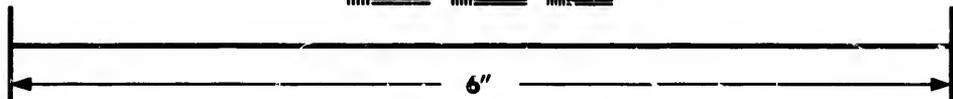
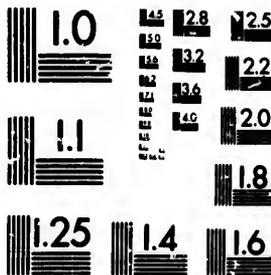


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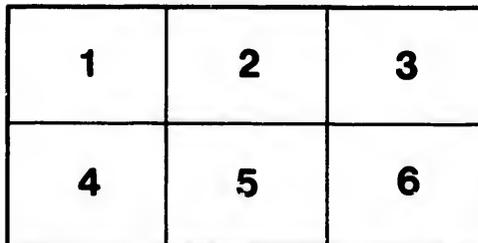
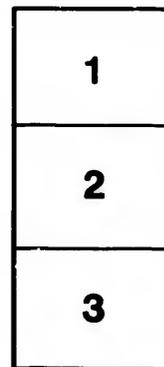
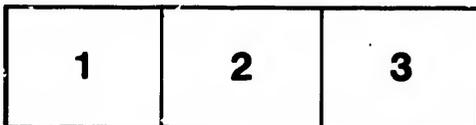
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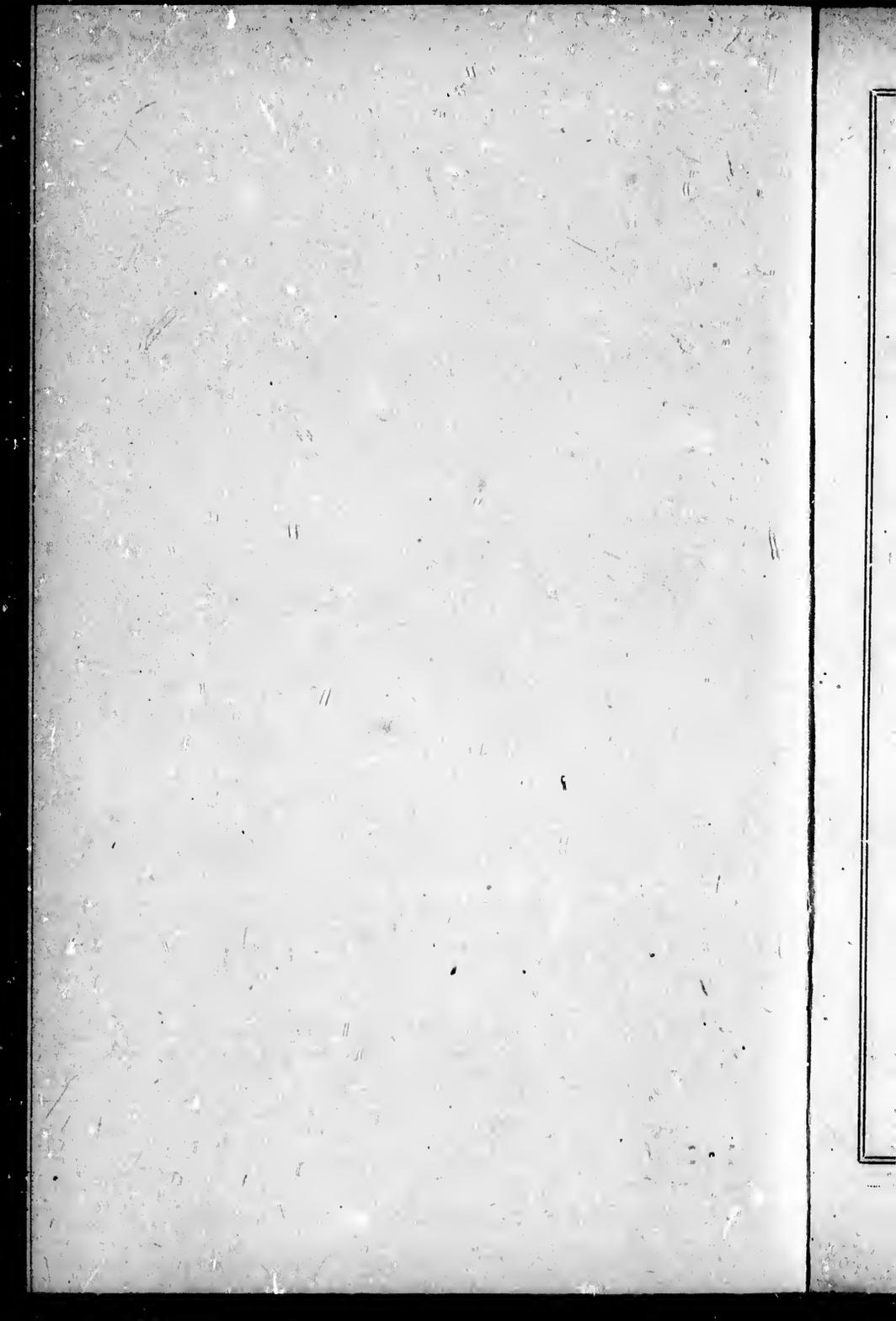
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**MINERAL RESOURCES**

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MONTREAL.

OF

**BRITISH NORTH AMERICA.**

BY

**CHARLES ROBB,**

MINING ENGINEER, MONTREAL.

EXTRACTED FROM

**"EIGHTY YEARS' PROGRESS IN BRITISH NORTH AMERICA."**

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1863.

# MINERAL RESOURCES

OF

## BRITISH NORTH AMERICA.

A SKETCH OF THE NATURE, EXTENT AND VALUE OF THE METALS AND OTHER  
USEFUL MINERALS FOUND IN CANADA, NOVA SCOTIA, NEW BRUNSWICK,  
AND BRITISH COLUMBIA, WITH AN ACCOUNT OF THE PROGRESS  
OF MINING INDUSTRY IN THESE PROVINCES.

BY CHARLES ROBB, MINING ENGINEER, MONTREAL.

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### INTRODUCTORY REMARKS.

CANADA is emphatically an agricultural country, and is pre-eminently favored by nature in the excellence of its soil, and the adaptation of its climate to the growth of wheat and the other cereals, which must long continue as heretofore to constitute its staple productions. Its natural resources, however, are by no means limited to the vegetable kingdom; and although, in the earlier stages of its history, the products of its fields and forests naturally occupy the greatest attention, and have received the fullest development, the extent and importance of the mineral treasures with which it abounds are now beginning to be duly recognized.

With the exception of coal, and a few of the less important metals, Canada has been found to produce almost all the known useful minerals; while, with regard to most of them, it may be safely asserted that she contains within herself a supply not only amply sufficient for her domestic consumption, but for permanent, profitable and extensive foreign commerce. These boundless sources of wealth have as yet been rendered available only to a very limited extent, owing partly to the fact of their existence having been so

recently brought to light, and partly to the want of the capital and skill requisite to develop them. As the resources of Canada are now rapidly becoming known to the rest of the world, and as it is gradually learning greater self-reliance, it may be reasonably expected that its mineral productions are destined to assume their due rank in contributing to the national wealth and prosperity. In relation to this department of the contribution made by Canada to the Great Exhibition of 1851 at London, the following judgment was pronounced by the jury: "Of all the British colonies, Canada is that whose exhibition is the most interesting and complete, and one may even say that it is superior, as far as the mineral kingdom is concerned, to all countries that have forwarded their productions to the Exhibition." This judgment will doubtless be more than confirmed by the results of the Great International Exhibition of 1862, to which Canada has contributed a collection of minerals far in advance of that of 1851.

We have stated that coal does not occur in Canada, and we fear it must be regarded as a fully established fact, at least in regard to those parts of the country which have as yet been settled and explored. The rocks are throughout of a lower geological horizon than the carboniferous; and although bituminous schists and shales abound, and thin veins of a substance closely resembling coal occur in certain parts of the country, these can not be regarded as of much economic importance. Canada is, however, very favorably situated in its proximity, at all points, to the carboniferous regions of the United States and Nova Scotia, and in the facility of conveyance afforded by its vast lakes, rivers and canals; and moreover, it contains within itself such ample supplies of wood, peat and mineral oil as will go far to compensate for the want of coal.

Many useful minerals yielded in abundance by Canada, and which require peculiar chemical treatment to render

them available in the arts, such as chromic iron, phosphate of lime, petroleum, &c., are rendered comparatively valueless from the fact, that in present circumstances, the crude material has to be transported at great expense to distant manufacturing centres. Such materials are peculiarly deserving of the attention of enterprising capitalists, as their manufacture in the province would be attended with the double advantage of rendering them available as a source of national wealth as well as individual profit, and of giving employment to an industrious and intelligent class of population.

The knowledge we possess of the mineral wealth of Canada, imperfect as it necessarily is, from the vast extent of unexplored and partially explored territory, as well as from the recent date at which public attention began to be directed to the subject, is nevertheless sufficiently accurate to admit of a certain classification and arrangement, and the geographical distribution of the various useful minerals has been ascertained with considerable accuracy. For much or nearly all of this knowledge we are indebted to Sir William Logan, the Provincial Geologist, and his coadjutors, who have devoted themselves assiduously, (under the liberal patronage of the Provincial Government,) during nearly twenty years to the investigation of the Geology of Canada; and whose labors have not only conferred incalculable benefit on the country, but procured for themselves a world-wide reputation. In order to illustrate our remarks upon the mineral productions of Canada, we shall give a slight sketch of the geological structure of the country as ascertained by the provincial geologists.

GEOLOGICAL STRUCTURE OF CANADA IN RELATION TO ITS USEFUL MINERALS.

The oldest geological formation in Canada, styled by Sir William Logan the Laurentian system, occupies all the

northern and portions of the central divisions of the province, extending over an area of about 150,000 square miles, and composed of various hard rocks, such as gneiss and white crystalline limestone; the total thickness of this formation in Canada is probably not less than 20,000 feet. These rocks consist of highly altered strata, in which no positive and unequivocal traces of organic life have been as yet detected; and which have been bent, twisted and tilted up at all angles, and in some places invaded by masses of intrusive rock. Among the useful minerals peculiarly characteristic of this formation, the ores of iron are the most important, being found in interstratified layers or beds in quantities which may be regarded as inexhaustible and of exceedingly rich quality. Veins of lead and copper also, cutting the stratification, occur in the formation, especially at or near its junction with the next succeeding system of rocks; plumbago and mica abound, and phosphate of lime and sulphate of barytes are of frequent occurrence. The Laurentian limestones furnish marbles of very excellent quality, together with a great variety of materials applicable to ornamental purposes.

The Huronian system, the next in ascending order, is wanting in the eastern and central parts of Canada, but attains a great development on the northern shores of Lake Huron and parts of Lake Superior; occupying a linear extent of about 400 miles, and consisting of slates, altered sandstones, limestones and conglomerates, associated with heavy masses and dykes of trap; the total thickness is estimated at about 18,000 feet. This system constitutes what has been called the lower copper-bearing rocks of the lake region; the ore occurring sometimes disseminated among the slates, but more frequently in quartz veins intersecting them. These deposits of copper ore have formed, for many years back, the object of mining operations; and there can be no doubt that this region contains metallic treasures

which will one day become the source of great wealth to Canada. In addition to copper, silver and nickel occur in this formation in quantities which promise to be of economic importance. Agates, jasper and other varieties of precious stones are of frequent occurrence, and the jasper conglomerate, which abounds in this region, affords a beautiful material, which will be found applicable to many purposes of decorative construction.

The upper copper-bearing rocks, including the well-known rich deposits on the south shore of Lake Superior, have recently been discovered to have their equivalents in what has been denominated the Quebec Group, in the eastern part of the province; consisting of altered and highly dislocated and disturbed limestone and sandstone strata, belonging to the inferior part of the Lower Silurian system, and extending in a belt varying from twenty to sixty miles wide, from the borders of Lake Champlain eastward to nearly the extreme point of Gaspé. This important region, which occupies an area of over 15,000 square miles, is a portion of the great metalliferous formation of North America, which includes the well-known mining regions of the Appalachian chain from Canada to Tennessee, as well as those of Missouri and the Lake Superior region. Although this fact has but recently been recognized, many valuable discoveries of copper and other metals have already been made in the eastern townships of Canada, and at other points comprised within the region specified. In addition to the metals, it abounds in roofing slates of excellent quality, besides many beautiful varieties of serpentine, marble, soapstone, whetstones, ochres, &c.

The central portion of the province, comprising the region bordering on the north shore of Lake Ontario, and extending over an area of about 7,000 square miles, is underlaid by rocks of the Lower Silurian age, which are comparatively unaltered, both as regards position and chemical

composition. They are for the most part hidden under thick deposits of drift clay, and have hitherto produced no important discoveries of the metals; but it is worthy of remark that it is in limestone rocks of corresponding age and condition that the extensive deposits of lead in Wisconsin and Iowa occur. The limestones of this region, besides contributing materially to its agricultural value, furnish excellent building and paving materials; and in many places beds of hydraulic limestone are found, and a superior description of lithographic stone may be obtained in unlimited quantity.

