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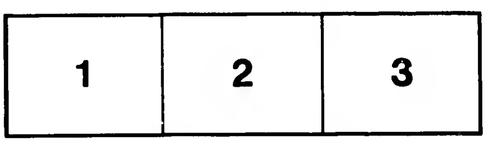
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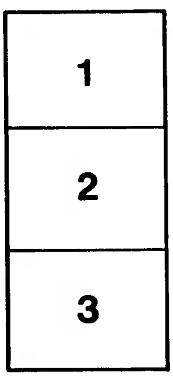
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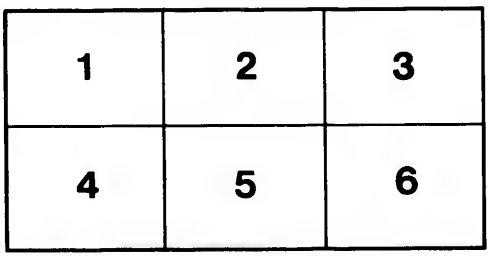
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A SKETCH

OF

THE GEOLOGY OF CANADA.

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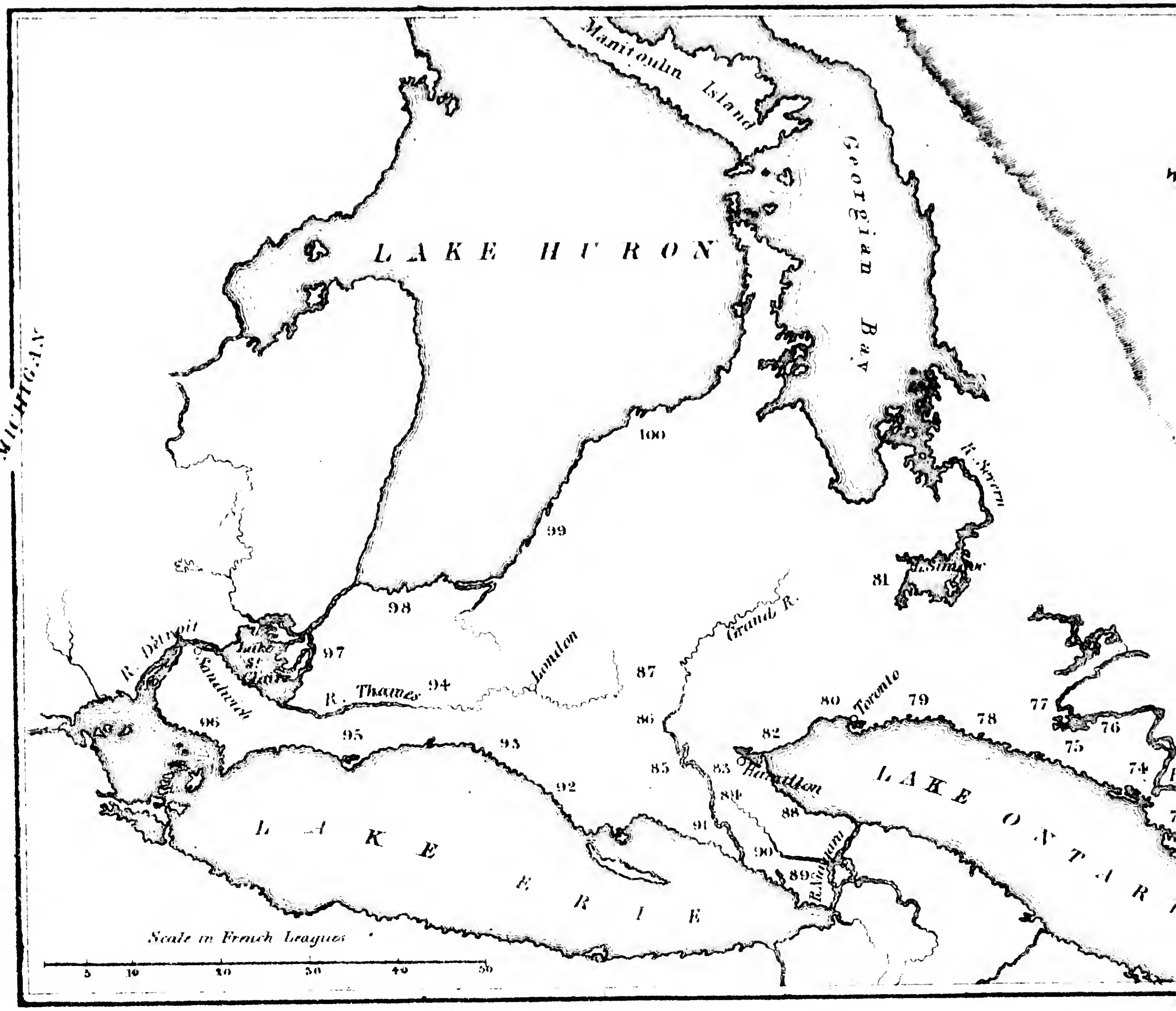
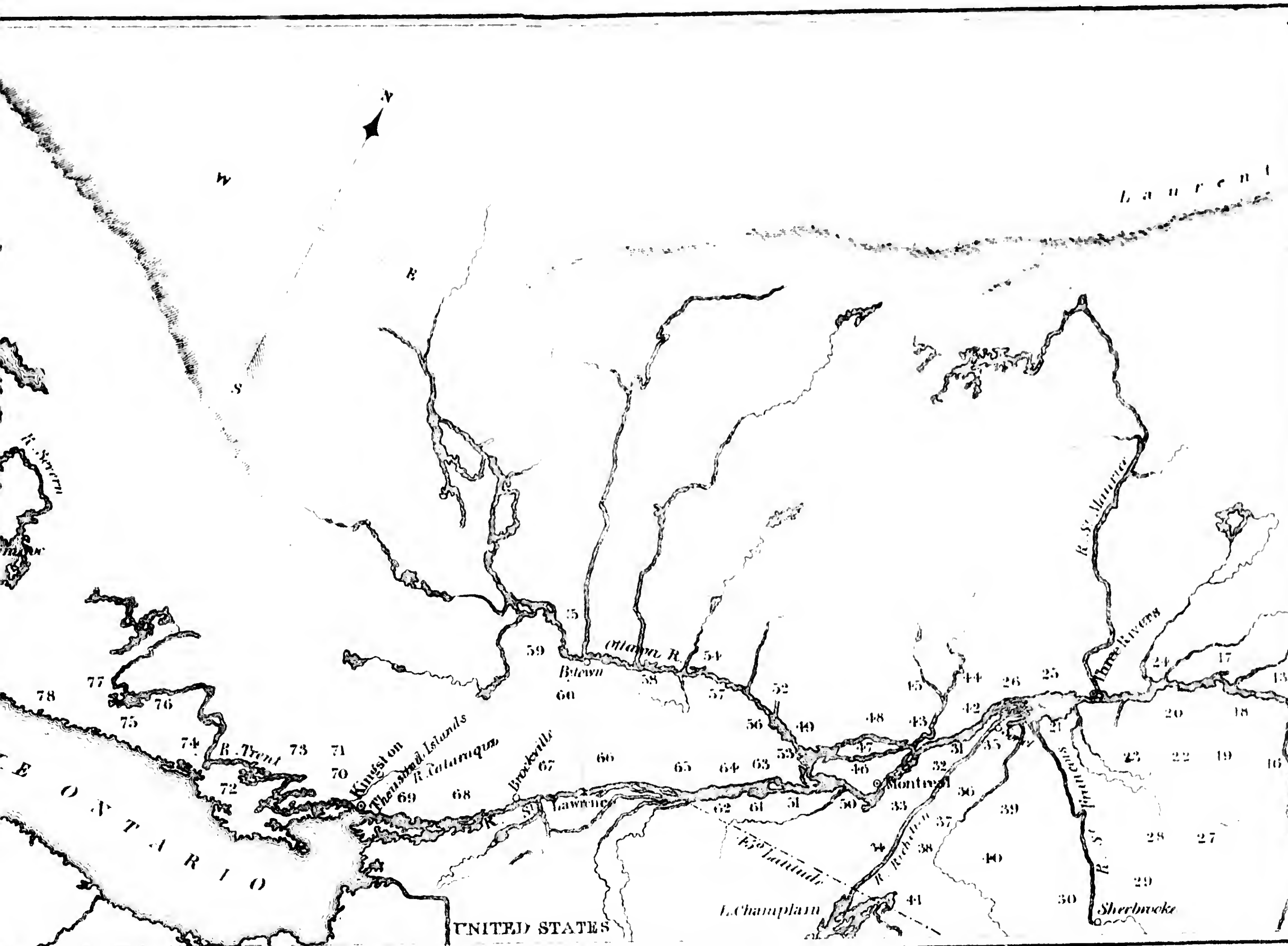
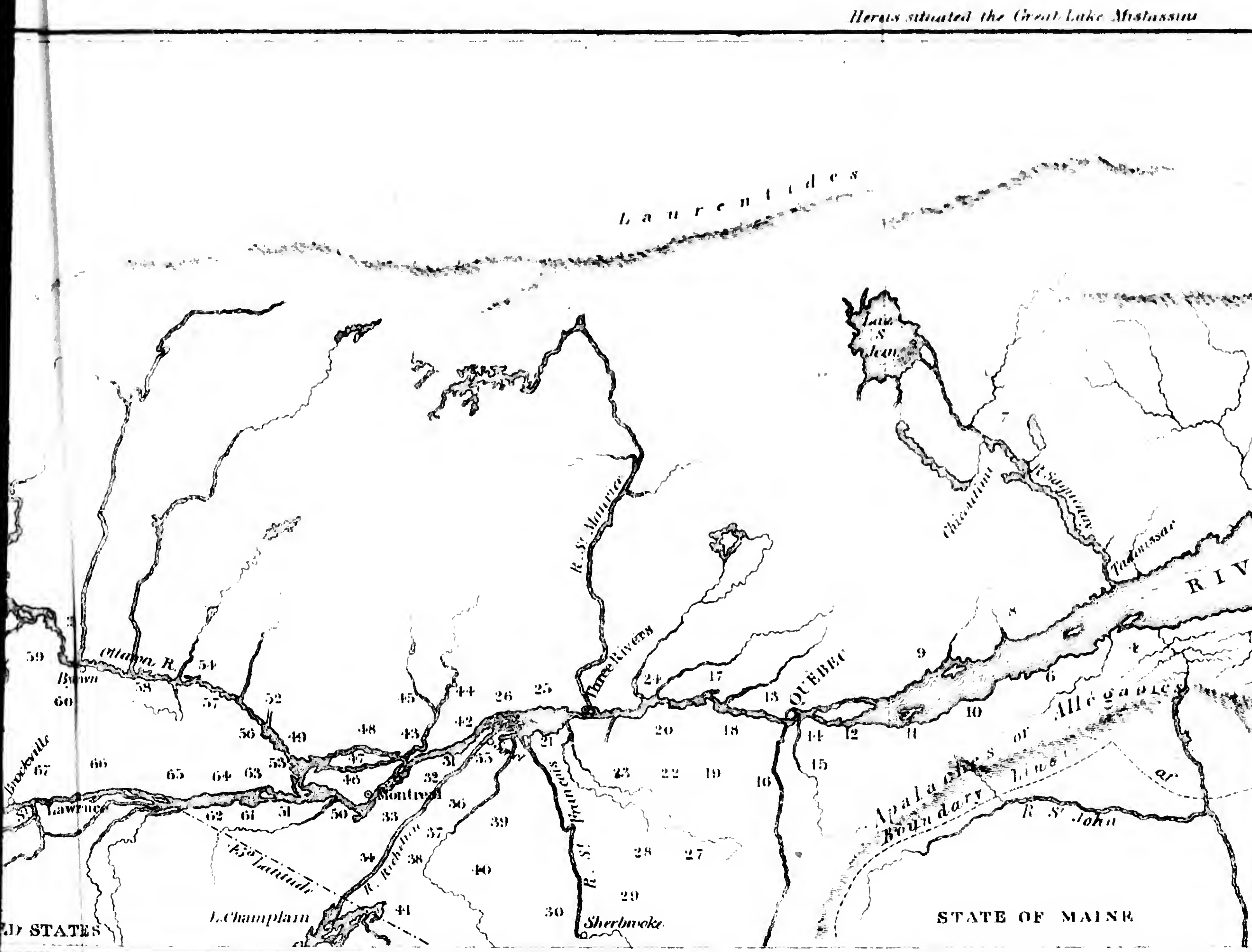
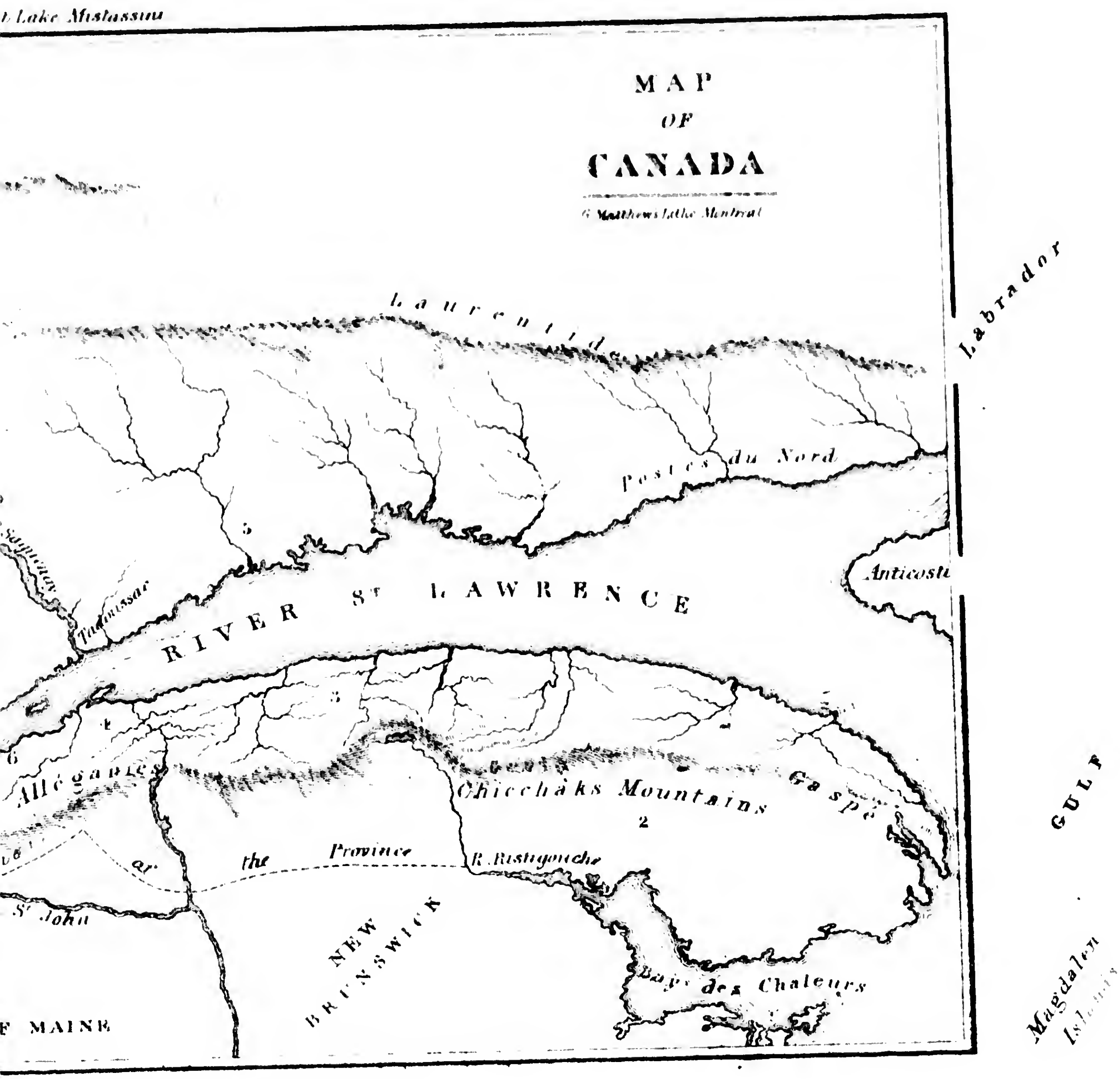




