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QUEBEC, A MINING EMPIRE, SUMMARY OF THE GEOLOGY AND MINERAL RESOURCES OF THE PROVINCE OF QUEBEC

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Québec

Aerial view of the Sorel smelter

PROVINCE OF QUEBEC, CANADA

DEPARTMENT OF MINES

HONOURABLE W. M. COTTINGHAM, Minister

QUEBEC

A MINING EMPIRE

Summary of the Geology and Mineral Resources

of the

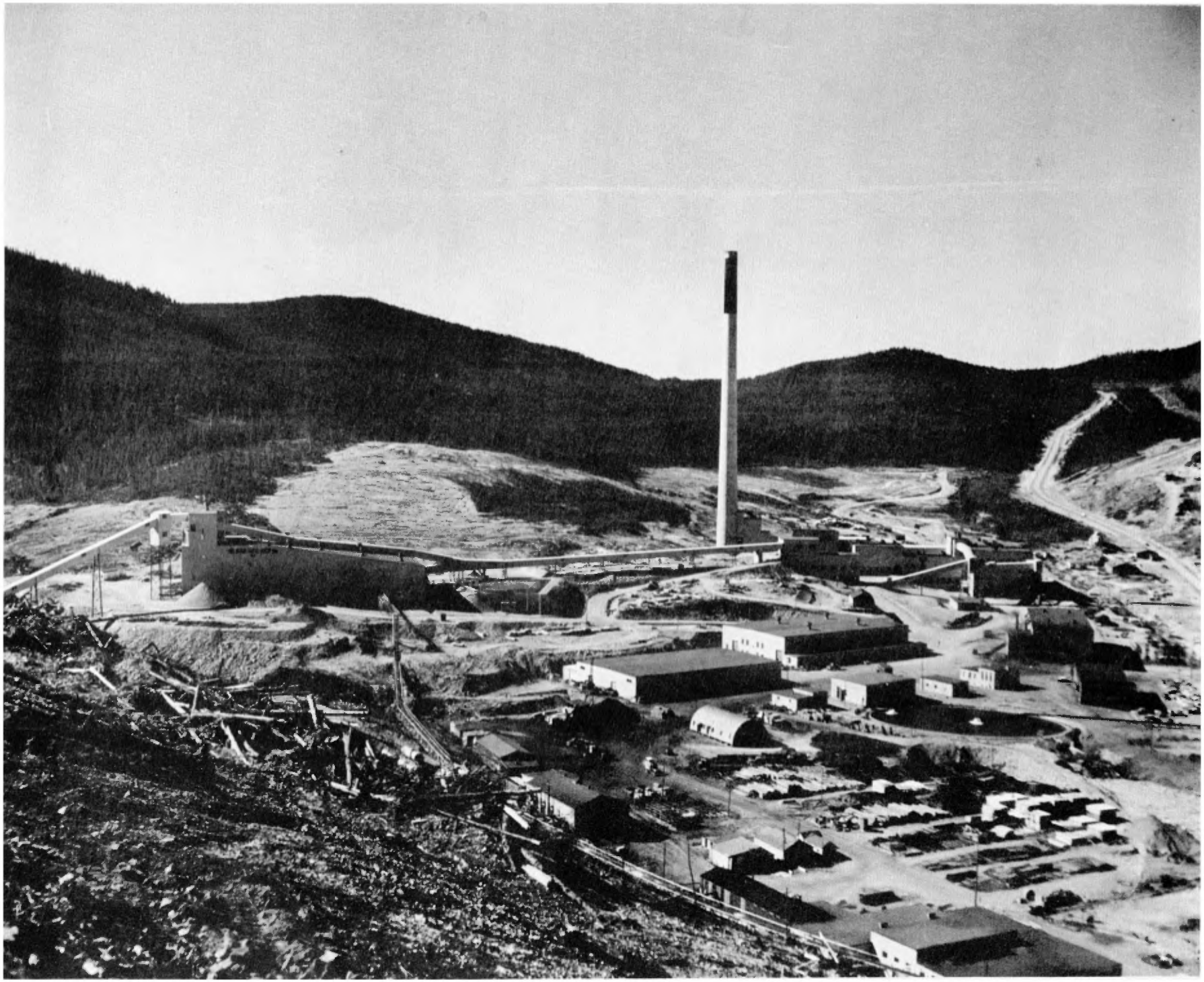
PROVINCE of QUEBEC

QUEBEC

RÉDEMPTI PARADIS

PRINTER TO HER MAJESTY THE QUEEN

1958



Gaspé Copper Mines at Murdochville, Gaspé-North Electoral District

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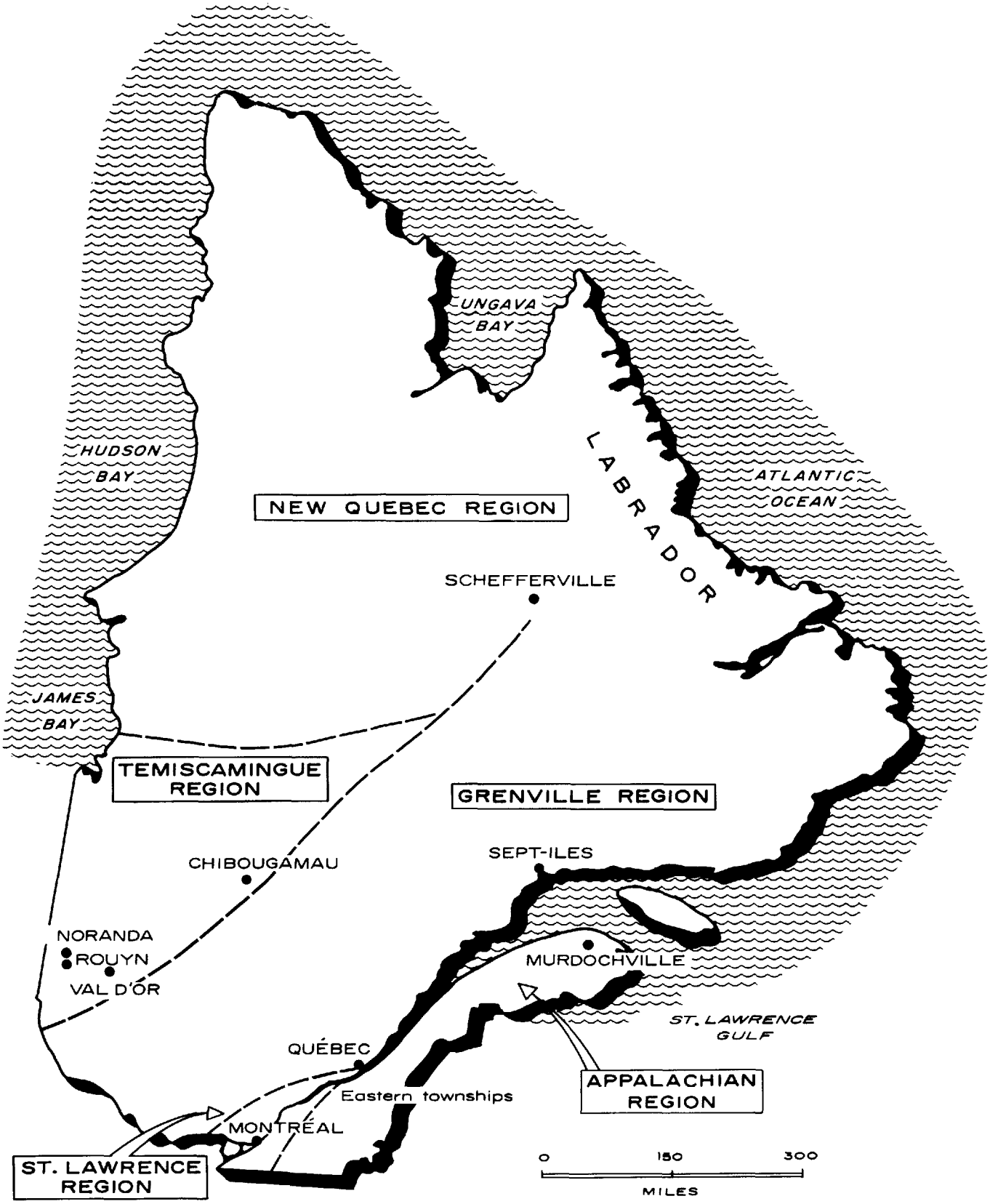


SKETCH MAP OF THE PROVINCE OF QUEBEC SHOWING GEOLOGICAL REGIONS

No 1190

PREFACE

This publication has been prepared to present to the general public a broad overall picture of the Geology and of the Mineral Resources of the Province of Quebec. The material has been compiled for the most part from published reports of the Quebec Department of Mines. For detailed information of a more technical nature the reader is referred to these publications.

QUEBEC

A MINING EMPIRE

INTRODUCTION

The Province of Quebec covers an area of approximately 600,000 square miles. It is the largest Province of Canada. Situated in the eastern part of the country, it is bounded on the north by Ungava bay and Hudson strait; on the west and southwest by Hudson bay, James bay, and the Province of Ontario; on the south and southeast by the States of New York, Vermont, New Hampshire, and Maine, the Province of New Brunswick, Chaleur bay, and the St. Lawrence gulf; and on the east by the Labrador coastal region of the Province of Newfoundland.

