soon cut off and no further trace whatever can be found of it. I do not think that this vein has changed its direction, but I am of opinion that it owes its existence to one of those accidents to which I have before alluded in this report, that is to say that it is a species of residuum of the decomposition of mineral matter which has undergone a less complete or more tardy electro-magnetic action than the general mass.

In going up towards Lake Superior on the south side of the *Ile du Camp des Ours*, white stone is found, this may be of great utility, as it serves admirably for hot furnaces.

In the north east portion of Lake George there exists refractory clay

The northern and eastern portion of this lake as well as that of the little lake St. George is held by Indians, except that portion which is on the river St. Maurice; it is the most fertile and perhaps the most important of all the locations west of Lake Huron. The land is superior in quality for agricultural purposes to any of that near the United States, both with regard to the richness of the soil and as its position, it being protected against the north and north-west winds by a chain of hills; these hills contain lime of the best quality. Copper ore should be found there, not only in the sulphuretted but even in the native state, because this chain of hills is of the same nature and character as that on Lake Superior. This place is one of the most important on Lake Huron, not only on account of the fisheries, but also as being a post. I went through the woods a distance of seven miles from the river, and am of opinion that a means of communication might easily be established between Goulais and Batchcewauanong Bays, Garden River and Echo Lake, in case

communication were required between Lake Superior and the river Tassalon which runs in the rear of the Bruce mines.

That part of the chain of hills which extends from Gros Cap, on Lake Superior, to Lake George, crosses a part which abounds in mines of different kinds. From the observations I made upon the nature and direction of the rocks, I do not think that I am mistaken when I say that anthracite coal ought to be found on the north side of that chain of mountains.

It appears to me that the purchase of the location upon which is situated No. 14 of the Indian Reserves, that is to say, that part which is situate upon Lake St. George, Lake St. John, and Echo Lake, would be of the highest importance to Canada, as the junction of the extreme west of Lake Huron with the extreme east of Lake Superior. This part of the country, after careful survey, should be divided into lots suitable for the working of mines and also for agricultural purposes, and in that manner a means of communication would be opened between the two Lakes.

At the entrance of Lake Superior the aspect changes completely, not only with respect to the scenery, but also as regards the nature of the rocks and the climate. Gros Cap, which is at the south-east extremity of the Lake, is 700 feet in height, it contains native copper and is composed of porphyritic rocks of amygdaloid greywacke and describes an arc in its direction towards Lake Huron.

The Bay of Goulais is separated from the Bay of Batcheewauanong by a point formed of new red sandstone. Opposite to those Bays are situated *Les Iles aux Sables*, where we also find red sandstone, part of which is completely discoloured and almost white. It is in a direction of 150° and inclined towards the north east and by east.

The white sandstone which in a state of decomposition becomes sand, contains in the splits or veins black sand composed of magnetic iron, titanic iron, zircon and small garnets.

Between Batcheewauanong Bay and Goulais Bay fossils are found which are of a genus altogether different from those to be found upon Michipicoten Island.

In a little bay between Batcheewauanong Bay and the location of Messrs. McCollagh & Scott, which is often used by bateaux as a place of shelter from the north wind, I found specimens of native copper in the fragments of rocks carried down by the mountain streams. From thence, going northward, we find that beautiful spot called Mamains, where the locations of Messrs. Ryan McDonald, Hugh Allan, A. Allan, Edmonston and others, are situated.

I found Mr. J. Catsworth and several men working the mines on Mr. W. O. Meredith's location. I was delighted to see works in operation, for I had then an opportunity of verifying the correctness of my observations on the spot. Before going to the place where the operations are carried on, I examined the rocks in the neighborhood and informed Mr. Catsworth of my observations and conclusions regarding the direction and nature of the ore, according to the theory before enunciated. He, having the experience, by surveys and the examination of the country, acquired in a whole season, was surprised at their precision.