The rocks of the western peninsula are of Upper Silurian and Devonian age; and furnish, by their decomposition, the materials for the rich and fertile soils by which this part of the province is distinguished, and rendered so invaluable for agricultural purposes. The most important mineral products of the rocks of this region are gypsum, hydraulic lime and petroleum.

The superficial deposits, all over the country, furnish abundant materials for the manufacture of bricks, tiles and every description of coarse pottery. Shellmarls occur in many places, and constitute a valuable manure. Bog iron ore is also found in great quantities, and at several points has been made available in the manufacture of iron of an excellent quality. Beds of ochre exist in many localities, and considerable areas in the eastern part of the province are covered by marshes yielding abundance of peat, which must in time become most valuable for fuel.

#### CATALOGUE OF USEFUL MINERALS FOUND IN CANADA.

It will be impossible, within the limits prescribed to us, to give more than a general and cursory account of the useful minerals of Canada; and with respect to many of them we must confine ourselves to a bare enumeration. As the basis of our remarks, we shall adopt the classification given by Sir William Logan; reproducing, in an abridged form, the

index to the elaborate and valuable "*Descriptive Catalogues of the Economic Minerals of Canada*," prepared by him for the Great Exhibitions of 1851 and 1862; and omitting such as are either common to most other countries, or of limited application in the arts, together with such as appear to be of rare occurrence in Canada. We shall then enter upon a more particular account of such as are of special interest or importance, giving such details as may serve to elucidate their nature, mode of occurrence and value, and the extent to which they have been developed.

#### METALS AND THEIR ORES.

- Iron.* Magnetic, specular, bog and titaniferous.  
*Zinc and Lead.* Sulphurets, (blende and galena.)  
*Copper.* Native, pyritous, variegated and vitreous sulphurets.  
*Nickel and Cobalt.* Sulphurets.  
*Silver.* Native, and associated with galena and copper ore.  
*Gold.* Native; in superficial deposits and in veins.

#### MINERALS APPLICABLE TO CHEMICAL MANUFACTURES.

- Chromium.* In chromic iron ore, for forming chromate of potash, &c.  
*Manganese.* In iron ore, and as earthy peroxide, for bleaching and decolorizing agents.  
*Iron Pyrites.* For manufacture of copperas and sulphur.

#### MINERAL PAINTS.

- Iron Ochres.* All varieties of color; very abundant.  
*Sulphate of Baryta.* For manufacture of permanent white, &c.  
*Steatite.* Soapstone, used both as a paint and a refractory stone.

#### MATERIALS APPLICABLE TO THE ARTS.

- Lithographic Stone, Mica, Moulding Sand, Fuller's Earth.*

MATERIALS APPLICABLE TO JEWELRY.

*Agates, Jasper, Labradorite, Sunstone, Hyacinth, Oriental Rubies, Sapphires, Amethysts, Ribboned Chert, (for cameos,) Jet.*

MATERIALS FOR GLASS MAKING.

*White Quartzose Sandstone, Pitchstone, Basalt, &c.*

REFRACTORY MATERIALS.

*Soapstone, Pipestone, Asbestos, Sandstone, Plumbago, Fire-clay.*

MINERAL MANURES.

*Phosphate of Lime, Gypsum, Shellmarl.*

GRINDING AND POLISHING MATERIAL.

*Millstones, Grindstones, Whetstones.*

MATERIALS FOR COMMON AND DECORATIVE CONSTRUCTION.

*Granite, Sandstone, Limestone, Hydraulic Limestone, Roofing Slates, Flagstones, Marbles, (in great variety of colors,) Serpentine, Clays for brick and tile making and coarse pottery.*

COMBUSTIBLE MATERIALS.

*Peat, Petroleum, and Asphalt.*

In the notices which we shall proceed to give of the progress of development of the various minerals under their respective heads, it is to be understood that the date to which this account is brought up is the early part of the year 1860.

IRON ORES.

The iron ores of Canada, with the exception of the bog ores, which are distributed over many parts of the province, are chiefly found associated, as we before remarked, with the Laurentian rocks, in which they occur in prodigious quantities, and generally in beds lying conformably with the

stratification. Most of these beds are of very great extent and thickness, and of excellent quality, yielding sixty to seventy per cent. of pure iron; and although the want of mineral fuel operates as a very serious obstacle to the development of this branch of industry, they have been partially worked in a few places.

At the Hull mine, situated about five miles above Ottawa City, the bed is about 90 feet in thickness, containing between 60 and 70 per cent. of metallic iron, and is of vast though unknown extent. At the lowest estimate this deposit is calculated to contain not less than 250,000,000 tons of iron.

The Crosby mine, situated on the Rideau canal, is on a bed 200 feet thick, and its yield over the same extent of ground would amount to double that above-mentioned; a quantity which, at the present rate of production, would afford employment for the whole mining force of Great Britain and the United States for a century.

In the township of Marmora, where iron works have been established and smelting done to a limited extent, the beds are in the aggregate about 150 feet in thickness, and by the same method of computation may be estimated to contain 100,000,000 tons; and at two other known locations which have been partially opened up, the probable contents may amount to 150,000,000 tons; thus making, for the five localities specified, an aggregate of 1,000,000,000 tons. Vast quantities of iron ore have recently been discovered in the neighborhood of Lake Nipissing, and it is certain that as the whole region overlaid by the Laurentian rocks becomes settled, many additional localities of the material will be discovered. It is thus evident that the supply of iron ore in Canada may be regarded as practically inexhaustible.

As regards the quality of the ore, and natural facilities for working and transportation, these are unsurpassed by

any country in the world. The ore consists chiefly, in the localities referred to, of the magnetic oxide of iron, which is the same species, and occurring in the same geological formation, with those of Sweden and Norway, from which the celebrated *Swedish Iron* is made. There is therefore every reason to believe that if treated in a similar way, it will produce an equally good material for the manufacture of steel and the finer descriptions of iron work. The ore-beds occurring immediately at the surface can be wrought with comparatively little labor, and many of the most promising are situated near the banks of navigable rivers and canals.

The extensive scale on which iron smelting works must necessarily be conducted, and the large capital involved, together with the want of mineral fuel and expense of labor, have hitherto operated as obstructions to the development of this branch of industry in Canada; while the low price of iron imported from the mother country renders it doubtful whether, in present circumstances, it would repay the cost of manufacturing. It is, however, in the highest degree satisfactory to know that this country possesses within itself such vast stores of a material indispensable to the comfort and progress of mankind, and which can be made available when circumstances render its application expedient or necessary.

It is a remarkable and somewhat anomalous fact, however, that in the British provinces in North America, iron smelting and some other branches of industry, received a larger share of attention half a century ago than they do at the present day. This is probably to be accounted for from the application of the modern system of division of labor, which tends to restrict the industry of countries, as well as individuals, to those branches only which are supposed to form their staple productions, or to which nature and custom are conceived to have best adapted them.

Several years ago iron works were established, and smelt-

ing carried on for some time, on the rich magnetic oxides in the townships of Marmora and Madoc in the county of Hastings; the produce was a very superior quality of manufactured iron; but owing chiefly to the want of roads, distance from markets, &c., they have been found unprofitable, and abandoned in the meantime. We have no statistics of the production of these works. Of late years a trade has sprung up, to a limited extent, in the exportation of the iron ores of Hull and Crosby to the smelting establishments of Pittsburgh, Penn.; which can be done with profit when taken as return freight by the vessels carrying the agricultural products of the West down the St. Lawrence. The ore is worth from \$5 to \$6 per ton at the furnaces, and can be put on board at Kingston for \$2.25. From the Hull mine about 8,000 tons have been thus forwarded since 1855, and from that of South Crosby, which is more conveniently situated as regards proximity to the shipping port, the exports up to the year 1860 are stated at 6,000 tons.

Besides the magnetic oxides, specular iron ore abounds in many localities in Canada, both in the Laurentian and Lower Silurian groups of rocks, and red hematite or carbonate of iron is also of not unfrequent occurrence. About fifty years ago, these descriptions of ores were mined for smelting purposes in the neighborhood of Furnace Falls in Landsdowne, but the works being found unprofitable at the time, were abandoned. Red hematite was formerly quarried in the township of Brome, Canada East, of such superior quality as to be found worthy of transportation a distance of about 180 miles to be smelted. A great extent of rich hematite has recently been discovered upon one of the islands in Lake Nipissing.

Titaniferous iron ore is very abundant in Lower Canada, chiefly in the Eastern townships and at Bay St. Paul, but it is doubtful whether it can be rendered available for the manufacture of iron, owing to the presence of the

titanium which is difficult to separate, but which probably may in the progress of the arts become itself a valuable product. The deposit at Bay St. Paul, which is ninety feet thick, and is traceable for about a mile, contains 48.60 of oxide of titanium.

The bog iron ores, which are found so extensively diffused throughout Canada, have been in a few instances the object of manufacturing industry. These ores occur in patches from three to twenty-four inches thick, on the surface, generally in the neighborhood of swampy lands, and consist of hydrated oxide of iron combined with an acid derived from vegetable decomposition; their yield of metallic iron is usually from forty to fifty per cent. The St. Maurice forges at Three Rivers, in Lower Canada, which have been in operation for upwards of a century, employ exclusively this description of ore, which is found in great abundance in the immediate neighborhood; and have produced largely both of cast and wrought iron of a very superior quality. This establishment, which at one time employed from 250 to 300 hands, is now discontinued; but the business is carried on vigorously at the Radnor forges in Batiscan, where the ore and fuel are abundant. The chief manufacture here consists of cast-iron car-wheels; and recently a rolling mill has been erected, which produces railroad and other descriptions of fine iron. The quantity of ore annually used at these works is between 4,000 and 5,000 tons, producing about 2,000 tons of pig iron; and the number of workmen varies from 200 to 400.

In Upper Canada an iron smelting work, in which the bog ores were employed, was erected and carried on for some time in the county of Norfolk, on the shore of Lake Erie, but is now abandoned, and no statistics of the production of this work have, so far as we are aware, been preserved. The excellent quality of the iron produced from the bog ores of Canada is remarkable, inasmuch as these invariably contain a notable quantity of phosphorus,

which is generally, although, as it appears, erroneously, supposed to be highly prejudicial to the iron.

#### ZINC AND LEAD.

Hitherto no available deposits of zinc ore have been discovered in Canada, although this metal is known to exist at many places, and may yet become of economic importance. Blende, or the sulphuret of zinc, is found associated with copper in considerable proportion at Pointe aux Mines, on Lake Superior, and it is also found with galena at several points in the eastern townships. Deposits of zinc ores must be large and favorably situated in order to be worked with profit, and the sulphuret is not the most valuable ore; its occurrence in Canada, therefore, can only be regarded as important in so far as it may lead, as in other countries, to the discovery of the more useful ore, calamine.

The officers of the geological survey have reported the occurrence of galena, in many localities in Canada. The most important is that now known as the Ramsay lead mine, in the county of Lanark, C. W. Here the rock intersected by the vein, which is of calc-spar, is an arenaceous limestone, or dolomite, belonging to that division of the lower Silurian series known in New York State and in Canada as the calciferous sand-rock. Mining operations have been prosecuted with some success, and have established beyond a doubt the important facts, that the ore exists in true veins, which may be depended upon for persistence in depth, and that its quality is most excellent, producing eighty per cent. of metallic lead. Upwards of thirty tons of ore of this produce have been obtained, and smelting works have been erected to reduce the ore; but the enterprise has languished from want of sufficient capital to carry on the work efficiently. It is expected that in the course of the present season (1862), these mines will be worked by a powerful company, and with good prospects of success. At other locations in the

same district of country, as in the townships of Bedford and Lansdowne, other veins have been discovered, holding a nearly uniform course, and which appear to be connected with the well-known lead lodes of Rossie, in St. Lawrence county, New York. Trial shafts have been sunk on many of these veins, and with good prospects of a successful result.

Galena is known to exist at several points in the Quebec group of rocks, stretching from Lake Champlain to Gaspé; but it is as yet uncertain whether it occurs at any place in sufficient quantity to be remunerative. At Indian Cove, in Gaspé, a lead vein has been partially explored, and has yielded about six tons of sixty per cent ore.

Galena has also been found in occasional bunches in the Niagara limestone rocks, skirting the head of Lake Ontario, and various attempts have been made to explore and work them; but no vein of any considerable importance has yet been discovered here.

#### COPPER.

This valuable metal undoubtedly constitutes the most important of the mineral treasures of Canada, and is destined to occupy a prominent rank among the resources of the country. The ores of copper are found to be distributed abundantly over large tracts of country in the western and eastern extremities of the province, their existence having been known in the former case for nearly two centuries, while in the latter, notwithstanding its being a much more populous and accessible region, it has only been brought to light within the last few years. The Laurentian rocks have not hitherto been found to yield any great deposits of copper ore, although veins of the sulphurets have been traced in this formation which may lead to more important discoveries.