Map for the assistance of the reader of the Essay on Canada by J. C. Taché Esq.



Map for the assistance of the reader of the Essay on Canada by J. C. Taché Esq.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NEW BRUNSWICK
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Islands

Member

Member

A SKETCH

OF

THE GEOLOGY OF CANADA

SERVING

TO EXPLAIN THE GEOLOGICAL MAP

AND THE

COLLECTION OF ECONOMIC MINERALS

SENT TO

THE UNIVERSAL EXHIBITION AT PARIS, 1855.

BY

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

Member of the Geological Societies of France and England, Director of the Geological Commission of Canada, &c., &c., &c.

AND

T. STERRY HUNT, A. M.

Member of the Geological Society of France, of the American Academy of Arts and Sciences, Chemist and Mineralogist to the Geological Commission of Canada, Member of the International Jury of the Universal Exhibition at Paris, &c., &c., &c.

(*Translated from the French.*)

PARIS

HECTOR BOSSANGE & SON,

QUAI VOLTAIRE, 25.

1855.

INTRODUCTION.

The commencement of a systematic investigation of the Geology of Canada, dates only from the year 1842. Before this time, however, several efforts had been made by men who appreciated its importance, to establish a commission for the Geological and Minerological examination of the Country, but it was only in 1841 that the Legislative Assembly having voted a sum of £1500 for a geological exploration of the Province, the Governor, Sir Charles Bagot, named in 1842, Mr. W. E. Logan, as Geologist, and Mr. Alexander Murray, as Assistant Geologist, to put the project into execution. The exploration, being thus commenced, was continued under Lord Metcalfe by a second grant of £2000 a year for a period of five years from 1845, and in 1850 the Act was renewed under the administration of Lord Elgin, for a similar period.

The Geological Exploration of Canada presents peculiar difficulties; in old countries where civilization of many centuries has developed the mineral resources of the soil, where mines and quarries furnish every where facilities for studying the nature and arrangement of the different formations, where, finally, the labors of the Topographer have preceded those of the Geologist and given exact maps of the country, geological researches become comparatively easy. But, in a new country like Canada, all these things were wanting; the geologist was obliged to precede civilization, and, penetrating into unknown regions, to point out sources of mineral wealth hitherto unknown, preparing thus the way for the industry of civilized men who shall replace the savages. If we add to all these considerations that a geographical knowledge is an indispensible preliminary to investigations of this nature, it has often been necessary to combine topography with geology, and to make at the same time a geographical and geological map of the country, we may form some idea of the difficulties to be surmounted in the Geological Survey of Canada.

Canada has an area of about 40,000 square leagues; and the researches of Messrs. Logan and Murray, aided by those of Mr. Richardson, have already made known the geology of a great portion of this extent. According to the evidence given before a Committee of the Legislative Assembly, in October, 1854, it appears that the explorations up to that date, comprehended the shores of Lakes Superior and Huron, as well as all the great western basin of Canada, the valley of the St. Lawrence as far as the Gulf, the valleys of the Richelieu, Yamaska, St. Francis and Chaudière, that of the Ottawa and its branches as far as Lake Temiscaming, as well as almost all that part of Lower Canada south of the St. Lawrence, including the district of Gaspé. To these geological labours must be added the topographical surveys of several rivers tributary to Lakes Huron and Superior, of a great part of the Ottawa and its branches, as well as the surveys executed by Mr. Murray upon two lines of exploration between the Ottawa and Lake Huron, and the measurements of the principal rivers of Gaspé. All these topographical labours were only accessary to the Geological Survey, although necessary to its prosecution, and have greatly augmented the task of the Geological Commission.

The Annual Reports of the Geological Survey form at present about 1200 pages in 8vo., summaries of the geological researches of each year, with descriptions of the economic materials met with in the progress of the investigation, as well as researches upon the rocks, minerals and soils of the country, by Mr. C. Sterry Hunt, who has, since 1847, been attached to the Geological Commission in the capacity of Chemist and Mineralogist.