The next day we went together over the ground where the works have been commenced at the distance of a mile and a half. Before descending, I pointed out the spot where I supposed the vein should increase in size and be developed. I traced its distance and course, and everything turned out in accordance with my calculations. However, for my own proper satisfaction, I went down into a sort of well to examine with more precision. I measured by means of an aneroidal barometer, the height of the mountain from which the native copper in veins is extracted, out of an old Indian well; the height is 269 feet above the level of the lake. The formula I used to calculate its height is $\frac{a+b}{a-b}$ 55,000=h.

The copper found at Mamains contains silver and also traces of gold. To the right of the location is a vein of lead which is, however, accidental.

Its presence under these circumstances renders more certain the existence of argentiferous copper ore which will hereafter become more profitable. Cobalt is also to be found with copper in one of the veins, and at a few miles distance in the north east direction there is a saline spring.

Proceeding from Mamains, towards the north by the lake, the rocks are of a different formation, and at *la Pointe aux Mines* the sandstone is of slaty structure lying in a direction of 339°, inclined towards the south west, and crossed by lines in a direction from west to east; it is slightly amygdaloidal. The amygdaloids are of a quartzy nature and often crystallized; sometimes they consist of agates or jaspers. It is in this rock that are found the veins of zinc known as "Black Jack" by the English miners, that is to say, ferriferous zinc. This vein runs in a direction of 160° and inclines 30°.

At Mica Bay several houses have been built, the commencement of a town. The site is beautiful in point of view, but the access to it is very difficult, even for small canoes, much more so for larger vessels, on account of the rocks which extend to some distance, and the shallowness of the water.

Here is situated the mountain, the study of which is so interesting as regards its peculiar formation, to which I have referred in my Report.

I found pieces of copper of different kinds, but it is useless to suppose that any vein could be worked, because it can only follow the nature of the formation of the rocks, that is to say that the vein possesses no continuity nor is of sufficient value to be worth working, notwithstanding all the appearances of richness. As soon as this point on the north side is passed, the formation becomes again more homogeneous with amygdaloidal rocks. It is to be deplored that the very generous efforts of capitalists have been so unfortunately applied. This is the location which Mr. Whitney refers to as an example of the richness of the mines at Lake Superior. It is probable that the overseer of the works has acted conscientiously and with the view of obtaining good results for the shareholders. In certain places the ore appears to be very rich. He, however, made a mistake in commencing where he should have finished, and has hazarded not only the interests of one company, but also those of all the mines on the north side of Lake Superior. If, instead of incurring extravagant expenses for useless works, he had made investigations with respect to the position of the veins, and the character and value of the products, the result would have been far different, fatal delusions would have been avoided, and he would have rendered valuable service, for I do not doubt that to the north and especially to the south east, at a certain distance he might have found a more homogeneous formation, and partial excavations would have reimbursed all the expenses.

I shall take the liberty of here mentioning, or rather suggesting, a plan for the locations. Parties are compelled to take a certain definite extent of land which is called a location, contiguous to some other location. This tract often contains but a very small portion of ore, and thus persons interested in the mines are afraid of incurring useless expense, because as the limits are fixed beforehand, they run the risk of incurring expenses to the profit of some other person who may be waiting the result attained by his neighbours. Government should allow parties to take locations, not those contained within the straight lines traced to indicate a certain extent of land, but according to the plan of the position of the mines made out by the applicants; subject to careful examination as to its correctness; under this system both the Government and capitalists would obtain great advantages; for parties wishing to invest stock in mines would choose those places which they fancy would insure to them future benefits, and would not be forced to make useless purchases of several miles of unproductive land whilst their capital might be laid out elsewhere to greater advantage. Besides, it often happens, that, after having made disbursements and incurred expenses in the survey,

if they have the good fortune to find a mine they are deprived of the benefits which might result therefrom, whilst others who have hazarded nothing reap the profits.