*Copper mining in the lake region.* In the western part of the province, the Huronian rocks, occupying the whole

northern flank of Lake Huron, and parts of Lake Superior, are traversed by numerous and powerful cupriferous veins, which have formed the object of mining enterprise for many years. The attention of travellers was attracted to the rich copper ores of this region as far back as the middle of the seventeenth century; and in 1770 a company was actually formed by some enterprising Englishmen to work copper mines on the north shores of Lake Superior; but owing to the remoteness and inaccessible nature of the country, it was found impracticable to continue operations for any lengthened period. In 1845, when the excitement consequent upon the great discoveries of copper on the south shore of Lake Superior was at its height, similar mining schemes were instituted on the Canadian side, and companies were formed in Montreal, Quebec, and various other Canadian cities, who with praiseworthy zeal, though questionable discretion, sent armies of explorers and miners into the field, equipped in the most extravagant style, and who certainly obtained abundance of ore, but at a cost greatly above its value. The consequence of these rash and imprudent proceedings was that most of the companies speedily abandoned their operations, after the irretrievable loss of large sums of money; and with those who have continued in the business till the present time, the debts thus incurred have proved a severe drag upon their subsequent more cautious proceedings. The Montreal Mining Company have prosecuted their works till this time, and with tolerable success, at the Bruce Mine, located on the shores of Lake Huron, where a group of copper-bearing quartz lodes are found intersecting greenstone rocks. On a careful examination instituted by Sir Wm. Logan, in 1848, it was found that about 3,000 square fathoms of the lodes would contain six and a half per cent. of copper. The average annual produce of this mine during the fourteen years of its existence has been about 700 tons, of 18 to 20 per cent. The deepest working is 50 fathoms from the surface; the mine employs about 34 hands.

About four years ago the Montreal Mining Company leased one of their locations, the "Wellington Mine," to a private English company, who have worked it with great vigor and success. The lodes here are apparently continuations of those found on the Bruce location, and are extremely powerful and productive. The quantity of ore obtained at this mine since 1857 is about 6,000 tons of twenty per cent., and it is said to yield twenty-five per cent. on the capital invested. The same company have also recently opened on an adjoining location, which is owned by the Huron Copper Bay Company, and have discovered very valuable deposits; this mine being reported to have yielded during 1861 not less than 1,300 tons of twenty per cent. ore. The number of men on the Wellington and Copper Bay Mines is supposed to be about 265. All the ore raised by this company is sent to Britain.

Smelting works have been established in connection with the Bruce Mines, the coal being supplied at a nominal rate of freight by the vessels which are sent to carry the produce of the south shore mines. These works have not hitherto been brought into successful operation, but if skilfully and economically conducted, they cannot fail to be of great advantage to the mining interests of this region. The aggregate produce of the three Lake Huron copper mines for 1861 is about 3,000 tons, worth about \$250,000, a considerable addition to the exports of the country from one small port, but a mere fraction of what might be done, should the government provide efficient steam communication with the upper lakes.

The ores of the Lake Huron copper region are entirely sulphurets, yellow, variegated, and vitreous—no native copper being found. This form of the metal is, however, found in considerable quantity at Maimanse, Michipicoten island, and various other points on the north shore of Lake Superior; and it is quite possible that these regions may ultimately prove as favorable for the production of copper as the far-famed "south shore."

*Copper mining in Canada East.* We have already remarked that the rocks of the Lake Superior mining region have their geological equivalents in the Quebec group in Lower Canada, and accordingly we find them characterized by similar features as regards their metallic contents. It is only within the last ten years that the existence of copper ores has been recognized in the eastern part of the province, and the discovery of their economic importance is of still more recent date. So far as hitherto observed, the deposits occur most abundantly, and in greatest richness, in the highly altered and disturbed strata constituting the mountainous and picturesque region of the eastern townships, extending from the province line, near the head of Lake Champlain, in a north-easterly direction as far as Quebec, and occupying a breadth of forty-five or fifty miles. They occur chiefly in beds subordinate to the stratification of the chloritic and micaceous slates, and associated dolomitic limestones of the metamorphic lower Silurian age, which are tilted to a high angle; and the most valuable deposits are found where these strata appear to have been fissured or otherwise disturbed, and the openings subsequently filled with ore. In some cases, also, veins occur cutting the stratification at small angles, and these give promise of being permanently reliable mines. The ores are generally of an unusually rich character, and are found in such variety as, by their mixture, to give great facilities for smelting.

During the last two years (1860 and 1861), much activity has prevailed in prosecuting the search for valuable minerals in the region in question, chiefly by individual enterprise or by small companies. Surface explorations have been made over a very large tract of country, and in several instances actual mining operations have been commenced, and the results so far have proved highly encouraging. Deposits of the sulphurets of copper, more or less promising, have been found to exist on upwards of 150 distinct lots, in various townships. On nine or ten loca-

tions, at great distances apart, trial shafts have been sunk to a considerable depth, and in as many instances large sums have been expended in core-veining and trenching; and in almost all cases the deposits, when traced in depth, have been found to improve in all the qualities requisite for permanent and profitable mining. All that seems wanting in order to establish the character of this promising mining region is the expenditure, at various well selected points, of a moderate capital judiciously and economically applied. These mines are very well situated as regards transportation of the ores to market, the whole district being traversed by railways, and at no point very distant from water conveyance.

The only copper mines in Lower Canada which have as yet produced much ore for the market are the Acton and Harvey Hill mines. At Acton, in Bagot county, the ore, which is associated with a dolomitic limestone, in consequence apparently of complicated dislocations of the strata, occurs at the surface, in a series of bunches of exceeding richness, which have now for the most part been extracted by open quarrying; but on tracing this ore in depth, the bunches appear to be connected with regular veins which afford promise of being permanently productive, although by a different and more satisfactory mode of working. In the absence of full official returns, it may be safely estimated that the Acton mine has, up to the close of the year 1861, produced not less than 6,000 tons of ore, averaging seventeen per cent. produce, and worth about \$400,000, at a cost probably about one-sixth of that sum.\* This mine gave employment in 1861 to between 500 and 600 hands; and although its character as a good mine for permanent

\* Since writing the above, it has been ascertained that the total value of ore obtained at the Acton Mine, within three years after it was opened, was \$490,000. "It is believed that the history of mining in America affords no parallel to this. In the majority of cases where copper mines have proved ultimately profitable, it is only after the consumption of much time and the investment of a large amount of capital that any returns have been realized."

—Dr. Jackson's Report on the Acton Mine, 1862.

and profitable working has been seriously injured by an injudicious system of development, it is certain that the ore is still very far from being exhausted.

At the Harvey Hill mine in Leeds (the property of the English and Canadian Mining Co.), the works have been prosecuted during the past three years with much skill and vigor, in opposition to many and formidable difficulties, which seem at length likely to be crowned with merited success. The ore, which consists of the pyritous, variegated, and vitreous varieties, here occurs both in rich bunches in a series of quartz courses of considerable though limited extent, cutting the stratification at small angles, and in a more diffused state in beds or bands coinciding therewith; and is attacked and extracted by regular and systematic underground operations. The principal adit, when complete, will cut all the courses at a depth of thirty-seven fathoms from the summit of the hill, and will be 250 fathoms in length. In order to save expense in transportation to market, the ore is concentrated by dressing to thirty-five per cent. or upwards. In opening up this mine, from \$80,000 to \$100,000 have already been expended, and during the past year it has produced about 130 tons of thirty-five per cent. ore, worth about \$18,000, and the total produce from the commencement may be estimated at about \$60,000.\* The number of men employed is about sixty; the produce of this mine is all sent to England. An experiment is now in process of trial at the Harvey Hill mine for concentrating the poorer ores from the beds, &c., by Henderson's patent process, which, if successful, as there is every probability it will be, will add greatly to the value of this, as well as all other copper mining property in Canada.

The Ascot Mine, near Sherbrooke, opened in the fall of

\* From a return made by Mr. Williams, at the close of the year 1862, we find that the total quantity of ore shipped to England was 322 tons of 35 per cent., besides about 2000 tons of poorer ore averaging 3½ per cent., then on the ground.

1861, has in five months produced about 100 tons of eight or nine per cent. ore, with very little cost for working. This mine has been opened on a twist in the stratification of the chloritic and slaty limestone of the country, which appears to have folded the copper-bearing bed upon itself, giving three courses of ore in the breadth of eighty feet. The ore-bearing bed, which is at one place about eight feet thick, carries the yellow sulphuret of copper disseminated throughout the mass, and is simply broken up and barrelled for market without any special dressing. The total depth reached is about seven fathoms, and the beds seem to increase in richness as they are traced in depth. The rock is mined with unusual facility; the ore has hitherto been sent chiefly to the Boston smelting works, where it is much prized for its valuable fluxing qualities.

At other mining locations in the townships of Sutton, Melbourne, Durham, Wickham, and Upton, and in the Seignory of Lotbiniere, some progress has been made in the extraction of ore, the total value of which may be estimated at \$8,000; but these operations must be regarded as only preliminary, this branch of industry being as yet quite in its infancy; and it is a highly gratifying feature in these mines, that the ore incidentally obtained in testing them frequently suffices to defray the expense.

As regards the comparative advantages of mining in Canada and in England, we have to remark, that although at present the expenses both of labor and transportation are considerably greater in Canada, these evils may be expected to cure themselves as soon as mining becomes an "institution" among us—the first by the immigration of Cornish hands, and the latter by the erection of smelting furnaces, or other means of concentrating the ores, at or near the mines, or at the nearest coal country in British North America,—Nova Scotia,—which must in time occupy the same position with regard to the mining region of Lower Canada that South Wales holds with respect to Cornwall. As an ample set-off to these present disadvantages, we may

mention the greatly superior richness of the ores in Canada, their greater proximity to the surface, dispensing with much costly machinery for pumping, &c., and abundance of wood for timbering and for fuel.

The mining adventurers in some instances purchase the land with the minerals, but in general the mode of tenure is by lease of the minerals only for a considerable term of years, with payment of a royalty. The extraordinary success of the Acton Mines, and the excitement consequent upon the novelty of the discoveries, at first rendered the proprietors exorbitant in their demands—a percentage of one-tenth of the gross proceeds, and in some instances a bonus besides, being required before granting a lease. As, however, it became apparent that the Acton deposits were altogether of an exceptional character, and that the risk and expense of proving locations and of underground working will not admit of any such terms, there is a general disposition on the part of the proprietors to encourage mining adventurers as well as benefit themselves by exacting only moderate royalties.

It is the duty of government also, and of all public companies interested in these lands, to foster and encourage this new branch of industry by assisting in the construction of roads, by low tariffs on railways, and by all other means in their power.

#### NICKEL AND COBALT.

Nickel has been found in several localities in Canada, in rocks of the Laurentian, Huronian, and Lower Silurian ages, but it is as yet doubtful if it exist at any one place in quantities which would be remunerative in working. The most remarkable instance of its occurrence is in the island of Michipicoten in Lake Superior, where it exists in the forms of the arseniurets and silicates of nickel, associated with copper, silver, and traces of cobalt, and yielding from seventeen to thirty-seven per cent. of nickel. It is reported that considerable quantities of this ore were

thrown into the lake after being stamped and washed for the native silver, the workmen being ignorant of its value. This metal has also been found in considerable abundance at the Wallace Mine, on Lake Huron, as an arsenical sulphuret, associated with iron pyrites; the ore here yields thirteen per cent. of nickel, with a little cobalt.

At Brompton Lake, in the Eastern township, nickel has been found in the form of *Millerite*, or needle-nickel, exhibiting beautiful slender elongated prisms, associated with calc-spar and chrome garnets—specimens of the rock yielding to analysis as much as one per cent. of nickel, which, according to the modern systems of separating, might pay for working. Traces of cobalt are found in many places in Canada, but not in sufficient quantity to be of much economic importance; at one locality, however, in Elizabethtown, near Brockville, a great bed of cobaltiferous pyrites occurs; the ore yielding to assays one-half per cent. of cobalt, which, according to the modern systems of working, would yield a profitable result. The presence of nickel and cobalt has been recognized in rocks in Canada, which in the neighboring State of New York, and in similar conditions, have yielded these valuable metals in considerable abundance.

#### SILVER.

Native silver is found with the native copper in Michipicoten, St. Ignace, and Spar Islands, in Lake Superior; also at the latter location it is found as a sulphuret, associated with sulphurets of iron, copper, lead, and zinc, in a thick vein of calc-spar, barytes, and quartz. An assay of a sample of several hundred pounds of the vein yielded about four per cent. of silver, with traces of gold.

Most of the galena found in Canada is exceedingly poor in silver, but specimens from Maimansee, and other points on Lake Superior, have yielded thirty ounces to the ton of metallic lead, and other ores from the Chaudière,

and from a vein near Sherbrooke, in Lower Canada, contain respectively twenty-five ounces and sixty ounces of silver per ton of lead. In all these cases, however, so far as yet ascertained, the galena is diffused through such masses of rock as to make it questionable if it would pay to separate the silver.