The inevitable expenses in a country where it has been necessary to carry on at the same time topographical and geological investigations, and to organize expeditions into regions still in a state of nature—have been such, that, notwithstanding the liberal sums accorded by the Provincial Government for these researches, it has not been without considerable personal sacrifice on the part of its director, that the Geological Survey has been carried on up to the present time. At the last Session of the Legislative Assembly there was accorded the sum of £2,000 for the publication of a Geological Map of Canada, upon a scale of, $\frac{1}{600,000}$, (having thus a length of more than six feet by a breadth of three feet,) to be accompanied by a condensed summary of all the Reports which have yet appeared. It is proposed, during the continuation of the Survey, to publish each year, besides the annual Report of Progress, a *livraison* of ten plates of the characteristic fossils of the different formations of Canada accompanied by a descriptive text, and also to give geological sections, with a minutely detailed geological Map on a large scale, which will be published in several parts to appear successively.

The geological commission has secured, for the palæontology, the cooperation of Mr. James Hall, of New York, who will direct the special studies required for the description, and publication of the fossils. This distinguished professor, so well known by his researches upon the geology of the United States, will soon publish a geological map of that country on the same scale as that of Canada, and as Mr. Logan has adopted the divisions established by Mr. Hall, in the palæozoïc rocks of the United States, their combined labours in these adjacent countries will give to the Geology of North America, a unity of plan which will greatly facilitate future geological researches on the American continent. The Map of Canada, which is now being engraved in Paris, will be published before long.

The Canadian government wishing to send to the Universal Exhibition at Paris a series of the economic minerals of the country, Mr. Logan was directed to collect them, and the minerals here exhibited, although in part, exhibited under the names of different individuals, were, with a few exceptions, collected by the personal care of the members of the Geological Commission. In order to indicate the geological relations of these materials, Mr. Logan has exhibited at the same time a map upon a scale of $\frac{1}{600,000}$, upon which he has brought together for the first time all the details of his geological labours; at the same time, as an explanation both of the map and the collection, we have thought proper to give in the little treatise which follows, a short account of the most interesting facts in the geology and mineralogy of Canada. We have added, moreover, a catalogue of the economic minerals of the country, and a small map, on a scale which is one-sixth of that about to be published. The geology of the neighbouring States is taken from the Maps of American Geologists, especially from that of Mr. James Hall.

For the geological facts, and for whatever relates to the physical structure of the country, all is due to Mr. Logan and his geological assistants; the mineralogy, as well as the chemistry of the metamorphic rocks and the mineral waters, is the result of the researches of Mr. T. Sterry Hunt, who has edited this little sketch.

Paris, August 1st, 1855.

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SKETCH

OF THE

GEOLOGY OF CANADA.

I

THE LAURENTIDES.

The province of Canada is traversed, through its whole length, by a mountainous region, dividing it into two basins, which may be distinguished as the Northern and the Southern basins. These mountains, which have been named the Laurentides, form the North shore of the St. Lawrence, from the Gulf as far as Cape Tourment, near Quebec; from which point they leave the river, and while they follow its general direction become more and more remote, until near Montreal, they are at a distance of ten leagues from tho St. Lawrence. Going further Westward, this mountainous region follows the line of the Ottawa, and crosses this river near the *Lac des Chats,* fifty leagues from Montreal. Thence taking a Southward direction, it reaches the St. Lawrence near the outlet of Lake Ontario and from this point running North-westward, the Southern limit of this formation, reaches the South-eastern extremity of Lake Huron, at Matchedash Bay, and forms the Eastern shore of the lake as far as the 47th degree of latitude, where quitting this lake, the formation gains Lake Superior, and extends in a North-west direction to the Arctic Sea.

To the South of the St. Lawrence, this same region covers a considerable space between the Lakes Ontario and Champlain, and constitutes the Adirondack mountains. With this exception and perhaps also a small exposure in Arkansas and another near the sources of the Mississippi, his formation is not found to the South of the St. Lawrence, and as it belongs especially to the valley of this river and constitutes the Laurentide Mountains, the Geological Commission of Canada has distinguished it by the name of the *Laurentian system.*

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II

THE LAURENTIAN SYSTEM.

The rocks of this system are, almost without exception, ancient sedimentary strata, which have become highly crystalline. They have been very much disturbed and form ranges of hills, having a direction nearly North-east and South-west, rising to the height of 2,000 or 3,000 feet, and even higher. The rocks of this formation are the most ancient known on the American continent, and correspond probably to the oldest gneiss of Finland and Scandinavia, and to some similar rocks in the North of Scotland.

The rocks of the Laurentian formation are in great part crystalline schists, for the most part gneissoid or hornblendic. Associated with these schists, are found large stratified masses of a crystalline rock, which is composed almost entirely of a lime and soda felspar. This rock is sometimes fine grained, but more often porphyritic, and contains cleavable masses of felspar, sometimes several inches in diameter; these felspars are triclinic, and have ordinarily the composition of andesine, labradorite, anorthite, or of intermediate varieties. Their colours are various, but the cleavable felspars are generally bluish or reddish, and often give colored reflections. Hypersthene is very generally disseminated in these felspathic rocks, but always in small quantity. Titanic iron-ore is also found in them, in a great number of places, sometimes in small grains, but often in considerable masses.

With these schists and felspars are found strata of quartzite, associated with crystalline limestones, which occupy an important place in this formation. These limestones occur in beds of from a few feet to three hundred feet in thickness, and often present a succession of thin beds intercalated with beds of gneiss or quartzite; these latter are sometimes quartzite conglomerates, and have in certain cases a base of dolomite, Associated with these limestones, are sometimes found beds composed in great part of wollastonite and of pyroxene, species which evidently owe their origin to the metamorphism of silicious limestones. Beds of dolomite and of limestone more or less magnesian, are often interstratified with the pure limestones of this formation.

The limestones of this system are rarely compact, and most frequently are coarsely granuted. They are white or reddish, bluish or grayish, and these colours are often arranged in bands which coïncide with the stratification. The principal mineral species met with in these limestones, are apatite, fluor, serpentine, phlogopite, scapolite, orthoclase, pyroxene, hornblende, wollastonite, quartz, idocrase, garnet, brown tourmaline, condrodite, spinel, corindum, zircon, sphene, magnetic and specular iron, and graphite. The condrodite and graphite are often arranged in bands parallel with the stratification. Beds of a mixture of wollastonite and pyroxene are sometimes met with, which are very rich in zircon, sphene, garnet and idocrase. The most crystalline varieties of these limestones often exhale a very fetid odour when bruised. The limestones of this formation do not yield everywhere well crystallized minerals; near the bay of Quinté there are met with beds which still preserve the sedimentary character, and show only the commencement of metamorphism.

The conditions in which they are sometimes found, indicate that the agents which have rendered these limestones crystalline, have been such as to render the carbonate of lime almost liquid, and that, while in that state, it has undergone great pressure. As evidence of this opinion, we find that the limestone often fills fissures in the adjacent silicious strata, and envelopes the detached, and often, folded fragments of these less fusible beds precisely like an igneous rock.

The crystalline schists, felspars, quartzites and felspars which we have described, make up the stratified portion of the Laurentian system, but there are besides, intrusive granites, syenites and diorites, which form important masses; the granites are sometimes albitic, and often contain black tournoline mica in large plates, zircon and sulphuret of molybdenor.

Among the economic minerals of this formation, the ores of iron are the most important, and are generally found associated with the limestones. The magnetic iron ore which supplies the forges of Marmora, C. W., is brought from Belmont, where it forms a succession of beds associated with crystalline limestone and a greenish talcons slate. The strata are here arranged in the form of a basin, and the iron ore predominates for a thickness of more than 100 feet. A few miles distant from this locality, in the Township of Madoc, there has been wrought a bed of magnetic iron ore which occurs in a micaceous schist and has a thickness of 25 or 30 feet. The ore, which is very fine grained, often possesses magnetic polarity, and contains a mixture of small quantities of actynolite with a little yellow uranite; it furnishes an iron of superior quality. Many other masses of this kind of ore are found in the surrounding region; that of South Sherbrooke has a thickness of 60 feet, and that of Crosby on the Rideau is nearly two hundred feet thick. At Hull on the

Ottawa, a bed of ore 100 feet thick is exposed by an undulation of the strata forming a sort of dome, so that the ore is wrought with great facility. These ores are for the most part pure magnetic oxyde of iron, sometimes mixed with a few hundreths of mica or quartz.

A compact variety of oligist ore, (red hematite,) often replaces the magnetic ore in this formation. At Macnab upon the Ottawa, a bed of this species twenty-five feet in thickness, is found in the crystalline limestone ; the ore is mixed with a little silica and carbonate of lime. Mr. Murray of the Geological Commission, has lately recognized the existence of a large extent of crystalline oligist ore upon one of the islands of Lake Nippissing.

The limestone of the Laurentian system are often traversed by veins of calcareous spar and sulphate of baryta, containing sulphuret of lead in disseminated masses, or in veins which are often two or three inches in thickness. One of these localities in the township of Lansdowne is already explored; what appears to be a continuation of the same vein, is met with in the township of Bedford ; these localities are in a general direction N.E. and S.W. The galena is sometimes accompanied with small quantities of blende and iron pyrites ; it is very slightly argentiferous, yielding by coupellation only about two ounces of silver to the ton of ore.

Veins containing copper pyrites have been observed in several localities in the Laurentian system ; but the quantity of metal which they contain, appears very inconsiderable. One of these localities is in the Seigniory of Lanoraie, in the county of Berthier, and near to it in the same Seigniory there is a vein of quartz 40 feet wide containing a great quantity of, cubic and magnetic pyrites. In the neighbouring Seigniory of Daillebout there is found a considerable vein of cubic iron pyrites, containing small portions of cobalt and nickel ; this same formation in the State of New York has furnished crystallized sulphuret of nickel.

Graphite is very frequently disseminated in small plates in the crystalline limestone, and also forms veins, sometimes of considerable thickness. Near Grenville, on the Ottawa, are two of these veins, one of which was wrought some years since. The graphite, according to the description of Mr. Logan, there forms three detached veins, each having a thickness of about five inches, and is accompanied by wollastonite, orthodase, idocrase, garnet, zircon, and sphene. Fine specimens of graphite have also been found in several other localities. The graphite of these limestones being very crystalline and lamellar, cannot be sawn like that of Cumberland, and besides, its colour is grayish and its lustre metallic, so that it is not suited to the manufacture of pencils. It may, however, be very well employed for the fabrication of refractory crucibles.