The Province has a population of four and a half million — twenty-nine per cent of the total population of Canada. The largest city is Montreal, which has over a million inhabitants and is also the largest city in Canada.

The major topographic feature of Quebec is the Laurentian plateau, which occupies nine-tenths of the area of the Province. This vast plateau extends from the valley of the St. Lawrence river to the northern tip of the Province. Its surface is broadly undulating and is trenched by many rivers, great and small. Lakes and swamps are numerous. Altitudes in the plateau are for the most part between 800 and 2,000 feet above sea level, with a few peaks reaching 3,000 feet.

To the south of the Laurentian plateau is a plain known as the St. Lawrence lowland, which extends westward from Quebec city on either side of the St. Lawrence river. Altitudes in this lowland area are 100 to 500 feet above sea level. The practically level surface of the plain is broken only by a series of eight isolated but geologically related hills spaced at intervals over a line extending southeasterly from Mount Royal, at Montreal, for fifty miles. These hills, known as the Monteregian hills, rise 600 to 1,000 feet above the surrounding plain, forming prominent landmarks that are visible for many miles around.

The hilly region southeast of the St. Lawrence is called the Appalachian highlands; it is a part of the Appalachian mountain system that extends through the eastern part of North America from Georgia to Newfoundland. The highest part of this system within the Province of Quebec is the Shickshock mountains, in Gaspé peninsula, where Jacques Cartier mountain has an elevation of 4,160 feet. Two other mountains in the vicinity are over 4,000 feet above sea level and numerous others are between 3,500 and 4,000 feet.

The geology of the Province may be summarized briefly by considering the generalized geology of the three topographic divisions outlined above. As would be expected, these three topographic divisions of the Province differ sharply from one another in their geological features and history.

The Laurentian plateau consists almost entirely of rocks of Precambrian age. These rocks are crystalline in character and are largely of igneous origin. They constitute the eastern part of the Canadian Shield, that great mass of basement rock on which rest the later sedimentary strata of the North American continent.

The St. Lawrence lowland area is underlain chiefly by unfolded sedimentary formations of lower Palaeozoic age.

The Appalachian highlands are made up of folded lower Palaeozoic sedimentary and volcanic rocks intruded by acidic to basic igneous rocks.

The St. Lawrence gulf and St. Lawrence river, in the southern part of the Province, form a shipping lane a thousand miles long from the Atlantic ocean to the city of Montreal. This great waterway has been an important factor in the development of the Province. With the completion in 1959 of improvements that are at present being carried out along sections of the river between Montreal and Kingston, Ontario, the St. Lawrence Seaway will be opened to ocean-going ships travelling westward from the Atlantic to the great lakes.

DISTRIBUTION OF ECONOMIC MINERALS

The economic minerals of Quebec are of great variety. To simplify the discussion of their distribution, the Province is here divided into five regions: a) the New Quebec or Ungava region, b) the Témiscamingue or Western Quebec region, c) the Grenville region, d) the St. Lawrence Lowland region, and e) the Appalachian region. The first three of these regions embrace all the high land north of the St. Lawrence river - the area commonly referred to as the Laurentian plateau. The St. Lawrence Lowland region comprises the whole of the St. Lawrence lowland, and the Appalachian region includes the southeastern part of the Province and Gaspé peninsula.

NEW QUEBEC OR UNGAVA REGION

This region lies north of Eastmain river and the height-of-land that extends eastward from its headwaters to those of the Hamilton River basin. It is occupied mainly by early Precambrian volcanic, with some sedimentary, rocks, early Precambrian gneisses and granitic rocks, and late Precambrian sedimentary and volcanic rocks. Mineralization of present or possible economic importance known to occur in the region includes deposits or occurrences of copper-, iron-, lead-, manganese-, nickel-, and zinc-bearing minerals.

The feature of outstanding interest in this region is the Labrador geosyncline, a zone of sedimentary and volcanic rocks of late Precambrian age which extends northwestward from the general area of the headwaters of Hamilton river to the west shore of Ungava bay. It has a length of over five hundred miles and an average width of forty-five miles. In a number of places, iron-bearing formations within this zone contain important deposits of iron ore. These iron formations were recognized by A.P. Low of the Geological Survey of Canada in the course of his exploratory voyages between 1892 and 1895. They consist mostly of beds of jasper, hematite, siderite, and chert. In 1929 iron ore was discovered by J.E. Gill in these formations near Ruth lake. Another discovery, by J.A. Retty in 1938, at Burnt Creek, in the Province of Quebec, led to active exploration

of the area and the discovery of large bodies of high-grade bessemer, non-bessemer, and manganiferous iron ore in the area extending northward from Schefferville. Reserves of positive ore at this locality are estimated at some five hundred million tons of an average grade of 55 per cent iron. In addition, there are immense reserves of lower grade ore which are amenable to concentration by metallurgical processes.