#### GOLD.

Discoveries of gold have been made at several localities, and in fair quantity in Eastern Canada; chiefly in the valleys of the rivers Chaudière and Du Loup, and their tributaries, and on the St. Francis, all in the eastern townships. In all cases it has been obtained by a laborious process of washing or *stream-work*, the material subjected to this process consisting of drift clay and gravel, the debris of the rocks on which they repose. These rocks consist of clay, slates, and interstratified gray sandstones, associated with conglomerates, serpentine, and various ores of iron; and it seems probable that the gold-producing regions will have the same geographical limits as those we have assigned to the Quebec group of rocks. The precious metal has not hitherto been found in any considerable quantity in the quartz veins which traverse these regions, but it has been proved that these veins do produce it, and there can be little doubt that the gold found in the drift has been derived from quartz veins, probably situated not far distant. The largest nuggets found vary from one-half to six ounces.

The work of gold-washing in the drift has been prosecuted to a limited extent, during the last twelve years, by various companies and individuals, and with fair success. In 1851, the Canada Gold Mining Company commenced a trial of the drift along the Rivière du Loup, near its junction with the Chaudière; their operations extended over three years, the greatest part of the gold being obtained in the bed of the river, and, allowing for the large amount of unprofitable preliminary labor, the results are sufficiently encouraging.

The following are the returns for the years 1851 and 1852, as given by Sir William Logan :

Year.	Area washed.	Gold collected.	Value.	Wages.	Profit.
1851	$\frac{1}{4}$ acre.	2,107 dwts., 11 grs.	\$1,826.46	\$1,644.33	\$182.13
1852	$\frac{1}{4}$ "	2,880 " 19 "	2,496.69	1,888.35	508.34
Total,	1 acre.	4,987 dwts., 30 grs.	\$4,323.15	\$3,532.68	\$690.47

Sir William states that during the time of his observations the deposit yielded about double wages. Since this company discontinued their operations, no regular attempts have been made to turn the auriferous drift to profitable account, excepting on a very small scale by the French Canadian habitants, who occasionally bring to Quebec nuggets of considerable size as the fruits of their labors. There seems little doubt, however, that, were the field laid open to foreign enterprise, and the improved modern systems of separating the precious metal systematically prosecuted, the gold fields of Canada would attract much attention. Probably the government does not deem it politic to encourage a description of industry which has, if unduly excited, somewhat of a demoralizing effect upon the population.

#### CHROMIUM IRON.

This mineral, which is highly prized for the manufacture of the chromates of potash and lead, and for the production of many beautiful red, yellow, and green colors, is found in considerable quantities in the eastern townships of Canada, chiefly in Bolton, Melbourne, and Ham, and in the Shickshock Mountains in Gaspé. It is usually found associated with beds of serpentine, in which the ore occurs in masses or nodules, sometimes about 1,000 pounds weight, but usually of much smaller dimensions. In the township of Ham the bed has been partially worked, and has produced about ten tons of the ore, containing forty-five per cent. of oxide of chromium, from seven square fathoms of the bed. Besides the localities specified, chromic iron is found in many other places in Canada, but generally not

in sufficient aggregation to be profitably workable. The value of this mineral in England is stated to be about one dollar per unit per ton, which would afford an ample profit upon its exportation, and a very handsome return to parties who would undertake to invest capital in the preparation of the oxide from the raw material, in the province itself.

The following remarks on the method of manufacturing bichromate of potash in Norway, by Mr. Thomas Macfarlane, of Acton, will be found interesting:

“The ore, in fine powder, is ignited in a reverberatory furnace, with about thirty per cent. of calcined potash and little or no saltpetre. The resulting mixture yields, on lixiviation with water, a solution of neutral chromate of potash, which separates as a granular salt on evaporation. It is redissolved, and the solution treated with a certain quantity of sulphuric acid, when crystallized bichromate of potash is obtained; one hundred parts of ore yield about thirty-seven of bichromate, equal to twenty per cent. of chromic oxide.

“The manufacture suffers from expensive cartage of fuel, and high prices of potash, which is chiefly imported from Russia. In Canada, at South Ham, Bolton, and Melbourne, the ores are much richer and more extensive; in the first named place, containing forty-three per cent. of chromic oxide. In Canada, around the mines of the eastern townships, the settler destroys acres of timber, the softer parts of which he might burn into charcoal, and manufacture tons of potash, which the chrome miner might buy, and use to manufacture his ore into chromate of potash, at a highly profitable rate. I am not aware of any district where greater advantages exist. May they soon be appreciated and taken advantage of as they deserve.”

#### IRON OCHRES.

Very extensive beds of hydrated peroxide of iron, constituting the ochres of commerce, are distributed in many parts of Canada, and chiefly in association with the bog

iron ores, which are, in point of fact, nearly of the same origin and composition, only differing in the condition in which their elements are combined. In many places these substances are actually found in process of formation, the iron being visibly precipitated from springs holding it in solution.

Some of the ochre beds of Canada have been partially worked, and supply an excellent material, of a great variety of shades of color. The principal locality where the manufacture of this description of paints has been carried on is at Pointe du Lac, on the north shore of the St. Lawrence, near Three Rivers, in Lower Canada, where the deposit occupies an area of about 400 acres, with an average thickness of eighteen inches; but the enterprise appears for the present to be abandoned. It was prepared for the market at very little cost, and the works were capable of producing twelve barrels per day, worth five dollars per barrel. Sir Wm. Logan remarks in his Report, in regard to the exhibition of Canadian minerals at London, in 1851: "I was informed by one of the principal manufacturers of paints in London, that the iron ochres from Canada were of the best usual description, and equal to those now imported from France. The French ochres imported into London in the crude state, and prepared there on a large scale, can be sold to a profit at £3 (\$15) per ton; and the superiority of the English manufacturers over the French is such, that the latter, preparing the material at home and exporting it to London, cannot obtain a profit unless they can sell the commodity at £6 per ton. The charges of freight may render it difficult to transport the Canadian ochre across the Atlantic at a profit, but the abundance of the material in the country should surely render it unnecessary that any should be imported into this or the neighboring colonies."

#### SULPHATE OF BARYTES.

This mineral, otherwise called heavy-spar, and which is much used in the manufacture of a white paint, and for

adulterating white lead, occurs abundantly at Baryta Island, in Lake Superior; and also in the townships of Bedford, Bastard, Lansdowne, and McNab; it forms, in conjunction with calc-spar, the gangue of many of the metallic veins, chiefly those of galena. At one place in the township of Bastard, as described by Mr. Murray, assistant provincial geologist, these minerals constitute a vein traceable for a quarter of a mile in length, with a breadth of twenty-eight inches, consisting in some places almost entirely of pure crystallized sulphate of barytes, yielding about ten tons per fathom. The value of the crude material is said to be \$8 to \$10 per ton to the manufacturer, while the manufactured article is worth \$30 per ton.

#### STEATITE OR SOAPSTONE.

This mineral, which is composed of silica and magnesia, possesses many valuable and useful properties. It is soft and unctuous to the touch, capable of being worked into any required shape by common carpenters' tools, and is little affected by exposure to intense heat or strong acids. In Canada it is used occasionally as a refractory stone, and is found in beds of twenty and thirty feet thick respectively, in the townships of Sutton and Bolton, associated with serpentine and dolomite. It also exists in the townships of Leeds and Stanstead, where it is ground and employed as a paint.

#### LITHOGRAPHIC STONE.

A species of limestone belonging to the period of the lower Silurian formation, and occurring in the township of Marmora, in the vicinity of the iron-works already mentioned, is found to be exceedingly well adapted to the purposes of lithography, and attracted much attention and commendation at the Great Exhibition in London in 1851, although hitherto no attempt has been made to quarry it for use. The bed from which this valuable material is derived is of great lineal extent and about two feet in thick-

ness, and is distinguished for its perfect homogeneity, closeness and compactness of texture, and other excellent qualities for the purpose referred to. Another locality of this material, in the upper Silurian rocks, has recently been discovered in Canada West, near Walkerton, Brant county, where not less than fifteen beds of limestone, admirably adapted for this purpose, occur in a thickness of nine feet. Good lithographic stone is said to be worth about seven cents per pound.

MICA

This remarkable mineral is found in great abundance and of extreme purity in some parts of Canada, and has been to a limited extent applied to economic purposes. "The cleavable character of mica," says Sir William Logan, "its transparency, its elasticity and refractory nature, render it valuable for several purposes; the more important of which relate to it as a substitute for glass for ships' windows, and in some countries for house windows, for stove fronts, and such like applications. For the latter purpose it is greatly used in North America. The price at which plates of five by seven inches sell in Montreal is about a dollar the pound." Sir William further states that the Canadian mica attracted so much notice at the French Exposition in 1855, as to induce inquiries by an artist in Paris, who stated that he could use about 12,000 lbs. annually. He could afford to pay the following prices for square plates of it, according to size:

From	3½ inches	to	5½ inches	\$34.00	per 100 lbs.
"	5½	"	7½	40.00	"
"	7½	"	"	46.75	"
"	9½	"	"	53.57	"

In Grenville, on the Ottawa River, where the mineral is found in great quantity, but in patches imbedded in massive pyroxenic rock in contact with a bed of crystalline limestone, crystals of mica have been obtained giving sheets measuring twenty-four by fourteen inches. At another

locality in the township of North Burgess, near the Rideau Canal, the mineral is found in regular veins, or rather bands, running parallel with each other at no great distance apart, some of which are as much as four feet in width, and can be traced for seventy-five yards in length. These deposits have yielded good plates, which when dressed measure twenty by thirty inches; the average size, however, varies from three to ten inches square, of which great quantities can be obtained in this locality.

At present the demand for mica is rather limited, but there can be no doubt that a material possessing such remarkable and valuable properties must, in the progress of the arts, and when its abundant supply is established, find many economic applications.

In addition to the uses mentioned above, it has recently been much employed in photographic manipulations, and for the manufacture of stable and other lanterns; and large flakes are eagerly sought after by optical instrument makers, for dials for ships' compasses. A flake one inch thick can be divided into the astonishing number of 2,000 sheets.

Recently a new field has been opened up, by a patent process for the application of mica, previously colored or metallized, to the decorating of churches, rooms, shops, and other ornamental and useful purposes. The mica from its unalterable nature, preserves the gilding, silvering, or coloring from deterioration, and from its transparency the articles so treated will preserve all their brilliancy. The value of mica depends upon the size of the sheets and their transparency. In the London market, to which Canada has supplied about two tons, of the total net value of £450 sterling, the Canadian mica is not so much esteemed as that from Calcutta, which commands from two shillings sixpence to four shillings per lb., while the Canadian will rarely exceed two shillings. The location in North Burgess, mentioned above, has supplied the only mica hitherto exported from Canada, so far as we are aware.

## PLUMBAGO, OR GRAPHITE.

The crystalline limestones of the Laurentian system, and some of the lower members of the Silurian system, are marked by the occurrence of this mineral in many cases, diffused in small scales and flakes; but sometimes in sufficient aggregation to be economically available. The chief locality where it seems to occur in workable quantities, is in the townships bordering the north bank of the Ottawa river, below Ottawa City. A bed of tolerably pure graphite has been partially worked in the township of Grenville; it has been traced at intervals for a distance of about three miles, and shows on the surface a thickness of ten inches; but the purer portions of the band appear to form lenticular masses, which cannot be depended upon for continuous working, and, consequently, may not be found profitable in mining. This, so far as hitherto ascertained, seems to be the character of the deposits of graphite generally throughout Canada. At the present time it is essential to the commercial value of this material, that it should be almost free from gritty or stony particles; but economical methods of purifying it will doubtless be applied at an early day, and will secure a regular market for the Canadian plumbago, some of which is found in a state of great purity, and is worth from eighty to one hundred dollars per ton. The chief applications of this material are for the manufacture of crucibles for brass-founders, for glazing gunpowder, blacking stoves, &c., and for diminishing friction in heavy machinery. Processes have recently been patented in England, by Messrs. Brockedon and Brodie, for the purification of ordinary plumbago, so as to render it fit for the manufacture of black-lead pencils. These have been ascertained to be successfully applicable to the Canadian article, and will thus render the mining of this valuable mineral, on an extensive scale, well worthy of attention. We are not aware

that any considerable quantity of plumbago has yet been produced in Canada.

MINERAL MANURES.—PHOSPHATE OF LIME.—GYPSUM.—  
SHELL-MARL.

*Apatite or Phosphate of Lime.*—This mineral, the constituent elements of which form the base of animal bones, is found in great abundance in the Laurentian rocks of Canada; and although not hitherto brought into very general use as an artificial manure, is plentifully distributed by the hand of nature from the débris of the rocks among the soils, contributing no doubt very materially to their fertility and value. Its occurrence in rocks of such primitive geological age, points to the existence of animal life at a period vastly earlier than the received geological theories admit.