The sulphate of baryta which is now very much employed in the fabrication of paints is common in the Laurentian formation. The gangue of the lead veins already mentioned, often consists of this mineral, and in a portion of that of Landsdowne in which the galena disappears, the vein which has a breadth of about two and a half feet, is filled with pure sulphate of baryta, often in large crystal. Bathurst and Macnab are also localities of this mineral.

The titaniferous iron-ores of this formation merit the attention of mineralogists by their abundance as well as by their associations; although these minerals are not adapted to the production of iron, when they contain a large proportion of titanic acid, they may become important as sources of titanium. The principal deposits of titanic iron in Canada, are at Baie-St.-Paul, where a single mass of 90 feet in breadth and 300 feet in length occurs with many other smaller ones in a rock which is chiefly composed of a triclinic felspar. The ore which is granular has the composition of the ilmenite of the Ural Mountains; it gave to Mr. Hunt titanic acid 48,60, protoxyd of iron 37,06, peroxyde of iron 10,42, magnesia 3,60=99,68; it contains in some parts, a considerable proportion of orange-red transparent grains which are pure titanic acid and belong to the species rutile or brookite. The felspathic rocks of this formation in several other localities, contain titanic iron often in small masses an inch or more in thickness and always marking the lines of stratification. If, in the progress of chemical science, titanium or its compounds should ever become important in the arts, these localities of Lower Canada will afford inexhaustible supplies of titanic iron-ore.

The crystalline limestone near Grenville furnishes a great quantity of mica in large crystals, capable of being divided into very thin plates, having a length and breadth of from twelve to twenty inches, and perfectly homogeneous and transparent. This locality is already wrought, and the mica is largely employed in the construction of stoves and lanterns.

The gneiss and quartz rock of the Laurentian system furnish in many localities excellent building materials, but, as these rocks occur for the most part in regions as yet but little inhabited, and as they are besides, more difficult to work than the silurian limestones, these harder materials are as yet but little explored. The Laurentian limestones furnish a white marble which is often marked with bluish or grayish undulation, as for example that of Arnprior; or it is mixed with grains of green serpentine as the marble which is wrought at Grenville. These limestones are fine-grained, but the dolomite of lake Mazinaw may be compared with the marble of Carrara.

Among the minerals in this formation having an economic value, we must not forget the phosphate of lime so precious for agriculture, which is often met with in these crystalline lime stones. In the township of Burgess, there is a remarkable locality of this mineral in a bed of coarse-grained reddish limestone, containing also large crystals of mica. The phosphate of lime of a pale green colour, often forms long prisms two or three inches in diameter; the angles of these crystals are never very well defined, and the mineral often takes the shape of rounded masses, giving to the limestone that aspect of a conglomerate, and recalling those beds of Silurian limestones which we find filled with coprolites composed of phosphate of lime. The proportion of phosphate of lime in the limestone of Burgess, may be estimated at about one-third of the mass.

As stones capable of being employed for the purposes of ornament, we may cite from this formation the aventurine felspar to which Thompson gave the name of *perthite*, but which is an orthoclase, and the *peristerite* of the same author which is a white translucent albite, remarkable for its beautiful reflections of blue, yellow and green, resembling those of labradorite. A beautiful variety of this latter species, which we have already stated to be abundant in the hyperstenic rocks, is found in several places in erratic blocks, and exists in place, in the seigniory of Mille-Isles. In the township of Burgess a red variety of corumdum resembling the ruby, is found in small quantities, and the red zircons of Grenville are sometimes transparent and of a fine colour, constituting veritable gems.

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III

THE HURONIAN OR CAMBRIAN SYSTEM.

The shores of lakes Huron and Superior offer a series of schists, sandstones, limestones and conglomerates interstratified with heavy beds of greenstone, and resting unconformably upon the Laurentian formation. As these rocks underly those of the silurian system, and have not as yet afforded any fossils, they may probably be referred to the Cambrian system (lower Cambrian of Sedgwick.) The schists of this system upon Lake Superior are bluish in colour, and contain beds of clurty, silex, marked by calcareous bands, and holding anthracite in its fissures.

These are covered by a considerable thickness of trap, upon which repose massive beds of red and white sandstone which sometimes becomes conglomerate and contains pebbles of quartz and jasper. Beds of a reddish argillacous limestone are often interstratified with these sandstones, which are intersected and overlaid by a second eruption of greenstone of great thickness and columnar in its structure. This formation, which, according to the observations of Mr. Logan, has, on lake Superior a total thickness of about 12,000 feet, is traversed by a vast number of trappean dykes.

In the corresponding formation on the north shore of lake Huron, the sandstones are more vitreous and the conglomerates more abundant than on lake Superior; they are, however, associated with conglomerates and schists similar to those we here just described, and the formation offers great intercolated masses of greenstone. A band of limestone, fifty feet in thickness forms a part of this series to which Mr. Logan assigns a thickness of about 10,000 feet. He has shown after the irruption of the interstratified greenstones, that of two systems of trap dykes and a third of granite, intermediate in time between the two eruptions of trap. The formation of the metalliferous veins is still more recent. The principal mineral species of these veins are native copper, quartz, calc-spar, dolomite, fluor, and sulphate of baryta with several zeolites, of which laumonite is the most common, heulandite, stilbite, thompsonite, apophyllite and analcime are also met with, as well as prelnite and datholite. These veins are only metalliferous where they traverse the beds of greenstones.

The most important localities of native copper are the islands near Nepigon Bay, lake Superior. Upon the island of St. Ignace a vein coincident with the stratification, has been traced from one end of the island to the other. This vein affords, whenever it has been explored, native copper often finely crystallized and associated with gray copper ore. Native copper has also been wrought on Michipicoten islands, at Maimanse and at Mica Bay, on the Eastern shore of the lake, where it is associated with gray sulphuret of copper and with copper pyrites. Native silver, often well crystallized, accompanies the copper in all the localities indicated in Michipicoten and St. Ignace islands. At Prince's mine on Spar Island, this metal is found in a vein of quartz and calcareous spar accompanied with sulphuret of silver and copper, blende, galena, malachite and arseniated cobalt. The native silver occurs in the form of little laminæ in the calcareous spar; several essays upon a mass of several hundred pounds weight, have yielded from three to four per cent of silver, containing traces of gold. Upon Michipicoten Island arsenical nickel is found with an arseniuret of copper (domeykite) and a green hydrated silicate of nickel and alumina containing 31 per cent of oxyd of nickel. Nickel is also found at Wallace mine on lake Huron as an arsenical sulphuret associated with pyrites; this ore furnishes 13 per cent of nickel with a little cobalt.

The veins as yet examined on Lake Huron do not contain native copper; copper pyrites are there the predominant ore, but the Bruce mines have furnished considerable quantities of gray sulpliment, and of variegated copper ore in a gaugue of quartz with heavy spar and dolomite. At Wallace's mine, at Root River, and at Echo Lake, there are also large veins where the metal is found in the form of copper pyrites.

This Huronian formation is known for a distance of about 150 leagues upon Lakes Huron and Superior, and everywhere offers metalliferous veins, which have as yet been very little explored. It cannot, however, be doubted, that this region contains metallic deposits, which will one day become sources of great wealth to Canada. The coal formation of the neighboring State of Michigan will then furnish the combustible required for melting the ores.

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IV.

THE PALÆOZOIC FORMATIONS.

Upon the islands of the north of Lake Huron a series of fossiliferous strata is found to repose horizontally upon the inclined strata of the Huronian formation, but, further south, these fossiliferous rocks rest directly upon those of the laurentian system, throughout the whole of their outcrop in the valley of the St. Lawrence. These fossiliferous strata correspond to the oldest fossiliferous rocks of Europe designated by Murchison as the silurian system, but forming the upper cambrian of Sedgwick. To this formation succeeds the upper silurian system of Murchison (Silurian of Sedgwick) and the devonian; these groups, with the exception of a small area of the carboniferous system, occupy the whole of the Canadian portion of that great basin which is bounded to the north by the Laurentian and Huronian systems.

Mr. Logan has shown that the basin thus indicated may be divided into two parts by an anticlinal axis, which, following the valley of the Hudson and of Lake Champlain, enters Canada near Missisquoi Bay, and thence, running North-West, reaches the St. Lawrence near Deschambault, ten leagues west of Quebec. The western portion would then form a subordinate basin containing the Apalachian, Michigan and Illinois coal fields, while the eastern portion would embrace the coal fields of New Brunswick and Massachusetts. The rocks of these two basins present remarkable differences in their chemical and physical conditions. The formations of the western basin are nearly horizontal, and offer a perfect conformity, while in those of the east, there is discordance between the upper and lower silurian, and between the devonian and carboniferous formations. The strata of the eastern basin are moreover very much folded and contorted, and have in some parts undergone profound chemical and mineralogical changes. We shall first give a description of the sedimentary deposits of the western basin.

V

THE WESTERN BASIN.

Reposing upon the Laurentian and Cambrian (*rocks*), and from the base of the palæozoïc series is found a sandstone, which is often purely quartzose, but sometimes (*colored*) by a mixture of oxyd of iron, and becoming slightly calcareous in its western prolongation. The fossils of this formation are few in number, being limited to two species of ***Lingula***, some fucoids, and those impressions which have been named ***Scolithus***. It is worthy of remark that the germ Lingula which characterizes the most ancient formations, still exists in tropical seas, and that the shells of all its species, both recent & fossil, are composed in great part of plurplatic (lime,) having a composition different from other shells and identical with that of the bones of vertebrate animals. The different species of *Orpicula* a germ closely allied to Lingula and the *conularia* offer a simular composition.

This sandstone to which the Geologists of New York have given the name of the *Potsdam Sandstone* often bears the foot prints of an animal which is regarded by Prof. Owen of London as a species of crustacea of which we have perhaps no living analogue. The impression of the feet on each side are very near to each other, but the width of the tracks from 5 to 12 inches, and there is an intermediate groove which appears to have been made by the tail of the animal. Prof. Owen has given to these impressions the name of *protechnites*. They are very abundant at Vaudreuil, St Anne and many other localities. The thickness of this formation of sandstone in the Eastern part of Canada is about 300 feet, but it diminishes towards the west.