Although no important deposits of high-grade iron ore have yet been discovered in the northern part of the Labrador geosyncline, large quantities of low-grade material having a tenor of 30 to 40 per cent iron have been found, and metallurgical research has shown that a commercial concentrate can be produced from these deposits.

In the Great Whale River-Duncan Lake area, about thirty-five miles east of the mouth of the Great Whale, a programme of exploration by means of diamond drilling is presently carried out in a large area of iron-bearing formations containing in places large deposits of magnetite having an average tenor of about 40 per cent iron. Preliminary concentration tests carried out on samples from these deposits suggest that it will be possible to increase their tenor substantially.

Next to iron, the most abundant metal of which economic deposits have so far been discovered in the New Quebec region is manganese, which occurs in variable amounts, in the iron ore. In the explored iron ore deposits of the region there are, it is estimated, approximately forty-five million tons of ore that contains, in addition to iron, 7.5 to 8.0 per cent manganese. Deposits of bog manganese, or wad, containing 10 to 35 per cent manganese have been discovered at Wilson lake, thirty-five miles south of Fort McKenzie.

Copper and nickel have been found in a zone of sulphide mineralization in the vicinity of Gerido lake, fifty miles west of Fort Chimo. This mineralized zone has a width of ten miles. It extends southeasterly from Rivière aux Feuilles for a distance of one hundred and twenty miles.

Copper and nickel are also present in large bodies of sulphides in a belt of late Precambrian rocks which extends across the northern part of Ungava peninsula from Cape Smith on the west shore of Hudson bay to Wakeham bay on the southwest shore of Hudson strait, a distance of two hundred miles.

Sulphide deposits carrying zinc, lead, and copper, with a little gold and silver, have been found on the east shore of Hudson bay between Richmond gulf and Little Whale river, and at inland points near Attikamagen lake and in the vicinity of Otelnuc lake.

TEMISCAMINGUE REGION

The Témiscamingue region is a triangular area bounded on the west by the Province of Ontario, on the north by Eastmain river, and on the southeast roughly by a line extending in a southwesterly direction from the headwaters of Eastmain river to the south end of Témiscamingue lake on the Quebec-Ontario boundary.

The rocks of this region are mainly early Precambrian sedimentary and volcanic rocks and late Precambrian sedimentary rocks, with some intrusive bodies of

granitic rock, but over vast sections of the area these are blanketed with deposits of clay. The region is at present the most important producer of metals in the Province with numerous active mines and plants producing gold, silver, copper, lead, zinc and lithium, and, either as by-products or in relatively small operations, bismuth, molybdenite, selenium, tellurium, arsenic, tungsten, and sulphur (from pyritic ores). Occurrences of asbestos are known, and there is some production of granite and clay.

Of historical interest is a deposit of argentiferous galena on the east shore of Témiscamingue lake, reported as early as 1686 and known later as the Wright mine. In 1901, molybdenite was found on the shore of Preissac lake, in western Quebec, and two years later occurrences of asbestos and of copper and iron (magnetite) mineralization were discovered in the Chibougamau area. Lode gold was discovered in the latter area in 1904 and at Lac Fortune, in western Quebec, in 1906. In 1911 and succeeding years there followed in western Quebec a series of discoveries of native gold deposits and of copper, lead, and zinc mineralization with associated gold and silver, and, as exploration extended eastward, other important deposits of copper-gold mineralization were brought to light in the Chibougamau area. More recent discoveries of gold, silver, zinc, and lead mineralization in the Bachelor Lake area are of considerable interest.

The first production of gold in the Témiscamingue region was from the O'Brien mine, in 1926. Prior to this, in 1923, claims that had been staked by Ed. Horne in 1920 were acquired by Noranda Mines Ltd., whose Horne mine was destined to become Quebec's major producer of copper and gold. Construction of the Noranda smelter was commenced in 1926 and the first ingots of blister copper were poured on December 17th, 1927. During the next decade twenty gold mines and five base-metal mines were brought into production in western Quebec and this number has grown steadily as further exploration and development proceeded. Noteworthy also has been the development of a spodumene (lithium) deposit situated between Amos and Val d'Or, where production of spodumene concentrate commenced in December, 1955.