The mineral phosphate of lime has for some years back attracted considerable attention, both in England and the United States, as a substitute for guano and bone-dust. So important is the substance deemed, that the British government sent commissioners to Estremadura in Spain, where the mineral is found, for the purpose of arranging for its importation into England; but the result was that it did not appear to exist in sufficient quantity; so that the only mineral phosphate now used by the agriculturists in England is obtained from the *crag* on the coast of Suffolk. This, however, is very impure, containing much carbonate of lime and other earthy matters; while the mineral phosphate found in Canada is nearly in a pure, and much of it in a crystallized state. Although it has not yet been mined to any considerable extent, sufficient has been ascertained with regard to its mode of occurrence to render it certain that it can be obtained in very great quantities, and it may be hoped that it will supersede the use of bones, of which probably not less than £400,000 or £500,000 worth are annually imported into England. Besides the use of bone-dust for agricultural purposes, several thousand tons of it are annually used in England for the

manufacture of china ware, at a cost of from seven pounds to ten pounds per ton. Probably the mineral phosphate might be successfully applied as a substitute for this purpose also. As a manure it has been actually applied to the land with great success; but a good and cheap method of decomposing it, previous to applying it to the soil, is still a desideratum. The usual mode of applying it as a manure, is to grind the mineral to powder, and treat with coarse sulphuric acid; about two-thirds of the phosphate is thus at once liberated, and enters into combination with the soil, while the remaining third will act upon the ground the ensuing year, by becoming soluble by natural agencies.

This mineral is found very extensively distributed among the Laurentian rocks, both in detached nodules and in crystals; but the most important locality of its occurrence hitherto discovered is in the township of South Burgess, where it forms a massive bed of unknown though evidently very great dimensions, which has been quarried to a small extent. Another deposit in the adjoining township of Elmsley, but which, from the direction of the beds, seems to be in the same band, has also been worked a little, and apparently forms an irregular bed in the Laurentian limestone. This bed has been traced upwards of a mile, and seems to be about ten feet wide, of which three feet are nearly pure crystalline apatite, containing about ninety per cent. of phosphate of lime, the remainder being mixed with the limestone rock, in which, however, the phosphate greatly predominates. The deposit in South Burgess has the great advantage of being very easily quarried, and of being situated immediately upon one of the reaches of the Rideau canal. The mineral is stated to be worth from twenty to thirty dollars per ton in England, the value of course varying according to the percentage of phosphoric acid. When we consider the bearing of the phosphate of lime upon the animal and vegetable economy, we must regard the discovery of this substance in such abundance,

and so easily accessible, as one of the most valuable of the sources of wealth which has been added to the country during the last few years.

*Gypsum.*—In regard to this valuable material, the following extracts from a lecture delivered by Professor Hind of Toronto, in 1857, are pertinent and exhaustive: "The vast areas occupied by the rocks yielding gypsum in Western Canada have for many years been regarded as sources of great national wealth. Our gypsiferous rocks extend from the Niagara to the Saugeen, a distance of 150 miles, and have a breadth varying from five to fifteen and even twenty miles. Gypsum has been quarried in the townships of Dumfries, Brantford, Oneida, Cayuga, and others in the valley of the Grand River; it will probably be found in great abundance in the valley of the Saugeen when that fertile tract of country becomes better known.

"Gypsum, or sulphate of lime, is used in the arts for numerous purposes. It is employed by potters for procuring moulds with its calcined powder, moistened with a proper quantity of water. The finer kinds are selected for the manufacture of the alabaster ornaments so much admired. When properly calcined, and ground to a fine powder, it is largely employed for stucco-work, statues, and statuettes; when mixed with glue or gelatine, colored stuccoes of great hardness and beauty are made from it. It is admirably adapted for taking casts of objects, and is frequently employed for that purpose. When mixed with alum, borax, or potash, a variety of materials greatly prized in the plastic arts are produced. The subject is one of general interest, and the vast deposits of gypsum in Canada will no doubt become considerable sources of wealth when the proper time arrives.

"For agricultural purposes the value of gypsum is too well known to require much notice here; a growing appreciation of its worth is shown in the yearly increasing demand, and it is now found for sale in large quantities in most Canadian towns. It is a fact ascertained by the ex-

perience of very many years in France and Germany, and more recently in America, that gypsum, when judiciously applied, sometimes doubles and even trebles the quantity of certain plants usually grown on a given area. A study of the mode and time of applying it, and of the plants most benefited by it, ought not to be lost sight of in Canada, where it so largely abounds. The value of the exports from Canada of ground plaster and hydraulic lime shows a steady and important increase. In 1853 it was £1,340; in 1854, £2,017; and in 1855, £19,112."

Sir William Logan remarks: "All the gypsum mines at present worked in Canada occur on the Grand River, in a distance of thirty-five miles, extending from Cayuga to Paris. All the mines appear to be confined to one stratigraphical position in the formation, which is probably about the middle. The mineral occurs in lenticular masses, varying in horizontal diameter from a few yards to a quarter of a mile, with a thickness of from three to seven feet. The layer of gypsum appears to be in general both overlaid and underlaid by beds of dolomite, much of which is fit for the purpose of hydraulic cement, and the gypsum itself is sometimes interstratified with thin beds of dolomite. In some parts there appear to be two workable ranges of gypsum, one a few feet above the other. But this probably is only to be considered as a thickening of the gypsiferous band with an interstratification of a larger mass of dolomite."

The business of mining gypsum in Canada, and of preparing it for the market, has been in existence for the last fourteen or fifteen years. The following is the amount raised annually from the quarries on the Grand River, according to Sir Wm. Logan's returns:

T. Martindale, Oneida, .....	Tons. 3,500
J. Donaldson, " .....	1,500
A. Taylor, York, .....	3,000
Thompson & Wright, Paris, .....	4,000
J. Brown, Cayuga, .....	2,000

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14,000

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

	Per Ton.
Plaster, unground.....	\$2.00
“ ground for agricultural purposes.....	3.50—4.00
“ “ stucco, raw.....	5.50—7.00
“ “ “ calcined.....	16.00

Much of the produce of these mines is sent to be ground and prepared for market by Mr. Brown of Thorold, on the Welland Canal, who has for the last fifteen years manufactured on an average 1,000 tons annually.

*Shell Marl.* Vast deposits of recent shell marl and calcareous tufa are found in various localities, and in all parts of Canada, too numerous to be here specified. Wherever they occur the land is characterized by a luxuriant vegetation, and dense growth of hard-wood timber, indicating their extraordinary fertilizing properties on the soil. The deposits of shell marl extend in some instances, as in the township of Sheffield, county of Addington, C. W., about 400 acres, with a thickness over the greater portion of at least ten feet. One of the deposits of calcareous tufa is supposed to extend over more than 1,000 acres, with an average thickness of five feet.

HYDRAULIC CEMENT.—ROOFING SLATES.

At several points, and in various geological formations in Canada, silicious dolomites occur, which, when carefully calcined and ground, are found to furnish a very superior description of water-lime or cement, which rapidly hardens under, and permanently resists the action of water; this invaluable property being due to their containing a definite proportion of silicious and magnesian salts associated with the lime. The principal localities where limestones holding the proper admixture of the materials named have been discovered are at Paris, Cayuga, Thorold, Kingston, and Loughborough in Canada West, and at Nepean or Hull, Quebec, and the Magdalen River in Gaspé, Canada.

East. In some of these localities the beds have been worked; those of Hull and Thorold are of excellent quality and are highly esteemed. During the construction of various railway and other public works within the last ten years, the quantity of cement manufactured by Mr. Brown of Thorold averaged 80,000 bushels annually, but at present the quantity does not exceed one-tenth of that amount. The present price of the cement is from twenty to twenty-five cents per bushel of sixty pounds. The average annual value of cement ground at the Thorold mills, for the last eighteen years, varies from \$3,000 to \$6,000.

*Roofing Slates.*—"Slate is a material daily becoming more valuable, on account of the vast variety of useful purposes to which it is applied. One of its most important characteristics is its strength; it is computed to be about four times as strong as ordinary stone, and slabs eight feet long and upwards can be safely used of a thickness not exceeding half an inch. It is a non-absorbent of moisture, and is thus adapted as an admirable lining for wells and for roofing houses. The economical importance of slates has attracted attention to their distribution in Lower Canada, and already large quarries are worked which furnish slate of a superior quality."—*Professor Hind's Lecture.*

Sir William Logan makes the following valuable remarks on the numerous useful applications of slate: "Not only is it applied as a covering for houses, but it is employed as walls for cisterns to hold water, slabs of fifteen feet by eight being sometimes used for this purpose; in smaller dimensions it is used for wine-coolers, dairy dressers, kitchen and hall flooring, tables, chimney mantels, and a multitude of other purposes where surface is required. In its application as tables and chimney-pieces, it is capable of receiving a high degree of decoration: the tables, after being dressed to the smoothest possible surface, are embellished with gilding, or with paintings in colors resisting fire, showing landscapes or imitations of stone; and a

silicious varnish being applied, the stone is subjected to a heat which melts the varnish into an enamel, and produces a brilliant result. Chimney-pieces in the same way are enamelled over the natural color of the stone, or over a fancy color given to it. When the color is black, it is difficult to distinguish the slate from a brilliantly polished and valuable black marble, while the cost is comparatively small. The great number of purposes to which good slate is applicable render the rock of great economic importance and well worthy of research." To the many advantages above enumerated, attending the use of this material, may be added the extraordinary facility with which it can be worked into any required shape.

The best slate quarry hitherto found in Canada is Mr. Benjamin Walton's, in the township of Melbourne, C. E.; the band of slate is one-third of a mile wide, and overlies serpentine rock; thus marking its geological position to be in the Quebec group of the lower Silurian system, and probably equivalent to that of the far-famed Welsh slate rocks. Mr. Walton commenced preliminary operations in 1860, and has produced slates for the market since the spring of 1861. In opening up the quarry an expenditure of about \$30,000 is said to have been incurred, and during last year the value of slate sold has been about \$8,000.

These slates are held in high repute for their excellent quality; and it is confidently anticipated that, when in full operation, this quarry will find an abundant market for its produce, not only in Canada, but in the western cities of the Union. The following table, given by Sir Wm. Logan in his Catalogue of Economic Materials for 1862, exhibits, first, the sizes of the slates in inches; second, the number of such slates in a square (of one hundred square feet); and, third, the price per square at which Mr. Walton supplies his slates, placed on the railroad cars on the Quebec and Richmond branch of the Grand Trunk Railway, which is within one and a half mile of the quarry.

Size.	Number.	Price.	Size.	Number.	Price.
24×16....	86....	\$4.00	16×10....	222....	\$3.75
24×14....	98....	4.00	16×9....	246....	3.75
24×12....	114....	4.00	16×8....	277....	3.70
22×12....	126....	4.00	14×10....	262....	3.00
22×11....	138....	4.00	14×9....	291....	3.00
20×12....	141....	4.00	14×8....	327....	3.00
20×11....	154....	4.00	14×7....	374....	2.75
20×10....	169....	4.00	12×8....	400....	2.75
18×11....	175....	4.00	12×7....	457....	2.50
18×10....	192....	4.00	12×6....	533....	2.25
18×9....	213....	4.00			

Canada abounds in materials of the best quality applicable to common and decorative construction, such as clay for bricks, etc., building stones of every description, flags, marbles, porphyry, and many stones applicable to jewelry—also grindstones, and whetstones of a very superior description; but want of space compels us to omit all special notice of these products.

PEAT.

We must not omit mention, however, of a substance which is found here, perhaps more largely distributed and of a better quality than in any other country in the world; and which is probably destined at no distant date to become of great economic importance. We refer to peat.

This description of fuel is found to form an excellent substitute for coal in many countries where the latter invaluable substance does not occur; and for the manufacture of the best kinds of iron, for which the Canadian ores are especially adapted, peat would be found peculiarly applicable. Various contrivances for compressing peat have recently been patented, and introduced into England and France; and if this can be economically effected in Canada, there will be a very large field open for the employment of this department of national industry. As the country becomes more thickly settled, wood will rap-

idly disappear, and in this exigency the peat bogs of Canada will afford an inexhaustible supply of fuel, second in value only to beds of mineral coal.

Peat occurs in great abundance in many parts of the province; in the Island of Anticosti, in the Gulf of St. Lawrence, there is an area of not less than 160 square miles, occupied by a peat bog; the thickness of peat varying from three to ten feet where observed. This is the largest peat field in Canada, and the general quality of the material is excellent. Including this deposit, Lower Canada contains probably not less than 1,000 square miles of this valuable material, and in many places the thickness is much greater than that mentioned above. Canadian peat is found, on a careful comparison, to contain less mineral matter than that usually found in Europe. An attempt was made, some eight or ten years ago, to introduce this material into Montreal as a fuel, but not being prosecuted with sufficient energy and perseverance, it fell to the ground. There can be no doubt, however, that at no distant date, and especially in that large and flourishing city, where the material is very abundant in the immediate neighborhood, sufficient inducements will be offered for the prosecution of this branch of industry.

#### PETROLEUM.

This very remarkable mineral product has for the last two or three years attracted a large share of public attention in Canada, where its existence in such abundance as to afford promise of a great and permanent traffic has been fully recognized. Never, perhaps, has there been an instance of an extensive trade so rapidly developed as in the case of the rock oil business in Canada.