Upon the Potsdam Sandstone reposes a formation known as the *calciferous sandstone* having at the East a thickness of 250 feet and it is characterized by peculiar organic remains among which are fucoids and several species of gasteropods. To the calciferous sandstone succeeds a mass of lime stone in which the New York Geologists have recognized four divisions designated by the names of Chazy, Birdseye, Black River and Trenton, each of these is characterized by particular fossils At Montreal this group has a thickness of about 1200 feet, and presents at its base massive greyish beds; towards the upper part the limestones became black and bituminous, and are intercalated with black shales which form the commencement of the succeeding formation. Towards the west, these limestones are less abundant and the divisions not so well marked: upon the Manitoulin Islands, according to Mr. Murray, their total thickness does not exceed 300 feet.

These limestones are often very rich in fossils, which are sometimes silicified; near Ottawa the casts of Orthoceræ and of some other fossils occur in a granular ferruginous dolomite, while the (encasing) limestone contains no carbonate of magnesia. In the Chazy limestone near Hawkesbury as well as in a bed of sandstone at Allumette Island, belonging probably to the summit of calciferous sandstone there, are found rounded masses from one to three-fourths of an inch in diameter, consisting in great part of phosphate of lime, and apparently composed of the exuviæ of animals subsisting on the phosphatic shells just mentioned which are very abundant in these same beds. Fragments of *Lingula* are often visible in the interior of these coprolites, which yield by analyses, from 36 to 45 per cent. of phosphate of lime, with a little fluorid and carbonate, and portions of magnesia and oxyd of iron. The residue is silicious sand, with two or three per cent. of organic matter, which exhales ammonia with an animal odour when the coprolites are tested. The formation which rests upon the Trenton limestone is known by the name of the *Utica Slates;* these slates are black, bituminous and very fragile, containing abundance of graptolites, and having a thickness of from 60 to 100 feet. To the Utica slates succeeds a series of bluish or grayish schists, intercalated with thin beds of sandstone and limestone. This series which is often very fossiliferous belongs to the Hudson River group of the New York Geologists, and attains in Lower Canada a thickness of about 1500 feet; on Lake Huron, however, it is reduced to about 200 feet.

Resting upon this last series we find in the western part of Canada, a red argillaceous sandstone, known as the *Medina sandstone* and regarded as the base of the upper silurian system. At the western extremity of Lake Ontario, this sandstone has a thickness of 600 feet, but it becomes thinner towards the west, and appears to be wanting in the eastern basin. It is followed by a series of limestone and fossiliferous shales of no great thickness, known as the Clinton Group; and overlaid by massive beds of bituminous limestone, known as *Niagara* limestone. This formation presents an elevated plateau at the Falls of Niagara, while following at a little distance the S. W. shore of Lake Ontario, is prolonged to Cabots Head, upon Lake Huron, and thence to the Manitoulin Islands. The upper beds of this formation, often contain cavities filled with crystals of calcareous spar, dolomite, sulphate of baryta, flour, celestine, selenite and anhydrite, sometimes with blende and galena. The combined thickness of the Clinton and Niagara groups on Lake Ontario is about 200 feet, but upon the Manitoulin Islands it rises to nearly 600 feet. To this formation succeeds a formation of shales and limestones known by the names of the *Gypsiferous Group* and the *Onondago Salt Group* which is followed by beds of limestone containing *Delthyris* and *Pentamerus.* These limestones form the summit of the upper silurian system, which attains between the Lakes Erie and Ontario, a total thickness of about 1100 feet.

The base of the *Devonian System*, in the State of New York, is the *Oriskany sandstone* represented in Canada by a white quartzose sandstone of little thickness upon which rests the *corniferous limestone* of the New York Geologists, the two forming together what they have named the upper Helderberg series. To these rocks succeed black bituminous shales known as the *Hamilton Group*. This is the highest formation met with in Western Canada, but in the neighboring States of Michigan and New York, we meet with the upper portion of the Devonian system in the form of massive sandstones intercalated with shales, and divided by the New York Geologists into the *Portage and Chemung Group*, and the *Catskill Mountain Group*. This last is regarded as the equivalent of the old red sandstone of England, and immediately underlies the carboniferous system.

The fossiliferous limestones of Montreal and St. Dominique take a fine polish and are employed as marbles; they exhibit white fossil form upon a gray or bluish gray ground. At Missisquoi Bay, and at Cornwall, is found a fine black marble, which belongs to the Trenton limestone. St. Lin furnishes large slabs of a beautiful reddish gray marble, filled with organic remains, especially with corals which have a bright red colour. This marble belongs to the Chazy division, which at Pakenham, gives a compact chocolate-brown marble susceptible of a very fine polish. The rocks of the Hudson River Group and the Trenton limestone furnish everywhere good material for building and paving The Chazy limestone containes an argillaceous bed which is largely wrought on the Ottawa, and furnishes the hydraulic cement of Hull, which is much esteemed. This bed characterized by the proximity of a layer filled with *Cythere*, has been traced over a large area and furnishes a hydraulic cement at Kingston and Loughboro'. At Quebec a black limestone belonging to the Hudson River group, yields also a very valuable cement. The Thorold cement so widely used, is derived from the base of the Niagara limestone while the gypsiferous formation at Cayuga, at Paris, upon the Grand River, and at Point Douglas on Lake Huron furnishes a cement which hardens very rapidly under water.

The chazy limestone in the vicinity of Marmora, contains beds of a superior lithographic stone in large quantities. The same stone may be traced at intervals as far as Lake Couchiching a distance of about 75 leagues.

The gypsum quarries of the upper Silurian rocks are very important, and are found all along the outcrop of the so called gypsiferous formation. The principal quarries wrought are in the townships of Dumfries, Brantford, Oneida and Cayuga. The gypsum is chiefly employed in the country as a manure or calcined as plaster of Paris. But apart from the domestic consumption, the townships of Oneida and Cayuga furnished last year 7000 tons for exportation to the United States. These gypsums are of recent origin; they occur in the form of mounds, which penetrate the palæozoic strata, and even the overlying clays of recent date. The beds of limestone which surrounds them are upraised, broken, and in great part absorbed. Mr. Sterry Hunt, of the Canadian Geological Commission has shown that these phenomena are due to certain springs containing free sulphuric acid which acting upon the carbonate of lime have changed it into gypsum. (*See Comptes Rendus de l'Académie des Sciences*, 1855, 1*st Semestre p.* 1348.) The Utica slates which are sometimes highly bituminous are worthy of attention as sources of oils and bituminous matters, but as yet no experiments have been made with them from an industrial point of view.

The Hamilton shales are still more bituminous and furnish in many parts of Western Canaada, springs of petroleum, as those upon the Thames and in Enniskillen where there are several superficial layers of asphalt, which appears to have been produced by the transformation of petroleum. The largest deposit of asphalt covers three acres, and there is another of half an acre with a thickness in some parts of two feet. This matter furnishes by distillation among other products a great quantity of naphtha.

VI.

THE EASTERN BASIN.

We have already indicated the existence of an anticlinal axis which divided in two parts the palaeozoic region of Canada. Upon the line of this axis the most recent formation (with the exception of the quaternary deposits) is the lower portion of the Hudson River group, distinguished by the name of the Lorraine or Richelieu shales. In the Yamaska valley an outcrop of the Trenton limestone marks this anticlinal line which separates the two basins. Not far to the east of this limestone, we find reposing upon the Richelieu shales a series of sedimentary rocks which constitute the upper part of the Hudson River group, but which are entirely wanting in the western basin from which they have probably been removed by denudation. This series is composed of massive grayish sandstone, often calcareous, associated with schists, gray, green, and red near the summit, and with other schists black, bituminous and graptolitic. In some parts of this formation the sandstone becomes conglomerate and encloses great fragments of the inferior fossiliferous formations. More frequently however these sandstones pass into a bituminous limestone containing fossils, and mixed with magnesia, oxyd of iron or silicious sand. These limestones are intercalated with silicious and bituminous dolomite which weathers yellow and contains a portion of carbonate of iron; the dolomite appears in some parts to be replaced by a ferruginous and silicious carbonate of magnesia. This series of rocks forms the heights of Point-Lévi and Quebec, where it has a thickness of 1000 feet. To this Quebec formation, succeed red and green schists holding little bands of calcareous matter, and intercalated, especially near the summit, with great masses of quartzose sandstone, often calcareous, and coloured reddish or greenish by a mixture of argillaceous matter. This series of sandstones and schists which may have a total thickness of 300 feet, has been named by Mr. Logan the Sillery group, and appears to be the equivalent of that which the New York Geogolists have designated as the Shawangunk or Oneida conglomerate, which in central New York is interposed between the Richelieu shales and the Medina sandstone. This Sillery group like that of Quebec is wanting in Western Canada, but to the east the two may be traced as far as the southern extremity of the Apallachian coal basin.

The Sillery group offers but very few organic remains; at Rivière Ouelle, however the sandstone has furnished bodies composed of phosphate of lime, and resembling fragments of bones. In the same locality also a bed of conglomerate with a calcareous base contains a great number of what appear to be coprolites; they are composed of phosphate of lime with a little corbonate, some animal matter, and 10 or 12 per cent. of oxyd of iron, and are intermingled with a large quantity of iron pyrites in small radiated globules. This association appears to be due to the reducing action of organic matters upon a neutral proto-sulphate of iron which would furnish at the same time bisulphuret and oxyd of iron. The graptolitic shales of Point-Lévi also contain coprolites.

Upon the Quebec and Sillery groups, which form the northern shore of the peninsula of Gaspé, repose unconformably about 200 feet of fossiliferous limestones and shales which represent the upper silurian system, and to these succeed 7000 feet of devonian sandstones interstratified with red shales. Upon the Southern shore of Gaspé the upturned edges of these devonian strata are overlaid by 3000 feet of horizontal beds of a sandstone, the mill stone grit which forms the base of the New Brunswick coal-field, but they are themselves destitute of coal.

The fossiliferous limestones of Gaspé may be followed to the S. W. as far as Lake Memphramagog upon the line of the United States, and from thence they continue southwards in the valley of the Connecticut until they are concealed by the triassic sandstones of Massachusetts, affording a continuous outcrop of 700 miles. The devonian system, which is purely silicious in Gaspé, presents towards the S. W. some beds of limestone, which are found associated with the upper silurian limestones, in the line of the great valley just indicated.

VII.

THE METAMORPHIC ROCKS.