I am therefore of opinion that if the present mode of granting these locations be continued, the development of mining interests cannot progress so rapidly as if the plan I have just suggested were adopted; the advantages which the Government has a right to expect on account of the wealth of the country and its direct and indirect influence upon the prosperity and extension of the different branches of trades will be more than retarded; for credit would thus be completely destroyed and the capital heretofore invested would be entirely lost.

To the north of Mica Bay is the river Montreal, here the rocks are of a different nature. Those to the rear of Pointe Agivany run in a direction of 70°, and those extending from the river Montreal in a direction of 130°, uniting almost perpendicularly. After these are the Gargantua rocks which present indications of great promise as regards mineral wealth. Near the Bay of Agivany, there is a vein of trappoidal jasper in a direction of 240°, of great density, almost equal to that of iron. It is three feet and a half in breadth; its crystallization is a rectangular parallelopiped and its position in the vein is such that one of its sides is perpendicular, and the other perfectly horizontal. This vein is sunk in a hill, the rocks composing which consist of quartz which is almost white. On the east side is a similar vein 100 feet in breadth but which is not however, of so compact a nature, for it appears to be in a state of partial decomposition. To the north of Gargantua, the rocks assume a different character and are in another state of gradual decomposition as far as the river Michipicoten.

At Cape Choyer the rocks run nearly east and north; at Point Brûlé, the feldspathic sandstone runs 328° with an inclination towards the south.

There is at Gargantua red sandstone, granite, and amygdaloid, which lies in the direction of 310° and towards the river Pakazoizibi. In one of the Gangantua Islands is to be found amygdaloid greywacke completely decomposed into black sand, with agates also in a state of decomposition. This sand is very pure and it differs in character from the others. It is rough to the touch and contains no silex or iron like that at the river Montreal and Michipicoten.

In the vicinity of the river Michipicoten the rocks are of a schistose nature and the sand in the river is auriferous. I found particles of gold in several places, not, however, in sufficient quantity to be worth collection. At the falls, the veins are of red quartz; on the right bank of the river, near the lake, I found iron in veins, and not far from the lake on the river Magpie which falls into the Michipicoten I found a vein of copper underlying gozlan or iron cap, which contains particles of gold; the rocks are of a talcose nature and the sandstone is of a schistose structure. The vein runs 160° north into the rocks in the direction of 140°.

At the entrance of the river Michipicoten, there is a vein of iron of but little importance which runs in a direction of 360° in the rock which extends from the south west to north east with an inclination towards the south west. The north side of the lake contains schistose sandstone, which has talc in quantities between the veins of quartz, generally in the direction of east and west. The Bay to the north of the river Michipicoten contains several veins of iron in talco-quartzose sandstone in the direction of 75 to 80° intersected by a vein of quartz of 4 or 5 feet in thickness containing iron and sulphuret of copper.

The north-east part is characterized by a description of iron ore which I have met with in several places, I was, however, unable to form any idea of its importance for mining purposes, as I was prevented from examining the country, on account of its being an Indian Reserve. In the direction of the river Dorée, that is, to the north west side of it, I noticed amygdaloidal sandstone. The amygdaloids are of a phosphoric character; it appears that this part of the country is under the in-

fluence of two currents, one from the north east to the south west and the other from the south east to the north west. The sandstone is in a transition stage and filled with iron pyrites and is ranged into small veins. To the right of the river Dorée there is a formation of talcose schist containing quartz and iron pyrites in a crystallized state. To the north of the river *à la Chienne*, there is a formation of talco-quartzose schist which runs in a direction of 145° intersected by a rock of gneiss in the direction of 60° these rocks are intersected by jaspers of different colors; I, however, did not meet with any agatiferous formation or native copper; I found copper only in veins in the state of sulphuret.