The locality in which the oil springs have for the most part been discovered and worked in Canada is the township of Enniskillen, county of Plympton, in the western peninsula; and the geological position is the summit of the upper Silurian, or base of the Devonian systems of lime-

stone rocks, being a lower horizon than that of the oil wells of Pennsylvania and Ohio. The petroleum owes its origin, in all probability, to the slow subterranean decomposition and bituminization of organic matter, both animal and vegetable, but chiefly the latter, which have been deposited with the other materials of which the rocks are composed. The resulting fluid and gaseous matters, floating on the surface of the water which permeates the strata, accumulate chiefly along the summit of a flat anticlinal axis, which traverses the western peninsula of Canada, penetrating the fissures or cracks in the rocks. The oil reveals itself at the surface, either by hydrostatic pressure or by the elastic force of the vapor, where the superficial clays are penetrated, either by natural or artificial means.

The fact of the existence of petroleum springs in Western Canada is by no means a new discovery, although it is only very recently that they have been ascertained to be of much economic importance. At several points along the banks of the river Thames and Bear Creek in the western peninsula, the oil has been long known to exude at the surface, and float along the water; and was used in the neighborhood as a remedy for cuts and cutaneous diseases in horses. In the south part of the township of Enniskillen two patches on the surface of the ground, of an acre or more in extent, are found to be covered to a considerable depth with a viscid mineral tar or asphaltum, which has resulted from the oxidation and drying up of springs beneath. It is the existence of these superficial deposits that first attracted attention to the substance as a source of illuminating oil; and it was speedily discovered that, on penetrating below the asphalt into the underlying clay, great quantities of the oil could be obtained in the fluid state, and consequently much nearer the condition required in the manufacture. The first adventurer in this field was Mr. W. M. Williams, of Hamilton, who commenced operations in 1857, and to whom alone is due the merit of developing this branch of industry in Canada, as

well as of pointing out the road to success in the same direction in the United States. The capital which Mr. Williams and his associates have embarked in the works is about \$50,000; the oil obtained at their wells is conveyed in barrels to Hamilton, a distance of upwards of 100 miles, and there refined for the market. Refineries are now, however, in operation to a considerable extent in the oil region itself, there being not less than six establishments of the kind in Enniskillen, and about an equal number in other parts of the province. The refining process consists in rectifying by repeated distillations, deodorizing by treating with acids, and subsequent washing in alkalis.

Sir William Logan estimates that "within an area of about four square miles in the first three ranges of the township of Enniskillen, there were supposed to be in August, 1861, about seventy wells yielding more or less oil. Of these forty were surface wells, that is, wells sunk from forty to sixty feet through the drift clay and gravel to the rock beneath. Some of these latter, which had yielded but little oil, gave abundant supplies by boring into the rock. The oil-bearing fissures or veins in adjacent wells were met with at depths varying from 36 to 100 and even 150 feet from the surface of the rock." Since the date to which Sir William refers many other wells have been sunk, and there are now several hundreds in the township, many of which, however, do not yield oil. In some cases, by penetrating to depths exceeding 200 feet from the surface, what are called "flowing wells" have been obtained, and these, from their extraordinary yield of oil, and from the circumstance that it is procured without pumping, for the present eclipse in importance all the rest; but experience in other regions has proved that these valuable qualities do not continue to exist for any very lengthened period at any one well. Some of the flowing wells, of which there are altogether twelve up to the present time, are said to have yielded at the rate of about 2,000 forty-gallon barrels in twenty-four hours. The petroleum from these deep wells

is lighter, more fluid, and better adapted for the manufacture of illuminating oil than that from the surface wells.

The total yield of the Enniskillen oil region, till the commencement of 1862, is probably about 500,000 gallons, but this quantity by no means represents the capacity of the wells; as, from the difficulty of communication during a great part of the year, the scarcity of barrels, or other vessels to receive the oil, and, above all, the want of a regular market for the produce, they have never been worked to their full capacity. At present much activity prevails among speculators in this interesting commodity, and there is a prospect of very large exports being made of the crude oil to England, and even to the United States, as the Canadian petroleum is reputed to possess superior qualities for refining purposes to that found in Pennsylvania and Ohio, which is said to be too light, and to contain too much volatile and explosive naphtha. So long as the flowing wells continue their extraordinary yield, the price of the oil at the wells is almost nominal; yet such is the cost of handling and transportation, that it is worth one shilling per gallon, or from £15 to £18 sterling per ton, in England, including packages.

The loss in refining, where illuminating oil only is produced, is considerable, and in these circumstances it will obviously be of advantage, so long as fuel can be obtained at a sufficiently cheap rate, to refine the oil in Canada and export it in that state. The refuse or heavier products of the distillation, however, contain highly useful ingredients, such as benzine, and many valuable coloring matters, which in present circumstances can be turned to much better account in England; and thus it will probably be found that the exportation of the crude oil will ultimately form the staple business in this commodity. At present rates, the cost of delivering one ton of crude oil in London or Liverpool will not exceed £9 or £10 sterling, which will leave a considerable margin for profit. There seems little reason to doubt that an immense traffic in this article

will spring up between the two countries; already about 6,000 barrels have been exported from Enniskillen to England during the present season; and from 40 to 50 teams are daily employed in hauling from the wells to the railway station. Although it is impossible to predict with any degree of certainty how long the supply may continue at any one point, yet, from the facts that wells sunk quite near to each other have evidently an independent source, and that there is a very large area of country underlaid by the oil-bearing veins, it is probable that the resources of the country in this respect will not speedily be exhausted.

#### MINERAL RESOURCES OF NOVA SCOTIA, NEW BRUNSWICK, AND NEWFOUNDLAND.

In Nova Scotia the most important minerals of economic importance hitherto discovered and wrought, are coal, gypsum, iron, and gold. We must be content with a very slight sketch of the history and statistics of these products. For the facts adduced we are indebted mainly to Dr. Dawson's valuable work on "Acadian Geology."

##### COAL.

The coal-fields of Nova Scotia have been long known to be of vast extent and value, and have been worked more or less since the first settlement of the colony by the British; when the imperial government, in making their grants of land, reserved for the crown all mineral rights, and subsequently leased them to a company of capitalists styled the General Mining Association, by whom the coal has been for the most part mined and exported. The most important are the Albion mines in the county of Pictou, in the northern part of the province, where two seams of excellent coal occur, of the enormous aggregate thickness of thirty-seven and twenty-two feet respectively; although

of this total thickness only about twenty-four and twelve feet can be said to be good coal. The *main seam* has been very extensively worked, and its outcrop has been traced for several miles; but it is remarkable that it preserves its character as a seam of good coal only for a very limited distance on either side of the main shaft. The coal hitherto exported has been obtained almost exclusively from the upper part of this seam, the workings being from twelve to nine feet deep, and the lowest shaft sunk to a depth of about 400 feet. Although the coal rapidly deteriorates in quality in all directions from the main shaft, its thickness, together with that of the underlying *deep seam*, is so great that there is no prospect of their being speedily exhausted; and long ere this occurs, there is little room to doubt that other good seams will be discovered in the same district.

The quantity of coal raised at these mines in 1851 was about sixty thousand chaldrons, and subsequently this yield has been still further increased. It is chiefly exported to the United States, and is admirably adapted and extensively used in making gas, as well as for general purposes. These mines afford employment to a population of 2,000, and their produce is conveyed by a railway worked by locomotives to the harbor of South Pictou, a distance of six miles.

The following is an abstract of returns of coal raised, sold, and exported at Pictou in the year ending 31st December, 1858:

	Large Coal.	Slack Coal.
Total quantity raised and sold in tons.....	100,607½	14,344½

Of this there was—

Sold for home consumption.....	9,212½	4,519½
Exported to the United States.....	89,217	6,396
Exported to the neighboring Colonies.....	2,178	3,419

Next in importance to the Pictou coal mines are those of Sydney, at the north-eastern extremity of Cape Breton. Here the productive coal measures cover an area of 250

square miles, and the aggregate thickness of the coal seams amounts to thirty-seven feet, of which, however, only twenty feet are of good quality, or workable thickness. The mines are worked here, as in the preceding instance, by the General Mining Association, who raise annually from the Sydney main seam 80,000 tons of coal, which is conveyed by railway to the bar at North Sydney for shipment. About 30,000 tons are annually consumed in Nova Scotia, the remainder being exported to the United States. The quantity of coal annually raised in the county of Cape Breton, and almost entirely at Sydney, is stated in the census of 1851 at 53,000 chaldrons.

In Cumberland county, on the confines of New Brunswick, occurs the celebrated "South Joggins Section" of the carboniferous system of rocks, which forms such an attractive object to geologists, and has thrown so much light on the theory of the coal formation, and all matters relating thereto. Here, from the relative conditions of dip and coast line, we find extending over a distance of about ten miles, an exposure of not less than 14,000 feet in vertical thickness, of successive rock formations, comprising the whole of the carboniferous series, and including more than *seventy* distinct seams of coal. Of these, however, only one seam is of sufficient thickness to work, consisting of two beds, three feet six inches and one foot six inches thick, respectively, with a clay parting between, varying from one foot to a few inches. It is a free-burning bituminous coal of fair quality. The quantity of coal shipped in 1851, was only 2,400 chaldrons; it was exported principally to St. John's, New Brunswick. Other seams of good coal, of much greater thickness, have been discovered in this carboniferous district, but at too great distance from navigable waters to be profitably mined, until the general progress of the country admits of the construction of railways or other sources of demand for the material.

The total quantity of coals raised in Nova Scotia in 1851, according to the census returns, was 115,000 chaldrons; in

1856, 120,668 chaldrons, valued at £86,027, were exported, while in the first nine months of 1857, the shipments were valued at £90,315, which are the latest official returns we possess. These figures show a rapid and extensively increasing trade.

There can be little doubt that the coal of Nova Scotia is sufficient to supply the whole steam navy of Britain for many centuries to come, and also to meet amply the demands of the other North American colonies bordering on the Atlantic, which possess within themselves no coal-fields of any importance.

#### GYPSUM

This useful mineral occurs in very great abundance, associated with the carboniferous rocks of Nova Scotia, and is mined to a considerable extent at several points, but chiefly in the districts of Hants and Colchester. The gypsum of Nova Scotia occurs in various forms and conditions; sometimes as an hydrite, or *hard plaster*, which is not at present applied to any useful purpose, being too hard to be profitably ground for agricultural purposes, though very well adapted as a substitute for marble. Sometimes the common gypsum is found in beds and masses, and sometimes in veins cutting the soft marly sandstones of the carboniferous series; in the latter case the gypsum is generally of a fibrous structure. The principal point where this mineral is quarried for economic purposes, is on the banks of the river Shubenacadie, in Hants, where immense masses of pure gypsum rise boldly from the banks, occasionally to the height of one hundred feet, presenting an inexhaustible supply of the mineral. It is also largely quarried at Windsor, Newport, Walton, and several other places. In 1851, the quantity exported amounted to about 80,000 tons, the value of which at the port of shipment would be about \$40,000, the greater part being exported to the United States for agricultural purposes. It is at present only quarried in places accessible

to shipping, and its small value per ton indicates the facility with which it can be obtained, in a country where wages are high.

At other parts of the province, as in Cape Breton, very large deposits of the mineral are found, but not at present worked.

#### IRON.

A very extensive and remarkable deposit of iron ore, which promises to be of much economic value, occurs, associated with the metamorphic upper Silurian rocks of the Cobequid hills, in the county of Londonderry. This deposit attracted attention as early as the time when the land on which it occurs was granted by the crown, and it had been brought into notice at various times subsequently. Since 1845 the extent and economical capabilities of this deposit have been discussed by several writers, and it has been opened, and smelting furnaces put in operation by an association of capitalists, under the title of the "Acadia Mine." This enterprise has recently been taken up by a powerful English company.

This vein occurs near the junction of the carboniferous and metamorphic series, and runs nearly, although not altogether, with the stratification of the rocks, which are tilted into a vertical position. It contains a great variety of different ores of iron, as magnetic, specular, hematite, &c., as well as other minerals; it is in one place not less than 120 feet in thickness, and has been traced for a distance of seven miles. "The deposit," says Dr. Dawson, "is evidently wedge-shaped, being largest and richest on the surface of the highest ridges. It contains, however, an immense quantity of valuable ores of iron, though its irregular character opposes many difficulties to the miner. Difficulties have also been found in smelting the ore to advantage; but these are often incident to the first trials of new deposits, to which the methods applicable to others, of which the workmen have had previous experience, do not apply. It is to be hoped, however, that these prelimi-

nary hinderances have been overcome, and that the mine will soon become highly profitable to the proprietors." The following general estimate of the value of the deposit is quoted from an elaborate report made in 1849, by Dr. J. L. Hayes, of Massachusetts, which is further interesting, as furnishing a statement of the comparative value of iron ores at different places :

"From the descriptions above given, it is evident that although the unlimited extent of the ore at a particular point can only be determined by working the deposits, yet an immense field is open for exploration and working. Although it is probable that an abundant supply of ore will be found upon the mountain last described, at a price not exceeding \$2 per ton of iron ; if this should not be the case, an ample supply can be furnished from the other localities at an expense which, including raising and hauling, could not exceed \$4 to the ton of iron. I would advise the opening of the veins at different points upon the line, to determine the cheapest point for mining, and the ores which can be used most advantageously. If this is done, the price of the ore cannot be fairly set down at the sum for which it can be obtained at the nearest locality, but at an average of the prices of the ores from different localities, delivered at the point selected for the furnace. This may be estimated at \$3 to the ton of iron.