The rocks of the eastern basin have been disturbed by successive foldings and dislocations, and form a series of parallel montain ranges which belong to the Apallachien system and which, traversing the province of Canada, in a south-west direction, may be traced as far as the State of Alabama, in latitude 34° N. Some of these mountains in Canada attain a height of over 4000 feet. The rocks of this mountainous region have been very much metamorphosed and rendered crystalline by chemical action, so that the fossils are for the greater part obliterated. The rocks thus altered belong to the Hudson River group and to that of Sillery, and they form a belt having an average breadth of about 40 miles, which limits to the north-west the valley occupied by the superior limestones throughout its whole length. The direction of this metamorphic belt does not coincide precisely with that of the undulations of the region, from which it results that the latter, in their northern prolongation, pass out of the limits of the metamorphic region and present the strata with their characteristic fossils. The changes which these sedimentary strata have undergone are often very remarkable, some of the beds have been converted into chloritic, micaceous and talcous schist and others into felspathic, hornblendic and epidotic rocks. With the talcne schists and agillites are intercalated beds of serpentine, which have already been traced for a distance of 150 miles in Canada and are accompanied by limestone, dolomite, magnesite and diallage.

The investigations of the Geological Commission go to show that during the changes which these sedimentary rocks have undergone, there has been no introduction of foreign materials, but that on the contrary all the minerals which are found in these crystalline strata have been produced by the reactions and chemical combinations of the matters already existing in a state of mixture in the sediments. The unaltered argilaceous schists yield by analysis four or five per cent. of alkali which suffices to form the felspar and the micas found in the crystaline schists; the dolomites and the magnesites always contain a large amount of silica and very often a portion of oxyd of chromium which under the form of chromic iron characterises the serpentines of this region. The sedimentary origin of these serpentines is very evident and they are probably the result of an action between silica and carbonate of magnesia in presence of water, and aided by a somewhat elevated temperature. Bischoff has shown that silica even in its insoluble modification decomposes the carbonate of lime, magnesia and iron, in contact with water at 100° centigrade. A similar reaction with highly silicious magnesites would furnish a hydrated silicate which is no other than serpentine, and with the dolomites would result amphiboles and diallages. Magnesites containing less silica would yield talcs and steatites, while dolomites containing too little silica to form amphiboles would give rise to the mixtures of serpentine with carbonate of lime so common in these strata.

Among the unctuous schists possessing a pearly lustre there are many which are not magnesian but owe their physical characters to a micaceous mineral, which in certain cases at least is a hydrous silicate of alumina, idential with the *pholerite* of cuillemin. It is worthy of remark that the principal minerals of these metamorphic rocks are hydrated, as for example, the serpentine, talc, chlorite and pholerite; the diallage is also hydrated. Among the anhydronus specise which these rocks contain, we may mention pyroxene, orthoclase, epidote, and more rarely garnet, sphene and tourmaline.

As we approach the north-western limit of the metamorphic region, it is easy to observe the gradual transition by which the schists lose their chloritic and nacreous aspect, and assume their original sedimentary character. Beyond the limits of the metamorphism, but in a region where the rocks are still much disturbed, there are found fissures filled with a black, bituminous and very fragile material, which sometimes forms botryordal masses. This matter loses by a strong heat 20 per cent. of volatile by hydrocarbons and leaves a pulverulent charcoal which burns with difficulty being only a few thousanthes of ash. This substance which is very common in the formations of Sillery and Quebec appears to have been derived from the bitumen of the palaeozoic rocks, which volatilized by heat has been condensed in fissures, where it has subsequently undergone such changes as have caused it to lose its volatility, and converted it into a coal-like material.

In the County of Gaspé, the limestone of the upper silurian sytem, which have suffered no mineralogical changes, rest upon the metamorphosed strata of lower silurian, and frequently enclose fragments of these latter, but towards the south-west, the fossils of these limestones show proofs of a commencement of such metamorphism, and in the valleys of the river St. Francis and of Lake Memphramagog, the limestone become crystalline and micaceous, although the fossils of the upper silurian and devonian epochs may be still recognized upon weathered surfaces and in thin sections of the limestones. Towards the south-east these crystalline limestones are overlaid by micaceous schists more or less calcareous, associated with chiastolite slates, quartzites and hornblendic rocks containing garnets, the whole being altered palaeozoic strata, and penetrated by granites of the devonian epoch. The facts which we have cited shew that the metamorphic action in this region, as well as the force which produced the undulations of the strata was prolonged up to the end of the palaeozoic epoch.

The crystalline strata just described contain many metallic veins which traverse both the upper and lower silurian rocks, and these veins, together with the mineral contents of the metamorphic strata themselves make this region very interesting in an economic point of view. A series of highly ferruginous slates of the Hudson River group, yield in the townships of Bolton and Brome beds of iron ore, in which the metal in the form of magnetic oxyd or peroxyd is disseminated in crystals or more often in grains and scales in a chloritic schist associated with dolomite. These beds have a thickness of from six to fifteen feet and yield from 20 to 50 per cent. of metallic iron. They often contain titanic acid, but generally in small quantity. The titanium also appears in the form of crystals of sphene in a vein traversing one of the beds of magnetic iron ore, and in another locality as crystallized rutile upon specular iron; chemical analysis shews the presence of titanium in the unaltered ferruginous slates of the altered region. These deposits of iron ore are very abundant, but from the mixture of chlorite and the presence of titanium, they cannot be compared with the deposits of the same species in the Laurentian rocks. The same ores are met with in many other localities in this formation A remarkable locality of magnetic and titaniferous iron occurs in Vaudreuil and Beauce, where the two species intimately mixed, form a bed fifty feet thick in serpentine. The ore is granular and after having been pulverized may be separated by the magnet into two portions; the magnetic portion which forms about two-thirds of the mass is pure magnetic oxyd of iron, while the residue is ilmenite containing 48.6 per cent of titanic acid. The serpentines of this region contain in many places disseminated grains of chromic iron ore, of which a bed of twelve inches occurs in Bolton, and one of fourteen inches in Ham. These ores contain from 46 to 50 per cent. of oxyd of chromium. Chromic iron also occurs disseminated in the dolomites and magnesites.

The copper ores of this metamorphic region are found in veins which are generally concordant with the stratification, and are associated with the dolomites of the Quebec formation. In Upton there is a vein twelve inches wide, of argentiferous copper pyrites, in a gangue of quartz, and another similar vein near Sherbrooke contains, besides silver, traces of gold. In Leeds and Inverness are found considerable veins of sulphuret of copper, variegated copper ore, with a gangue of quartz and dolomite. In Leeds a bed of ferruginous dolomite contains sulphuret of copper and specular iron with a little native gold. Small quantities of copper ore are met with in various other localities; they are often disseminated in beds of dolomite, with blende and galena.

The seigniories of Vaudreuil and St. George, in the Valley of the Chaudière, present veins of quartz which traverse slates belonging to the base of the upper silurian limestone, and contain native gold in small quantities, with galena, blende, arsenical sulphuret of iron, cubic and magnetic pyrites. The blende and pyrites are both auriferous, and the galena from a recently opened vein contains one-thousandth of silver. The *debris* of these slates and of those of the Quebec formation, have furnished the auriferous sands which cover a large area on the south-east slopes of the metamorphic belt. The gold, the existence of which Mr. Logan has shewn in the alluvium over a surface of about 10,000 square miles, is associated with magnetic, chromic and titanic iron ores, rutile, zircon, and small quantities of native platinum and iridosmium. The gold, which sometimes occurs in masses weighing several ounces, but more often in the form of small scales and grains, contains from eleven to thirteen per cent. of silver. It is not easy to say what proportion of gold is contained in these sands, but experiments on a large scale have shewn that the exploration cannot be pursued with profit with the present price of labour. Cobalt and nickel have been found in traces only in these rocks. An arseniated oxyd of nickel is found in small quantity at Bolton, and the oxyds of the two metals are associated with the chromic iron of Ham.

Among the economic materials of this region, the roofing slates must not be forgotten. It is now only six years since the geological commission first signalized their existence, and already large quarries are wrought, which furnish in abundance slates of superior quality. The quarries of Melbourne, Richmond and Kingsey, belong to the Hudson River group, but those of Westbury and Rivière du Loup, are near the base of the upper silurian. These slates have a cleavage independently of the stratification, and have shining surfaces. Silicious slates which serve as whetstones, are common in many localities in both of these formations.

Steatite, which generally accompanies the serpentines of Lower Canada, is abundant in Bolton, Potton, Vaudreuil, Beauce, and many other localities. The former beds, intercolated for the most part with argillaceous or hornblendic schists, may be obtained in large masses. A compact chlorite or potstone is also very abundant in many parts of the same formation, and may readily be sawn into large blocks. The serpentines throughout their whole extent, furnish very beautiful dark green marble, often resembling the *vert-antique*; green serpentines of various shades are mingled with white and grayish limestones, giving rise to many varieties of these marbles, the finest of which are from Broughton and Oxford. Near Philipsburg the Trenton limestones afford a fine white marble; in their southern prolongation, these limestones become more crystalline, and form the white marbles of Vermont, which are now celebrated. The upper silurian limestone of Dudswell are grayish and yellowish, with veins and spots of black; they still exhibit on their polished surfaces, the traces of fossils, and often form marbles of great beauty.

The dolomites and magnesian carbonates of this region furnish in abundance the materials for the fabrication of the salts of magnesia. A deposit of magnesite in Bolton has a breadth of more than 300 feet; the rock is crystalline and colored green by oxyds of chrome and nickel: another bed of it has been found at Sutton. The analysis of the two has given as follows:

	Sutton.	Bolton.	
Carbonate of magnesia	83.35	60 13	— magnesia.......28.62
Carbonate of iron	9.02	8.32	— oxyd of iron.... 5.13
Silica, insoluble	8.03	32.20	
	100,40	100,65	

The insoluble part of these magnesites is chiefly silicious sand. It is worthy of remark that the Bolton rock contains silica and magnesia in the proportions required to form a serpentine.

The granites already alluded to, which traverse the devonian system, are very fine grained, of a grayish color, and splitting with facility, yield a superior building material; that of Stanstead is the best known. Vaudreuil furnishes a bluish-gray variety which is used by the country people for the fabrication of mill-stones.