The completion in 1949 of a road into the Chibougamau area brought about increased activity in mineral exploration in this area that resulted in bringing four base-metal mines into production. Also the new railway line linking Barraute and Beattyville with the Chibougamau district will likewise contribute to lower appreciably exploration and mining costs in the area.

GRENVILLE REGION

The Grenville region extends from the Ottawa river in the west to the extreme eastern tip of the Province at Belle Isle strait. It is bounded on the northwest by the Témiscamingue region and on the southeast by the St. Lawrence lowland, river, and gulf.

Only a small part of this region has been mapped geologically. The rocks in the mapped areas are chiefly crystalline limestone, quartzite, gneiss, and lime-silicate rocks, all highly altered and greatly disturbed, with large areas of later anorthositic, granitic, and gabbroic intrusive rocks. A great variety of economic minerals, both metallic and industrial, occur in these rocks, notably in replaced limestones, and in many places mining of the deposits has been, and is being,carried on. Developments to date are summarized in the paragraphs that follow.

Deposits of ilmenite at St. Urbain, eight miles north of Baie St. Paul, were known and investigated as early as 1667. References to deposits of apatite in the vicinity of the Lièvre river and of magnetite, with some associated hematite, in the Ottawa valley, appear in the literature in 1829 and 1830. Intensive prospecting of the south margin of the Laurentian plateau between Lachute and Calumet island since the middle of the nineteenth century has resulted in the discovery of several hundred occurrences of a variety of industrial minerals, principally apatite, feldspar, mica, and quartz. The St. Charles titaniferous magnetite deposits on the upper Saguenay river were investigated in 1883. Economic deposits of zinc and lead ores were discovered on Calumet island, in the Ottawa river in 1892, and at Montauban, fifty miles west of Quebec city, in 1910. In the summer of 1914 the presence of large bodies of hematite and magnetite containing 32 to 61 per cent iron was reported in the vicinity of Achouanipi lake, one hundred and fifty miles north of Sept-Iles, and in 1941 several deposits of ilmenite were discovered in the Allard Lake area, some twenty miles north of Havre St. Pierre.

Recent exploration in the vicinity of Mount Reed, approximately one hundred and fifty miles northwest of Sept-Iles, and in the Mount Wright area, sixty miles northeast of Mount Reed, had led to the discovery of extensive bodies consisting largely of specular hematite and containing 30 to 35 per cent iron. Preparations are being made for the mining of twenty-five million tons of ore annually from these deposits. Work to be undertaken in the near future includes the construction of a railway from Shelter Bay to the Mount Reed area and of a mill to concentrate the ore, and the establishment of a town to provide accommodation for the employees. Later, it is planned to extend the railway to the Mount Wright area.

Farther west, in the Mistassini - Albanel Lake district, exploration work on large areas of iron formations has revealed the existence of substantial tonnages of magnetite of a low tenor in iron.

Deposits of iron ore were the source of the earliest metallic mineral production in the Grenville region. About 20,000 tons of magnetite ore were shipped from the Forsyth mine, five miles northwest of Hull, in 1855. Development work presently carried out on this deposit allows to hope that it will soon be back into production. The Bristol mine, thirty-five miles west of Hull, has been operated intermittently since 1872 and, following an intensive exploration programme by modern techniques, is now being equipped for large-scale production. The ore is magnetite with some associated hematite. The ilmenite deposits at St. Urbain were worked for their iron content alone during the period 1872-74, the ore being smelted locally in two charcoal-fired blast furnaces. The furnaces have long since disappeared, but the deposits are still being mined on a small scale for their iron and titanium content.

The discovery of columbium in 1953, near Oka, twenty-five miles west of Montreal, stimulated interest in the area, and, during the intensive prospecting that followed, several very large low-grade deposits were discovered. Exploration work carried out during the past few years indicates upwards of one hundred million tons of ore in these deposits.

An interesting, although small, copper-nickel mineralization has also recently been discovered at de Renzy lake, forty-five miles northwest of Maniwaki.

Ores of zinc and lead have been mined intermittently in Calumet island since 1893 and at Montauban since 1910. Likewise mining of molybdenite ore commenced at the Moss mine, twenty-seven miles northwest of Hull, in 1916, and has continued intermittently since then. Exploration of the ilmenite deposits in the Allard Lake area was commenced in 1945. The largest deposits outlined were at Tio lake. With reserves estimated at upwards of one hundred million tons of ore containing 36 per cent iron and 32 per cent titanium dioxide, these deposits are reputed to be amongst the largest known ilmenite deposits in the world. Production started in 1951. The ore is mined by open-pit methods and hauled twenty-seven miles by rail to Havre St. Pierre for shipment by boat to a smelter at Sorel.