"The value of this locality with respect to ore may be judged of by comparing it with establishments in the United States. In Berkshire Co., Mass., at some establishments which have been successfully conducted, the price of the ore is between five and six dollars to the ton of iron. In Orange Co., N. Y., ore yielding between forty and fifty per cent. costs between four and five dollars to the ton of iron. At one locality in New York State the ore costs ten dollars to the ton of iron ; at some establishments on Lake Champlain, ore costing one dollar per ton at the mine is carried twelve miles to the furnace. The ore at the Baltimore furnaces costs over seven dollars to

the ton of iron; this is also about the average cost of the ore at the furnaces in Pennsylvania. Estimating the cost of the ore even at four dollars to the ton of iron, there will be an advantage over the average American localities.

"The cost of ores at some of the Swedish and Russian furnaces is still greater. In certain parts of the Ural Mountains the minerals are carried by land to the forests, a distance of from forty to eighty miles. Some of the forges of Sweden are supplied with minerals from Preabhungh and Dannemora, which are transported by land carriage, the lakes, and the sea, to distances exceeding 370 miles.

"I have no doubt that iron of the first quality for purity and strength, and which will command the highest prices in the market, can be made from these ores. If Mr. Mushet's opinion, based on his own experiments, that these ores will furnish steel-iron equal to the best Swedish brands, should prove correct, these ores possess a rare value; for of the many charcoal iron establishments in the United States, I know but one which furnishes iron suitable for making the first quality of steel."

In the district of Pictou and the neighborhood of the Albion Mines, already described, there occurs an immense bed of iron ore, which, from its situation and concomitant advantages, must eventually become of great economical importance.

#### GOLD.

Since the excitement with regard to the wonderful gold discoveries in California and Australia arose, reports have from time to time obtained circulation of similar discoveries in Nova Scotia, where the rock formations of the south-east Atlantic coast bear a remarkable resemblance to those of the auriferous regions in the countries named. Until a very recent period, however, these rumors have invariably been found to be devoid of adequate foundation. In fact, in 1855, Dr. Dawson, in his "Acadian Geology," expressed

the opinion, founded on geological considerations, that gold would probably be found in that region, but his remarks would lead to the inference that it might not prove to be of much economic importance. In 1857, Mr. John Campbell, a gentleman of considerable scientific attainments, obtained gold by washing the sand of the beach near Halifax harbor. This was the first actual discovery on record of gold being found in Nova Scotia, and since that time Mr. Campbell has devoted himself assiduously to the development of this branch of her natural resources.

In the year 1860, some important discoveries of the precious metal were made in the valley and toward the headwaters of the Tangier River, about forty miles north-east of Halifax, which created an immense excitement for a time, and tempted many to leave their ordinary avocations to search for gold, which, however, was not found in sufficient quantities to reward the labor, and consequently the excitement speedily subsided.

In the month of March, 1861, fresh discoveries of considerably larger quantities were made near the mouth of the same river; and since that time there has been a steady increase in the number, and also in the confidence, of the adventurers engaged in this pursuit, as well as in the ascertained extent of the gold-producing country, which may now be regarded as comprising an area of 6,000 or 7,000 square miles, being the entire region occupied by the metamorphic lower Silurian rocks of the Atlantic coast, the corresponding geological position to that in which it is found in most other countries. The description we have already given of these rocks as they occur in Canada, will apply to the same formations in Nova Scotia.

The most recent and authentic information hitherto obtained in regard to the Nova Scotia gold fields, is contained in an article contributed by Dr. Dawson to the "Canadian Naturalist," for December, 1861; and in an elaborate report by Messrs. Poole and Campbell (1862), who were specially appointed by the provincial govern-

ment to investigate the matter. From these documents we shall condense the most important particulars relative to this interesting subject. In this province, although the general conditions in which the gold occurs are doubtless the same as in other auriferous regions, it is remarkable that it is found chiefly in the quartz veins traversing the rocks, rather than in the superficial clays constituting the debris of these rocks. With the exception of one locality, "The Ovens," near Lunenburg, seventy miles west from Halifax, where a considerable quantity has been obtained in the sand of the beach, formed by the action of the waves upon the rocky cliffs, placer washings and surface diggings have not proved remunerative in Nova Scotia. On the other hand, the quartz veins, on which the Californian and Australian digger is accustomed to look with suspicion, are here remarkably productive; an instance is upon record where one and a half ton of quartz has produced seventy-two ounces of gold, valued at \$1,296. The veins have been traced continuously for a distance, in one case, of two and a half miles, and found to pay well throughout this whole extent. In many instances the veins are exposed at the surface, and, where concealed by drift clay, its thickness is very inconsiderable, rarely exceeding six or eight feet. In mining in the veins themselves, their richness appears to increase with the depth; and there is much to encourage the hope that deep mining will prove the most successful to the adventurer, as well as the most permanent and reliable source of wealth to the province.

The most important gold fields in Nova Scotia hitherto discovered occur in the district of country eastwards from Halifax to Cape Canso, a distance of 130 miles, with an average breadth of about twenty miles. Within this area, Mr. Campbell has recognized the existence of five bands or lines of elevation, running nearly parallel with each other and with the general coast line, and exhibiting at some places arched or folded strata of dark-colored clay-slate,

traversed by quartz veins, of thickness varying from one to nine or ten inches, following the planes of bedding in the strike, but frequently cutting the strata in the direction of the dip, sometimes in wavy or zigzag lines. There are also larger veins, from one to three feet in thickness, but the thin veins first referred to are invariably the richest in gold. The metal occurs, for the most part, disseminated in irregular grains and masses in the quartz: it is found most abundantly at and near the walls of the veins, and is usually associated with iron pyrites and *mispickel*, or arsenical pyrites. The largest nugget yet found is said to be valued at \$300.

It is impossible to state, with any degree of accuracy, what amount of gold has been hitherto obtained in Nova Scotia, as, in almost every instance, the claims have been worked by private individuals, who are generally unable or disinclined to give the requisite information. Even if ascertained, this would afford no criterion of the value of the gold fields, as the search has hitherto been prosecuted only in the rudest manner. At one claim at Tangier \$2,400 are said to have been realized in a very short time; \$1,300 from another, and \$480 from a third, while many have yielded little or nothing. A statement we have recently seen gives the daily yield as 100 ounces, valued at \$18 per ounce. The Nova Scotia gold is of remarkable purity. The principal localities where mining has hitherto been carried on are Tangier, Wine Cove, Laurencetown, Sherbrooke, Isaac Harbor, and Lunenburg. With the exception of Lunenburg, the district of country westward of Halifax has not as yet produced much gold.

The provincial government have surveyed and divided the principal gold fields into claims of twenty feet by fifty feet, and exact an annual license fee, or rent, of \$20 for each claim. It is to be hoped that a more liberal policy will prevail, and greater encouragement be extended to the adventurers, as the claims are much too small, and the rent too high, where the risks of mining are so great.

"In one important respect," says Dr. Gesner, "the Nova Scotian gold fields possess a very great advantage over those of Australia, California, or British Columbia: namely, that the rocks containing the gold in the greatest abundance are near the Atlantic coast; and intersect a number of the smaller rivers and harbors, whereby facilities are afforded to supply the requirements of mining. It is not at all probable that the richest gold deposits in Nova Scotia have yet been discovered; but there is enough known to satisfy the most sceptical that the province contains an ample amount of the precious metal to warrant the most extensive operations, and the employment of machinery for its mining and purification."

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### NEW BRUNSWICK.

THE province of New Brunswick has not hitherto attained much consequence as a mining region, although a very great part of its area is underlaid by the coal-measures; and many of the metals and other useful minerals are known to exist within its bounds.

The coal formation of New Brunswick occupies an area which is somewhat triangular in outline. Its base rests on the Gulf of St. Lawrence, and extends from Bathurst on the north to the Nova Scotia frontier on the east. Its apex is at the Oromocto Lake; and its north-western margin runs from thence to Bathurst, while on the south-east it approaches the Bay of Fundy.

It is worthy of remark, that only the south and south-east sides of the great New Brunswick carboniferous basin have yet been explored.

Within this area the only point at which coal mining operations on an extensive scale have been carried on, is

at the Grand Lake in Queens County, between Little River and Coal Creek, at the head of the lake. Here mining leases, covering a space of about forty-five square miles, were granted by the crown in 1849; this area being supposed to cover all the available coal ground in this locality.

The number of distinct beds of coal is uncertain; the average thickness of those which are worked, is about twenty inches; the depth of the coal below the surface seldom exceeds forty feet. The quality is excellent, being hard, rather lustrous, giving out much heat in burning, and lasting longer than most other coal. The amount brought to market in 1854, was about 3,000 chaldrons, but the mines are capable, with proper management, of producing at least double this amount. We are not aware whether these mines are now in operation.

We have now to refer to a very remarkable mineral deposit, allied to coal, which has been discovered in this province, and somewhat extensively developed, and has assumed much economic importance as a source of illuminating oils and gas.

We refer to the Albert coal. This remarkable mineral, which appears to partake of the distinctive characteristics of coal, asphalt, and jet, without belonging to either class, occurs in the county of Hillsborough, near the southeastern boundary of the province, in an irregular vein, varying from one to thirteen feet in thickness, sometimes cutting and sometimes coinciding with the strata through which it passes, and which has been mined to an extent of several hundred feet on the length of the vein.\* We are not aware of the amount or value of the material extracted; it has been used chiefly in the manufacture of illuminating oil, of which it yields, by distillation, a very high percent-

\* The material is one of the most beautiful of all carboniferous products; it is jet black, brilliant, and lustrous, with a conchoidal fracture, and is extremely brittle. Its composition is: carbon (fixed at redness), 36.04; volatile, 61.74; ash, 2.22; equal to 100. Cocks, 28.26. Specific gravity, 1.13.

age, and of the very best quality; but since the discovery of the extraordinary petroleum wells of Pennsylvania and Western Canada, no other source (so long as it lasts) can at all compete with this for the purpose named.

The metalliferous rocks of the Appalachian chain traverse the northern part of the province, and may be expected, when the country becomes settled and explored, to yield the same results as in Canada, Nova Scotia, and the Eastern States of the Union. Already gold, lead, and copper have been found in these rocks in New Brunswick, and the deposits of iron ore are rich and extensive. The principal locality of copper is at and near the village of Bathurst, on the Bay Chaleur. Here rocks of the carboniferous system, or perhaps even higher in the geological horizon, and occupying the region bordering on the coast for a distance of five or six miles back, are found resting on the "primitive slate formation," probably of lower Silurian age. About seventeen years ago, a deposit of very rich copper ore was discovered in the bank of the river Nepisiguit, about one and a half miles from Bathurst, where mining operations were commenced, and about twenty-four tons of very rich vitreous copper ore, said to contain a considerable proportion of silver, were taken out; but the deposits not being sufficiently regular to pay mining expenses, the enterprise was abandoned.

Subsequent observations on the nature of these deposits, and of the enclosing rocks, leading to the belief that they were secondary products, derived from the debris of the older rocks lying farther inland, search was instituted in these rocks, which resulted in the discovery of some important copper lodes on the Tattagouche river, seven miles from Bathurst, which are now being developed by an American company. The lodes are said to be highly promising, being of great thickness, and having all the usual accompaniments of good copper veins; but the works having been temporarily suspended, we are unable to learn the results. Very considerable sums of money

have already been expended in mining in this locality. One remarkable peculiarity in the mineralogical character of this region is the occurrence of great veins of manganese ore in the neighborhood of the copper lodes, though in a rock of a different color.

A considerable deposit of copper pyrites has been discovered near Woodstock, Carleton county, about sixty miles north-west from Fredericton, in a true vein which has been traced for upwards of 2,000 feet on the strike, and traversing talcose and felspathic slates of the same geological age with those of the Tattagouche river. Mining operations were instituted here in 1858, to the extent of sinking trial shafts and costeeings, which have proved the deposit to be of considerable importance and value. We are not aware whether this mine is still worked, or to what extent it has proved commercially profitable. The Tattagouche and Woodstock mines are situated at a distance of about 130 miles apart, on a broad band of the formation; and the fact of such apparently valuable deposits being found at the extreme points of such an extensive area, the intermediate parts of which are as yet entirely unexplored, points to this as a highly promising field for mining enterprise.

Besides the metals above named in New Brunswick, deposits of plumbago and gypsum, and salt springs of a high degree of saturation, are found in many parts of the province.

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### NEWFOUNDLAND.

THE geological structure and mineral resources of the island of Newfoundland were examined and reported on in 1849, by Mr. Jukes, who gave it as the general result of his investigations, that the island is not favorably situated for useful minerals.

The coal formation occurs on a small portion of the

west side of the island, but the beds of coal do not appear to be of any considerable thickness; although it is quite possible that more important seams may be found, should the district ever be thought worthy of a thorough examination. Gypsum is very plentiful on the island. Copper was worked in Newfoundland upwards of a century ago, to a slight extent, and in 1845 attempts were made to revive the work. The copper veins were found in the "lower slate formation" (probably the equivalents of the Quebec group in Canada), in Shoal Bay, south of Peck Harbor, at the eastern extremity of the island. Owing to the unproductive character of the work, however, it was speedily abandoned.