To the east of the great anticlinal axis which divides in two partst he palaeozoic formations of Canada, are the mountains of Brome, Shefford, and Yamaska; these are great masses of an intrusive rock, which is a coarse-grained diorite, often having the aspect of a granite, and containing generally a white felspar with augite and a little mica. The mountains of Monnoir, Beloeil, Montarville, Montreal and Rigaud, to the west of the same axis, are also formed of intrusive rocks; Beloeil, which is the most elevated, has a height of about 1,300 feet. These hills are composed of diorites having much resemblance to that of Brome and Yamaska; these diorites are characterized by the presence of small amber-yellow crystals of sphene.

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VIII.

THE QUATERNARY OR ALLUVIAL DEPOSITS.

We have already indicated the existence in Canada of the palaeozoic rocks and the base of the carboniferous system, but with the exception of the post-tertiary deposits, the more recent formations are entirely wanting. The surface of Canada is formed of clays interstratified with sands and clays, and in many parts overlaid by diluvium. These stratified deposits contain the remains of a great many species of marine animals, identical with those now inhabiting the gulf of the St. Lawrence. The concretions found in a bed of clay near Ottawa contain in great abundance the remains of the capeling (*mallotus villosus*) associated sometimes with the *Cyclostomas lumpus*, and great numbers of the leaves of exogenous trees. The skeletons of a cetacea and of a species of *Phoca* have been found in the clays of Montreal, where beds filled with shells exist at a height of 500 feet above the present sea-level. Similar stratified clays, but without fossils, have even been remarked at an elevation of 1,200 feet. The detached bones of the *Elephas primigenius* and of a species of deer have been found in a stratified gravel on the shores of Lake Ontario. In the Valley of the St. Lawrence several terraces may be distinguished, marking the different limits of the sea during the deposition of these post-tertiary strata.

The clays of this series form the superficial soil of a great portion of the country; they are often calcareous and constitute a soil remarkably fertile. The alluvium which is spread over but limited areas, has been transported from the north; in the eastern part of the St. Lawrence Valley it consists almost exclusively of the ruins of rocks of the Laurentian system, but in the south-west of Canada the *debris* of the palæozoic formations are mingled with those of the crystalline rocks.

The soil of the south-east of Canada is composed of the ruins of the metamorphic palaeozoic strata which form that mountain chain, already described as a prolongation of the Alleghanies. In the Laurentide mountains the soils are very fertile near the limestones and the lime felspars, and we find that the settlements have followed the outcrops of these rocks, while the gneissoid and quartz ore districts are still uncultivated. Among the economic materials of the superficial deposits are clays for the fabrication of bricks and coarse pottery which are wrought in a great number of places. In the vicinity of London, of Toronto and of Cobourg there are clays which yield white and yellow bricks that are much esteemed. Moulding sands and tripolis are also abundant in different localities. Deposits of shell marl, very valuable as manure, occur often in beds of large extent; among other localities we may cite Sheffield and Olden, near Kingston, the vicinity of Ottawa, Stanstead and New Carlisle.

The hydrated peroxyd of iron limonite, is widely spread in Canada, and forms superficial deposits often of large extent. The forges of St. Maurice, near Trois Rivières, have been supplied for nearly a century with the limonite of that neighborhood, and a furnace for the smelting of the same ore has lately been established at Champlain in the same vicinity. It is worthy of remark that although the St. Maurice ore contains a considerable proportion of phosphate, it furnishes castings and malleable iron of an excellent quality. In the County of Norfolk, on the shores of Lake Erie, there are beds of limonite which have been wrought for a long time, and there are also extensive beds of this ore in Vaudreuil, near Montreal, and at Saint Vallier.

These deposits of limonite on the north side of the St. Lawrence, are often associated with iron ochres; the most remarkable localities of which are at Pointe-du-lac and St. Anne de Montmorenci. The ochres of Pointe-du-lac are wrought, and yield by different processes a variety of valuable pigments. The phosphate of iron, vivianite, in a pulverulent form is found in abundance with the limonite of Vaudreuil.

Considerable areas in the eastern part of Canada are covered with marshes which furnish abundance of peat, but this combustible is as yet almost unknown in the country. There are a great many of these marshes upon the north side of the St. Lawrence from Mille Isles, in the District of Montreal, as far as Champlain, a distance of about 120 miles; and upon the opposite shore they are found from the County of Beauharnois to the Rivière du Loup, over a length of about 300 miles. The *savanne* of St. Hyacinthe covers an area of about two leagues, and there are others still larger. The peat is often twelve and fifteen feet in thickness, and of excellent quality; that of Longueuil, in the vicinity of Montreal, has been wrought for a year past, and furnishes a fuel which will before long become very important for a country where coal is wanting and where wood is already becoming dear.

IX.

THE MINERAL WATERS.

The mineral waters of Canada without exception issue from the unaltered palaeozoic rocks, and offer from their number and their various composition a very interesting subject of investigation. The annual reports of the geological commission give the analysis, by Mr. Sterry Hunt, of fifty-nine springs, of which fifty-four are more or less saline, and may be divided into two classes: the neutral waters which contain besides salts of soda, chlorides of calcium and magnesia, and the alkaline waters holding carbonate of soda. Both of these classes contain with but few exceptions, bromides and iodides in small quantities, as well as bicarbonate of lime and magnesia, often in great abundance. In those springs which do not contain sulphates, salts of baryta and strontia are constantly met with, and small traces of oxyds of iron and manganese are never wanting. In some of the neutral salines the quantities of chlorides of magnesia and calcium are so considerable that the waters are very bitter, but others, which contain less of these salts are very agreable to the taste, and much frequented by invalids. In the report of the geological commission for 1853, there is a list of twenty springs of this class, containing, from four to thirty-six parts of solid matter in one thousand parts of water. Among these springs the best known are Saint-Lèon, Caxton, Plantagenet, Lanoraie, and Point-du-Jour, but others equally good are found at Nicolet, St. Geneviève and elsewhere. The quantities of bromides and iodides, and the salts of baryta and strontia contained in several of these springs give them valuable medicinal properties.

In the report already cited there is also a list of eighteen alkaline springs, of which twelve furnish from two to twelve parts of solid matter to the thousand of water. Among these twelve there are nine which contain salts of baryta and strontia, these two bases being almost always associated. In the more saline of these, the quantity of carbonate of soda is relatively small, being equal to from one to twelve hundredths of the total weight of soda salts, while in the weaker waters it rises to fifty and even eighty-hundredths. The greater number of these waters contain small quantities of borate of soda, which is included with the carbonate in the numbers which we have just given. The best known of these springs are those of Varennes and Caledonia, which are feebly alkaline and pleasant to the taste. A spring at Chambly contains two thousandths of solid matter, of which one half is carbonate of soda, and another at Nicolet contains in a litre 1·135 grammes of alkaline carbonate, and only 0·423 grammes of chlorids. The proportion of potash in these mixed salts rarely rises above two or three-hundredths, but the alkalies of a spring at St. Ours, determined in the state of chlorides, give twenty-five hundredths of chloride of potassium. The water of this spring contains 0·53 grammes of solid matter in a litre, principally alkaline carbonates. All the waters of this class hold in solution silica, often in considerable quantity, and deposit by boiling, silicates of lime and magnesia, mixed with carbonates of these bases. Silica in a soluble form is always found even in the neutral saline waters.

With some few exceptions, the springs of these two classes rise from strata belonging to the lower silurian system, the waters of the limestones which form its base are generally neutral, while the springs which flow from the schists which cover these limestones are often alkaline.

Among the springs of the upper silurian rocks there are some neutral salines, and those of the acid waters, of which we have spoken in noticing the gypsums of Upper Canada. The analyses of four of these springs have furnished from 2·00 to 4·30 grammes of free sulphuric acid, and from 0·60 to 1·87 grammes of sulphate of iron, alumina, lime, magnesia, and alkalies to the litre. Of these acid waters that of Tuscarora is the best known and has a great reputation among the country people of the vicinity in the treatment of various diseases; all these acid springs contain a little sulphuretted hydrogen. Many of the springs of the silurian rocks are more or less sulphurous, but that of Charlotteville, which is upon the outcrop of the devonian strata contains in addition to a considerable amount of chlorides and sulphates, the large proportion of 32 cubic inches of sulphuretted hydrogen to the gallon.

The acid springs of which we have just spoken, as well as a great number of salines, evolve carburetted hydrogen gas, and often in considerable quantities. None of the springs of Canada as far as yet observed appear to merit the appellation of thermal.

X.

THE GREAT NORTHERN BASIN.

This great basin, of which the Laurentides form the southern limit is very little known. Among the Laurentian rocks at lakes Nipissing, Saint Jean, and des Allumettes, small areas of lower silurian rocks are met with, which are to be regarded as detached portions of the southern basin. The last of these localities occurs on the Ottawa at the mouth of the Mattawa, and sixty miles further north, after having passed the great Laurentian axis, we reach the valley of lake Temiscaming, which belongs to the northern basin. Here Mr. Logan found a series of chloritic schists, sometimes conglomerate in character, nearly horizontal in their attitude, and having a thickness of about a thousand feet. To these schists succeed 500 feet of massive greenish white sandstones, overlaid by a calcareous formation 300 feet thick, and composed of strong beds of yellowish and grayish limestones intercolated with calcareous shales. The whole filled with the characteristic fossils of the upper silurian period.

The chloritic schists probably correspond to the Huronian rocks, but it is difficult to fix the age of the sandstones which are destitute of fossils. In all the collections brought from this northern region, there have as yet been found no fossils more ancient than those of lake Temiscaming; the numerous fossils found in the diluvium on the shores of lake Superior, also help to show that the lower silurian system is entirely wanting in the vast basin to the north of the Laurentides; from which fact Mr. Logan concludes, that these mountains from the coast of Labrador to the Arctic Ocean formed the limits of an ancient silurian sea.

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CATALOGUE

OF THE

ECONOMIC MINERALS OF CANADA.

METALS AND THEIR ORES.

Magnetic Iron Ore.—Marmora, four localities; Madoc, four localities; South Sherbrooke, Bedford, Hull, three localities; Portage du Fort.

Specular Iron Ore.—Wallace Mine (Lake Huron,) MacNab, St. Arnaud, Sutton, three localities; Brome, three localities; Bolton.