A wide variety of industrial minerals have been mined from several hundred deposits in the Grenville region since the middle of the nineteenth century, the most important being apatite, feldspar, mica (phlogopite chiefly), and silica. The mining of apatite commenced in 1875, and was very active for two decades, but in recent years most of the output has been obtained as a by-product of the mining of mica. Feldspar has been produced in the Buckingham area since 1889. The principal producer is the Back mine, near the town of Buckingham. The first production of mica was in 1886, and the period of greatest activity was from 1919 to 1928. The output comes from a large number of small operations. Silica is obtained as quartz from veins in the Buckingham area and as quartzite at St. Donat and St. Rémi d'Amherst, where the main silica-producing mines are located. Other industrial minerals of special interest that are mined in the Grenville region are magnesite at the Kilmar mine in the Lachute area and brucite at the Maxwell mine at Wakefield.

Building and ornamental stone is obtained from pink granite and anorthosite (black granite) quarries in the Lac St. Jean area and from pink granite quarries at Guenette and Rivière à Pierre and in the vicinity of Grenville.

Large deposits of clay are found in the vicinity of Lac St. Jean.

Extensive deposits of magnetic 'black sand' on the north shore of the St. Lawrence gulf are potential sources of iron. The most important of these deposits extends for six miles along the shore near the mouth of Natashquan river. Lode deposits of magnetite have recently been reported east of Matonipis lake and in the vicinity of Gad lake, respectively one hundred and seventy-five miles northwest, and sixty miles northeast, of Sept-Iles.

Radioactive minerals have been reported from many localities in the Grenville region since 1880. Thus far, however, there has been no production of these minerals.

ST. LAWRENCE LOWLAND REGION

St. Lawrence lowland is bounded on the north by the Grenville region and on the south by the Champlain fault which extends from Champlain lake to Quebec city and the Lower St. Lawrence valley.

This region is underlain for the most part by horizontal beds of limestone, sandstone, and slate of Lower Palaeozoic age. Intruding them are a number of stock-like bodies that form the Monteregian hills. Much of the area is covered by clay of marine

origin. Clay, granite, limestone, marl, ochre, peat, sandstone, shale, silica, sand and natural gas are the principal economic minerals found in the region.

The occurrence of deposits of bog iron ore in the St. Maurice valley was reported to King Louis XIV of France in 1663 and there was some investigation of these in 1667. This is the earliest record we have of the occurrence in the Province of economic deposits containing a recoverable metal, in this case iron. Small as they are when compared with the enormous bodies of iron ore now being mined in the Ungava region, they were of considerable importance to the early settlers in the region. In 1733 furnaces for reduction of the ore were set up in the St. Maurice valley and production of iron continued almost without interruption until 1910.

Deposits of earthy iron oxide in the vicinity of Trois-Rivières have been worked for over a hundred years. The product is used for the preparation of mineral pigments and as an agent for the purification of coal gas.

Limestone for use as building stone and for burning into lime has been quarried at numerous localities in the St. Lawrence region at least since 1619. At present, the most extensive operations are in the Hull, Joliette, Montreal, Quebec, St. Hyacinthe, St. Marc des Carrières, and Trois-Rivières areas. Besides the earlier uses noted, and as an aggregate in concrete and asphalt, important quantities of the stone are used in the manufacture of Portland cement, first produced in the Province in 1840, and for a great variety of other industrial purposes.

Essexite, known to the trade as 'ebony black granite', is quarried at Mount Johnson, southeast of Montreal, for monuments and for the exterior decoration of buildings.

Sandstone for building and other purposes is quarried in the Beauharnois-Hemmingford and St. Canut areas, and large quantities of sand from various localities are used by the building trade.

Shale and clay from deposits in the Deschaillons, Montreal, and Quebec areas are used in the production of building brick, hollow building tile, and drain tile.

Natural gas has long been known to be present in the St. Lawrence Lowland region. Found in shallow water-wells drilled into the overburden, in some places it has been extracted for more than a hundred years in sufficient quantity to furnish the needs of one or two farm houses and their dependencies. An active search is presently under way to find gas in commercial quantities in the underlying formations. A search is also being made at the same time for petroleum, small quantities of which have been observed in limestone quarries and other rock exposures in different parts of the lowland.

APPALACHIAN REGION

The Appalachian region comprises that part of the Province which lies to the southeast of the St. Lawrence lowland and south of the St. Lawrence estuary.