A very remarkable lode of iron pyrites, containing also much copper ore, was discovered during the year 1861, about one mile inland from Little Bay, on the northeast coast of Newfoundland, and a company has been formed for working this and another similar deposit on Trump Island. A grant of these claims has been obtained from the colonial government, free from royalty during the first five years. Vigorous operations were commenced, during August of that year, by Mr. F. A. Gisborne, mining engineer, who turned the course of two rivers, at the junction of which the lode came to the surface. The lode was thus uncovered for a length of 200 feet, showing a thickness varying from twenty to forty feet of solid ore. The true course of the lode appears to be six or eight degrees north of east, and south of west; the northern country being a soft serpentine, and the southern killas, or slate; the north wall, so far as proved, goes down vertically. After various trial pits had been sunk (all of which proved a rapid increase in the richness of the vein for copper, within a short distance from the surface), a stope was commenced, forty-two feet in length and eight feet wide, along the north wall; from this stope a cargo of 150 tons was obtained, and shipped to Swansea. The ore is found in compact horizontal beds, or floors, averaging twenty

inches in thickness ; and at ten feet from the surface, would average eight per cent. for copper, and forty per cent. for sulphur : the surface ore yielding only from one to two per cent. of copper, this rapid increase in richness is truly remarkable. A shaft is now being sunk in the lode, and will yield about twenty-five tons of ore per cubic fathom, a result rarely surpassed in any mine.

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### BRITISH COLUMBIA, AND VANCOUVER ISLAND.

THE present has been, perhaps, more prolific than any preceding generation in wonderful discoveries in the arts and sciences, and especially in those means and appliances which tend to promote intercourse between distant parts of the world. A striking illustration of this remark is afforded by the late extraordinary and unprecedented discoveries of gold in California and Australia, which have done more in a few years for the settlement and civilization of these remote regions, than might otherwise have been effected in as many centuries. Still more recently another region, yet more remote from the beaten paths of nations, has been discovered to abound in the precious metal ; by whose potent influence British Columbia is rapidly becoming linked to the brotherhood of civilized nations.

Vancouver Island, on the western shores of the Pacific ocean, has been long regarded in England, notwithstanding its great distance, as a promising field for settlement and colonization, on account of the fertility of its soil, the security of its harbors, the excellence of its climate, and the reported abundance of coal on the island. These circumstances, together with its admirable adaptation generally, as a depot for the naval forces on the Pacific, early attracted the attention of the British government, and dis-

posed them to afford every encouragement to emigration ; but it was not till the year 1856,\* when the governor of the island reported to the imperial government the fact, that gold had been found in considerable quantities within the British territory on the Upper Columbia, that any considerable emigration took place. From that date to the present, the ascertained area and reputed richness of the British Columbian gold fields have steadily and rapidly increased ; and the influx of adventurers into Victoria, the capital of Vancouver Island, and the nearest port for the gold fields, has augmented in proportion.

The auriferous region of British Columbia comprises a vast, though unknown, area on the western slopes of the Rocky Mountains. Hitherto the discoveries have been chiefly confined to the left bank of the Frazer river, and its numerous affluents from the east, and to the head waters of the Columbia river ; the aggregate linear extent of which may be computed at 1,000 miles. The country is broken up into mountains and ravines ; there is really no level ground, except the tops of the mountains, which, curiously enough, are all flat and level. The ravines are characterized universally by what the miners call " benches," or terraces running along their sides. These benches are all auriferous as far as they have been tested. The geological formations and conditions are precisely similar to the gold-bearing region of California, of which in fact this forms only the northern extension ; and it is worthy of note, that gold mining has proved more successful in California the further north it has been prosecuted. The rocks consist of what (for want of a more precise designation) is now called the primary slate formation—probably, as in other auriferous regions, the metamorphic lower Silurian—thrown up and pierced by masses, veins, and dikes of quartz, granite, porphyry, and other so-called igneous rocks ; the débris from which, together with their precious

\* The earliest reported discovery of gold in British Columbia, however, was in 1850, and again in 1853.

metalliferous contents, form vast accumulations of sand, gravel and clay, extending from the base of the mountains to the banks of the rivers, which, as we have before stated, constitute for the present the field of labor for the miners. There is, however, reason to believe that ample scope will be found for their exertions at a distance from the principal rivers.

As a general rule, the gold is found in smaller particles and less in quantity nearer the mouths of the rivers, and both size and quantity increase as we ascend them. At the celebrated Cariboo district of the Frazer river, a lump of pure gold, weighing seven pounds, is said to have been obtained, and all the gold there is coarse. It will be readily inferred from what we have said, that the adventurers confine their attention entirely to placer digging, and washing, and this method of working will doubtless, for many years, be that universally adopted; but there can be little doubt that the auriferous veins which have supplied these washings will ultimately be discovered,\* and will afford inexhaustible supplies of the precious metal for generations to come. The principal difficulties to be contended with at present are, the want of roads or means of conveyance into the interior of the country; the difficulty of obtaining provisions, tools, and other materials; the freshets on the rivers, &c.; to which may be added, the hostility of the native tribes of Indians, who, though at present apparently friendly, are treacherous and capricious.

In Vancouver Island, although gold has been found and actually worked in a few places, it has not hitherto been obtained in paying quantities. There is every reason to believe, however, that important gold fields may yet be discovered on the island. Rich copper ore has also been found, but hitherto it is undeveloped.

Although here, as in all other gold-producing regions, wonderful instances of good fortune occur, and are noised

\* A rich auriferous vein was discovered in 1852, in Mitchell Harbor, Queen Charlotte's Island.

abroad, there are equally lamentable, and, we fear, much more numerous cases of failure, or at least of very moderate success. We do not therefore think it necessary to chronicle, as is the fashion with newspaper paragraphists, any *great strikes*, but shall confine ourselves to a statement, from authentic sources, of the quantity of gold actually obtained, and the number of hands employed, during the years 1858 and 1859, from which we shall be enabled to deduce their average earnings.

"In 1858," says Mr. Despard Pemberton, the surveyor general of Vancouver Island, in a recent work containing much valuable information on this subject,\* "the greatest monthly shipment of gold from British Columbia was \$235,000, and the least was about \$6,000; and the total product of the gold mines for that year was estimated at \$1,494,211 (Vide *Gazette*, April 19th, 1859). From data before me, I believe the amount mined in 1859 to have been about \$2,000,000; but, to be moderate, assume the product of the two years at \$3,000,000; the number of miners actually at work at any time in the country cannot have exceeded 3,000, as the mining licenses show. (*Gazette*, June 9th, 1859, estimates them at 2,000), which gives the miners' average earnings at £100 sterling." Mr. Pemberton probably somewhat underrates the prospects of success, but his "facts and figures" render it sufficiently obvious that, taking into account the aggregate results, adventurers will not be justified in forming very sanguine expectations.† Mr. Pemberton adds: "In California the average earnings are about half as much, but the country is open and accessible; and therefore the means of living and creature comforts much more plentiful, which leads the miner to prefer it far to British Columbia, notwithstanding the higher pay in the latter."

\* "Facts and Figures relating to British Columbia and Vancouver Island." London, 1860.

† It should be remarked that the miners can only work four months in the year.

Assuming, as we have every reason to believe, that Mr. Pemberton's statistics are correct up to the time he wrote, the last two years seem to have greatly improved the prospects of the gold miner in British Columbia, for we find a statement, apparently upon reliable authority, of the yield of 1861, and number of men employed, which gives a much higher average:—

79 miners took out an aggregate of .....	\$226,680
400 ditto, claim owners, took out.....	600,000
1,021 ditto, at \$7 a-day, in 107 days .....	764,729
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Total yield, nearly all from Cariboo ..	\$2,291,409
1,500 miners who worked in other places for 180 days at \$10 per diem .....	\$2,700,000
2,000 ditto, at \$5 .....	1,800,000
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	4,800,000
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5,000 miners—gross yield for 1861 .....	\$6,791,409

Giving an average of \$1,358 or about £272 sterling a year.

COAL.

The consumption of coals by steamboats on the Pacific is enormous, perhaps not less than 200,000 tons a year. It is, therefore, an object of much importance to secure a supply at the nearest point. The coal formations come to the surface towards the coast of British Columbia, and have attracted some attention; but the principal source of mineral fuel on the Pacific coast is undoubtedly Vancouver Island. Outcrops of coal occur at several points along the eastern coast of the island, and attempts have been made at various times, by the Hudson's Bay Company, who have, until very recently, held possession of it, to turn these discoveries to profitable account. The earliest record we can find of such works is in 1849, at Beaver Harbor, at the north-east extremity of the island; but this locality was soon abandoned as hopeless. Further search has, however, been rewarded by the discovery of extensive seams of workable coal at Naniamo, about sixty miles north of Victoria, in latitude 49° 15', longitude 123° 45'.

We subjoin the following detailed account of mining operations here, abridged from a paper by Col. Grant, read before the Geographical Society of London, in 1857.

“The coal at Naniamo was first discovered by Mr. Joseph McKay, in 1850, who was directed to it by the Indians of the neighborhood. The same seam was discovered on Newcastle Island, and several other small islands in the channel, and the Indians soon got out two hundred tons. A pit was commenced by ten regular miners, on the 17th of September, and a shaft sunk to a depth of fifty feet, being through twelve feet of alluvium, eight feet of sandstone, and thirty feet of shale; the situation of the pit is at the north-west extremity of Naniamo harbor. Here they struck another seam of from six to seven feet in thickness, lying on conglomerate; they are now regularly working this seam in several parallel galleries, extending to a considerable distance already underground. The seam here runs nearly level, although with sufficient dip to insure good drainage. The greatest quantity of coal that has been raised from it was at the rate of 120 tons per week, with eight regular miners. The other seam has been discovered outcropping at another place, at a considerable distance from the working already described, and an adit level is being driven upon it. Work has been done at four different places, three on the upper seam, which is of an average thickness of six feet, and one as above described, on the lower seam, about the same thickness and of precisely similar quality, situated fifty feet lower than the first. The pit is situated within a few yards of the water side, and vessels drawing sixteen feet can anchor close to it; notwithstanding its proximity to the water, very little pumping is required. It is the opinion of the head miner that coal may be found anywhere within a circumference of two miles from Naniamo, at a depth of fifty or sixty feet below the surface. Altogether, there are few places where coal can be worked so easily, and exported so conveniently as from Naniamo.”

As the Hudson's Bay Company have recently surrendered their territorial rights, it has been decided to sell the coal mines, which have accordingly been acquired by a powerful English company, who will doubtless work them to their full capacity. Altogether about 6,000 tons of coal have been exported from Naniamo up to the present date, of which one-half may be said to have been worked and loaded by Indians, and the rest by regular miners. It is chiefly used by the British steamers, those of the Hudson Bay Company, and by the steamers plying between Victoria and Frazer river; and is worth from four to six dollars per ton at the pit mouth. The coal is of excellent quality, very like that from the West Riding of Yorkshire; the chief objection to it is that it burns too quickly, and leaves behind a good deal of slag, which makes it difficult to keep the furnaces clear; it is, however, very strong, rich coal, and of high heating power.

Mr. William Downie, who was sent by the governor of Vancouver Island to explore the region in the north of British Columbia, along the coast to Fort Simpson, and back into the interior, as far as Stuart Lake, reports, under date October, 1859, that he considers this the best looking mineral country in British Columbia; in some places gold was discovered; rich veins of excellent plumbago were found, and an extensive coal country occurs, where seams, varying in thickness from three to thirty-five feet, were exposed in the banks of the rivers. Notwithstanding its excellent soil and climate, however, and its mineral riches, it is to be feared that unless the government assists in its development, this region must long remain in its primitive condition.

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#### THE NORTH-WEST TERRITORY.

QUITE recently gold has been discovered on British territory on the eastern slope of the Rocky Mountains, toward the head-waters of the Saskatchewan and Peace

rivers, and expeditions have been fitted out and are now engaged in proving the productiveness of this vast and unknown region. Should the gold be found in any considerable quantity, this will be a great stride toward the attainment of an object which has long been deemed of vast importance for the intercourse and civilization of the world; namely, the opening up, on the northern hemisphere, of a practicable route between the Atlantic and Pacific oceans. The magnificent lake and river system of Canada affords uninterrupted water communication for nearly half the distance, and Lake Winnipeg and the river Saskatchewan, together with the rivers flowing into the Pacific, form a great part of the rest; leaving only the district lying between Lake Superior and Red River, and the pass of the Rocky Mountains, to be overcome by land transport. The country traversed by the Saskatchewan is said to be remarkably fertile and to enjoy an excellent climate, while coal and other useful minerals abound.

Were it for no other object, the opening up of this region would be of inestimable importance, as the most direct route from England and Canada to British Columbia and Vancouver Island, in preference to a long, dangerous, and expensive voyage by sea. There can be no doubt that the existence of a supply of coal in British territory on the shores of the Pacific, and in the valley of the Saskatchewan, will exercise a powerful influence, in combination with the gold discoveries in British Columbia, in furthering communication between the Atlantic and Pacific coasts along the route we have designated.