Limonite (*Bog Ore.*)—Middletown, Charlotteville, Walsingham, Gwillimbury West, Fitzroy, Eardley, March, Hull, Templeton, Vaudreuil, St. Maurice, Champlain, Batiscan, Ste. Anne, Portneuf, Nicolet, Stanbridge, Simpson, Ireland, Lauzon, St. Vallier.

Titaniferous Iron.—St. Urbain (Baie St. Paul,) Vaudreuil (Beauce.)

Sulphuret of Zinc (*Blende.*)—Prince's Mine and Mamainse (Lake Superior.)

Sulphuret of Lead (*Galena.*)—Fitzroy, Lansdowne, Ramsay, Bedford, Bastard, la Petite Nation, Ause des Sauvages, and Ause du Petit Gaspè, Maimanse.

Copper.—St. Ignace and Michipicoten Islands (Lake Superior,) St. Henri, *native copper.* Prince's Mine (Lake Superior,) *sulphuret of copper.* Mica Bay and Maimanse (Lake Superior) *sulphuret variegated copper and copper pyrites.* Bruce's Mine (Lake Huron,) Root River, Echo Lake and Wallace Mine (Lake Huron,) *copper pyrites.* Inverness and Leeds, *variegated copper.* Upton, *argentiferous copper pyrites.* Ascot, *copper pyrites containing gold and silver.*

Nickel.—Michipicoten (Lake Superior,) *arsenial nickel, with a hydrated silenite of nickel.* Wallace Mine (Lake Huron,) *sulpharseniuret of nickel.* Daillebout Berthier, *nickeliferous pyrites.* Ham and Bolton, in small quantities, associated with chromic iron; the nickel in most of these different localities is associated with a little cobalt.

Silver.—St. Ignace and Michipicoten Islands (Lake Superior,) *native silver with native copper.* Prince's Mine (Lake Superior,) *native silver with sulphuret of silver.*

Gold.—Seigniory of Vaudreuil, Beauce, on the Rivers Guillaume, Lessard, Bras, Touffe des Pins, and du Lac. Seigniory of Aubert de Lisle. Rivers Famine and du Loup. Aubert-Gallion, Poser's Stream, and the River Metgermet. All these localities in the County of Beauce afford native gold in the alluvial sands. This auriferous region has an area of 10,000 square miles, and the precious metal has been found at Melbourne, Dudswell, Sherbrooke, and many other localities in the valleys of the St. Francis and the Chaudière. Native gold is also found in small quantities in Leeds, in a vein with specular iron, and at Vaudreuil, Beauce, with blende and pyrites. These sulphurets are both auriferous, and the copper pyrites of Ascot also contain a small proportion of gold. The native silver of Prince's Mine likewise contains traces of gold.

NON-METALLIC MINERALS.

Uranium.—The yellow oxyd of uranium is found in small quantities with the magnetic iron of Madoc.

Chromium.—Bolton and Ham are localities of chromic iron.

Cobalt.—At Prince's Mine, Lake Superior, *arseniate of cobalt* and associated with nickel in the localities mentioned above.

Manganese.—Bolton, Stanstead, Tring, Aubert-Gallion, Ste. Marie, Beauce, Ste. Anne, *earthy peroxyd.*

Iron pyrites.—Clarendon, Terrebonne, Lanoraie, Garthsby.

Graphite.—Grenville, Fitzroy.

Dolomite.—Lake Mazinaw, North Sherbrooke, Drummond, St. Armand, Dunham, Sutton, Brome, Ely, Durham Melbourne, Kingsey, Shipton, Chester, Halifax, Inverness, Leeds, St. Giles, Ste. Marie, Saint Joseph.

Carbonate of Magnesia.—Sutton, Bolton.

Sulphate of Baryta.—Bathurst, Macnab, Lansdowne, and many localities on Lake Superior.

Iron Ochres.—St. Nicholas, Ste. Anne de Montmorency, Champlain, Waltham, Mansfield, Durham.

Steatite.—Sutton, Bolton, Melbourne, Ireland, Potton, Vaudreuil, Beauce, Broughton, Elzevir, the steatite of the last four localities is employed as a refractory stone, and that of Stanstead and of Leeds is ground and employed as a paint.

Lithographic Stone.—Marmora, Rama, lake Couchiching.

Agates.—Isle St. Ignace, Michipicoten, and Thunder Bay (lake Superior) Gaspé.

Jasper.—Great Rivière Ouelle, Gaspé.

Labrador felspar.—Mille Isles, Drummond and many other localities.

Aventurine.—Burgess.

Hyacinthe.—Grenville.

Corumdum.—Burgess.

Amethyst.—Spar Island, and many other localities on Lake Superior.

Jet.—Montreal.

Quartzose Sandstone.—For the manufacture of glass, Cayuga, Dunn, Vaudreuil, Isle Perrot, Beauharnois, and many localities on the north shore of Lake Huron.—The sandstone of St. Maurice is employed as a fire-stone for iron furnaces.

Retinite and Basalt.—For the fabrication of black glass: many localities on Lake Huron and Superior.

Gypsum.—Dumfries, Brantford, Oneida, Seneca, Cayuga, &c., the localities are very numerous.

Shell Marl.—Calumet, Clarendon, North-Gwillimsbury, Bromley, MacNab, Nepean, Gloucester, Argenteuil, Hawkesbury, Vaudreuil, St. Benoit, Ste. Thérèse, St. Armand, Stanstead, St. Hyacinthe, Montréal, New Carlisle, (Gaspé.)

Phosphate of lime.—Burgess, Hull, Calumet, Ottawa.

Millstones.—Several kinds of stone, more or less adapted to the purpose, are employed in Canada for the fabrication of millstones. The best is a corneous quartzite which accompanies the serpentine of the Eastern Townships, and has been wrought at Bolton.

A silicous conglomerate which serves to make millstones is found at Vaudreuil, at the Cascades, Ham and Port Daniel. We may mention also for this purpose the granites of Stanstead, Barnston, Barford, Hereford, Ditton, Marston, Strafford, Weedon and Vaudreuil, Beauce, the granite millstones of Vaudreuil are much esteemed. The pseudo-granites and diorites of the mountains of Ste. Thérèse, Rouville, Rougemont, Shefford, Yamaska and Brome, are also sometimes employed to make millstones.

Grindstones.—A sandstone, known as the gray-brand, and found at the base of the upper silurian of Western Canada in many localities is employed for the fabrication of grindstones. The Potsdam sandstone and a sandstone from Gaspé basin are also employed for the same purpose.

Whetstones.—Madoc, Marmora, lake Mazinaw, Fitzroy, Potton, Stanstead, Hatley, Bolton, Shipton, Marston.

Tripoli.—Laval, Lanoraie.

BUILDING MATERIALS.

Granites.—Large masses of a very beautiful intrusive granite are found in many of the townships of the East. Among other localities we may cite Stanstead, Barnston, Hereford, Marston, Megantic mountains, Weedon, Winslow, Stafford, and Lambton. The diorites of the mountains of Ste. Thérèse, Rouville, Rougemont, Yamaska, Shefford, and Brome, furnish also good building stones.

Sandstone.—A beautiful variety of yellowish-white sandstone occurs at Niagara, Queenstown, Barton, Hamilton, Flamboro' West, Nelson, Nassagaweya, Esquesing, Nottawasaga, and Cayuga. Other localities are Rigaud, Vaudreuil, Ile Perrot, St.-Eustache, Terrebonne, Beauharnois, St. Maurice, Lac des Allumettes, and Fitzroy.

Calcareous Sandstone.—Brockville, Ottawa, and a great many places on the Ottawa river, St. Nicolas (Lauzon), Cape Rouge Malbaie.

Limestones.—Malden, Manitoulin and St Joseph's islands, Cape Hurd, Cabot's Head, Sydenham, Euphrasia, Nottawasaga, Mono, Esquesing, Nelson, Ancaster, Thorold, Matchedash Bay, Orillia, Rama, Mara, Marmora, Madoc, Belleville, Kingston, Macnab, Ottawa, Plantagenet, Hawkesbury, Cornwall, Isle Bizard, Isle de Beauharnois, Caughnawaga, Montreal, Isle Jésus, Terrebonne, Philipsburg, St. Dominique, Grondines, Deschambault, Beauport, Baie St. Paul, Malbaie. Upton, Acton, Wickham, Magoon's Point, Stanstead, Hatley, Dudswell, Temiscouata Gaspé, Port Daniel, Richmond, Anticosti.

Hydraulic Limestones.—Point Douglas, (Lake Huron,) Paris, Cayuga, Thorold, Kingston, Loughboro', Hull, Quebec.

Roofing Slates.—Kingsey, Halifax, Lambton, Melbourne, Westbury, Rivière du Loup.

Flagging Stones.—Toronto, Etobicoke, River Credit, York, Temiscaming, Bagot, Horton, Clarendon, Sutton, Potton, Stanstead, Inverness, Port Daniel.

Clays.—Clays suitable for the fabrication of red bricks, tiles and coarse pottery, are everywhere found through the valleys of the St. Lawrence, Richelieu and Ottawa. Clays, for the manufacture of white bricks are met with at London, Toronto, Cobourg, and Peterborough.

Moulding Sand.—Augusta near Prescott, Montreal, Acadie, Stanstead.

Fullers' Earth.—Nassagaweya.

Marbles.—White.—Lake Mazinaw and Philipsburg.

Black.—Cornwall, Philipsburg.

Red.—St. Lin.

Brown.—Pakenham.

Yellow & Black.—Several varieties at Dudswell.

Grey & variegated.—Macnab, Philipsburg, St. Dominique, Montreal.

Green.—Serpentines affording several beautiful varieties of marble occur at Grenville, and along a range of 150 miles in the Eastern Townships. Among other localities we may mention Stukely, Brompton, Oxford and Vaudreuil—Beauce.

COMBUSTIBLES, ETC.

Peat.—Humberstone, Wainsfleet, Westmeath, Beckwith, Goulbourn, Gloucester, Cumberland, Clarence, Plantagenet, Alfred, Caledonia, L'Orinal, Osnabruck, Finch, Winchester, Roxburg, Longueuil, St. Hyacinthe, Monnoir, the Seigniory of Rivière du Loup, Rivière Ouelle, Macnider.

Petroleum.—Mosa and many localities on the Thames, River St. Jean and Ruisseau-Argenté, (Gaspé.)

Asphaltum.—Enniskillen.

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