The rocks of the region are chiefly quartzite, sandstone, slate, and limestone, of ages ranging from Cambrian to Devonian. Volcanic rocks are in places

interbedded with these sedimentary rocks, and both are invaded by intrusive bodies that range in composition from acidic to ultrabasic. In general the rocks are strongly folded and highly altered. The principal economic minerals of the region are chromite, copper, placer gold, lead, molybdenite, nickel, tungsten, zinc, asbestos, granite, limestone and marble, marl, peat, pyrite, slate, soapstone, petroleum, and natural gas.

The first recorded mineral discovery in the region was a nugget of gold, found in 1823 in a tributary of Chaudière river (now known as Gilbert river). Gold-bearing gravel was found later in other tributaries of the Chaudière and also in other parts of the Eastern Townships. Between 1870 and 1890, two to three million dollars worth of gold is said to have been recovered from the district which is presently investigated for possible large-scale dredging operations.

In the Eastern Townships, production of copper at the Acton mine commenced in 1859. The Eustis mine was in operation from 1865 until 1939. The Huntingdon and Suffield mines, which were first active in 1865, are now back in production after many years of inactivity. The Weedon mine, which was in production during the period 1913 to 1921, resumed operations in 1952. The Gaspé Copper mine, at Murdochville in Gaspé peninsula, started production in 1955. With a mill of 6,500 tons daily capacity, it is the largest metal mine of the Appalachian region. In addition to copper, the ore contains gold, silver, and molybdenite.

The first recorded production of chromite in the Appalachian region was in 1861. Under normal market conditions the chromite mines of the Province cannot compete with foreign producers. They have experienced only short periods of operation, during times when imported chromite was in short supply.

Many of the copper deposits of the region contain abundant pyrite (sulphur ore) which, at some of the mines, has been recovered as a by-product.

Zinc and lead sulphides are found in Gaspé peninsula, and these metals occur also in some of the copper deposits of the Eastern Townships.

Asbestos mining in the Eastern Townships commenced on a small scale in 1878 and rapidly developed into the dominant industry of the region. Deposits of chrysotile asbestos occur in a zone of basic and ultrabasic intrusive rocks, generally referred to as the "Serpentine belt", that extends northeasterly throughout the length of the Townships, following the southeast slope of the anticlinal Sutton range. To the northeast these intrusive rocks continue in the Shickshock mountains in Gaspé peninsula, and to the southwest they are found in the Green mountains of Vermont. Most of the commercial deposits of asbestos, and the main producing mines, are in the Tring - Thetford Mines - Black Lake and Shipton - Tingwick areas.

In the early years of the asbestos industry all mining was carried on in open pits. In some of the larger operations the pits grew to enormous size and attained considerable depth. Several of these pits have reached the economic limit for open-pit mining, and operations are now carried on from underground workings beneath the floors of the open pits.

For many years the Serpentine belt of the Eastern Townships was the source of almost the whole of the world's supply of asbestos, and it still accounts for more than the combined production of all other countries. There are at present twelve producing mines along the belt. Of outstanding interest is the Jeffrey mine, at Asbestos, the world's largest asbestos mine, which has a mill of 20,000 tons daily capacity and a rated yearly output of 625,000 tons of asbestos fibre.

Grey granite, extensively used throughout Canada for building and ornamental purposes, is quarried in the Little Mount Megantic, St. Gérard, Scotstown, Stanhope, and Stanstead areas in the Eastern Townships.

High-calcium limestone is quarried at Bedford, Lime Ridge, and Phillipsburg in the Eastern Townships and at Nouvelle in Gaspé peninsula. It is used as building stone and for a variety of industrial purposes. Marble, used mainly for the interior decoration of buildings, is quarried at Phillipsburg and at three localities between Sherbrooke and Waterloo.

Marl deposits on the south shore of the lower St. Lawrence river and in Gaspé peninsula are worked on a small scale. The marl is used as a soil amendment.

Several deposits of slate in the vicinity of Richmond have been worked extensively for the production of roofing material.

Soapstone, an impure variety of talc, is mined at East Broughton and Mansonville.