In passing the river *à la Chienne* the formations take a more determined direction and stimulate the activity of the formation of Mamains; those which exist between river *à la Chienne* and the river Michipicoten have completely changed their nature. The Island of Michipicoten and the Bays of Mamains, Gargantua, and Mica, are worthy of the greatest attention with respect to their mineral wealth, and each of those places should be examined more carefully. I am of opinion that Mamains and the Island of Michipicoten are locations of the first class for mining purposes, Gargantua and Mica Bays are very difficult places to be worked unless the formations in the rear are of a more uniform nature. Garguntua and Mica Bays form a sort of knot where the currents meet, and although they present every appearance of wealth I am of opinion that they are very limited in extent.

The Island of Michipicoten is interspersed with veins of every species of barytes, jaspers, agates and carbonate of crystallized lime. The amygdaloid zeolitic greywacke is filled with native copper. In one place I ordered one of my men to take 100 lbs. of rock and to break it up with hammers upon the stones. As the work was a very long and fatiguing one from the want of tools I caused one half to be taken away. The 50 lbs. of rock contained native copper from the finest dust to pieces several inches in diameter. The most common state, however, is that of zeolite. The 50 lbs. of rock that was broken when well washed contained 16 lbs. of copper; there is also native copper in red sand stone. This island seems to contain a very productive formation of copper. To the north of the Island I saw no copper in veins but in one place only. The richest formation is on the west and south sides. On my arrival at the Island, I met with Mr. Joseph L. Wilson, the Superintendent of the Quebec Mining Company, who, notwithstanding the strenuous exertions which he uses in the working of the mines, will have great difficulty in completely satisfying the shareholders. One should be on the spot to form a correct idea of the numberless obstacles which obstruct progress. It would be a difficult task to enumerate them, and no one but a person accustomed to visit foreign regions at the time of their earliest settlement, can describe them. I think it my duty to state my opinion that unless the Government grant the Company and those persons who devote themselves to the working of the mines in this new country, all the assistance in their power, they will be unable to continue the works notwithstanding the almost heroic efforts which they have used; for, besides the risk to which capitalists expose their fortunes in opening new resources to the country, the workmen have to undergo all manner of privations and fatigue such as necessarily attend a new settlement in this barren and uninhabited country, besides the very laborious task of working the mines.

The Islands of Michipicoten and Mamains are in my opinion, places which hold forth the best inducements to the miner. They possess all the characteristics of mineral wealth. Several species of rocks contain native copper. It is to be found in every state, from its first appearance in molecules to pieces of several pounds in weight. The rocks are softer than those upon the main land and consequently are more easily worked.

After a survey and a minute examination of the positions of the rocks and of their nature, it would not be a difficult task to decide which localities possess the

greatest mineral wealth. In this island copper is found not only on the surface but even beneath the mountains, and it is probable that it might be found in veins The proof that the mineral wealth of this place will hereafter be of the greatest importance, is that the rocks contain a talcose serpentine which appears in the crystallization of the rocks.

The bulk of zeolitic matter, both amygdaloid and in veins, agates, and copper, when it seems to have become the principal component of the formation, takes the character of the bodies which compose it. It takes the place of the zeolites and a species of cupriferous amygdaloid sand stone.

I shall refrain from entering into a detailed description. This would require competent leisure and not a flying visit such as mine. In a general survey of several hundreds of miles in a very brief space of time, it is probable that I may have passed over several characteristics which might induce me to modify my opinions were I to enter into a more strict examination. As I have already said, I might contradict myself; and the interests already involved are too serious and important to allow me to make any assertion which might not be susceptible of proof. I think nevertheless that I have made a sufficient survey and have collected evident proof enough to shew that the Canadian portion of Lake Superior contains a real and not accidental formation of mines of native copper as well as of other metals of the highest value and that these mines will soon be sufficiently advanced to compete with all others.

I was obliged to return from the Island of Michipicoten on account of the lateness of the season.

In presenting you this Report, Sir, I beg you to receive the assurance of the respect with which,

I have the honor to be,
Your most humble and obedient servant,
(Signed,) De ROTTERMUND.

Formerly a pupil of the Central School at Paris, and member of the Geological Society of France.