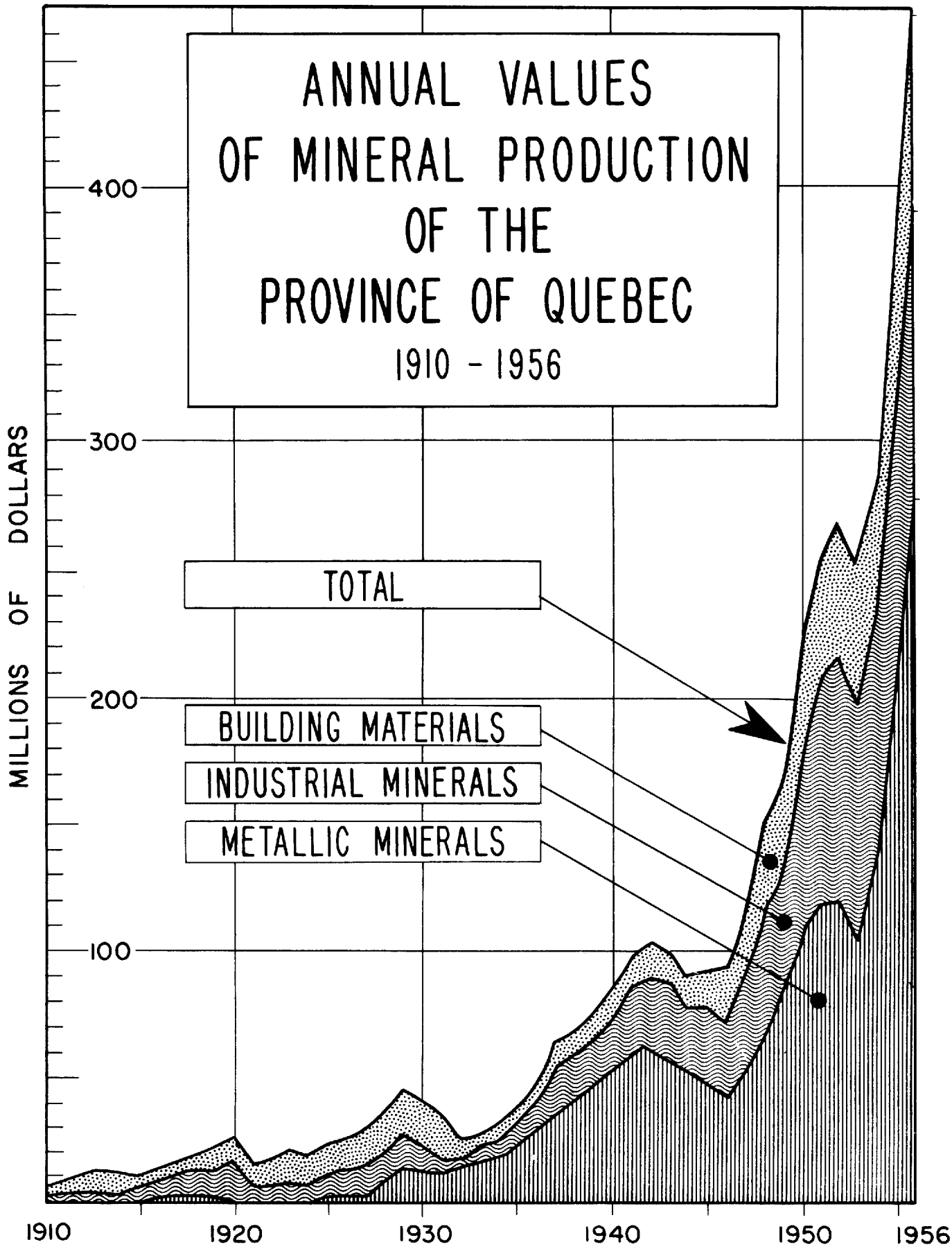
The presence of seepages of petroleum in Gaspé peninsula was known more than a hundred years ago. Small amounts of oil of excellent quality have been found in several of the holes that have been drilled and, in 1956, a flow of one hundred thousand cubic feet of gas per day was obtained in one well. Some bituminous shales are known in the southeastern part of the peninsula.

PROSPECTS FOR THE FUTURE

The frontier regions of the Province annually attract large numbers of prospectors and exploration companies. During 1956, 17,203 miner's certificates were issued to prospectors and 55,523 mineral claims were recorded.

Although mining is continuing at an ever-increasing tempo, new discoveries have so far been more than sufficient to offset the depletion of known deposits, and many of the mines in the Province now have reserves of ore large enough to assure many years of continuous operation.

The geological mapping of the Province is being actively pursued. However, more than three-quarters of its area is still unexplored. Most of the unexplored territory is in the Ungava, Témiscamingue, and Grenville regions, which are considered favourable for the occurrence of economic minerals.


ANNUAL VALUES
OF MINERAL PRODUCTION
OF THE
PROVINCE OF QUEBEC
1910 - 1956
MILLIONS OF DOLLARS
400
300
200
100
TOTAL
BUILDING MATERIALS
INDUSTRIAL MINERALS
METALLIC MINERALS
1910
1920
1930
1940
1950
1956

No. 1191