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REPORT ON IMPORTANT LOW GRADE IRON DEPOSITS OF THE PROVINCE OF QUEBEC

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"IMPORTANT LOW GRADE IRON DEPOSITS OF THE PROVINCE OF QUEBEC"by Robert Bergeron *

Large scale mining and beneficiation of low grade iron ores provide answers to two major problems now facing the United States steel industry, namely the rapid exhaustion of the "direct shipping ores" of the Lake Superior area and the sharp need of steel scrap and lump ore, both of which have been essential to the open hearth process which produces 90% of the steel in North America. The beneficiated concentrate, properly agglomerated, has higher iron content and a lower moisture than most "direct shipping ores." It can be used in the blast furnace which makes pig iron, and in the open hearth furnace which converts pig iron to steel. In the latter operation, the need for scrap steel is cut 50%. In 1955, consumption of low grade iron ores in the United States, was about 1% of the total consumption of iron ores. In 1984, it will be 27%, according to Verne D. Johnston's estimates (1).

The mineral resources of the province of Quebec are known to be varied and extensive. This is particularly true of the iron ores. In addition to the large and remarkably high grade deposits of Iron Ore Company of Canada in the Schefferville area, huge deposits of low grade iron-bearing material have been found in many parts of the province. The locations of most such deposits are shown on the accompanying map.

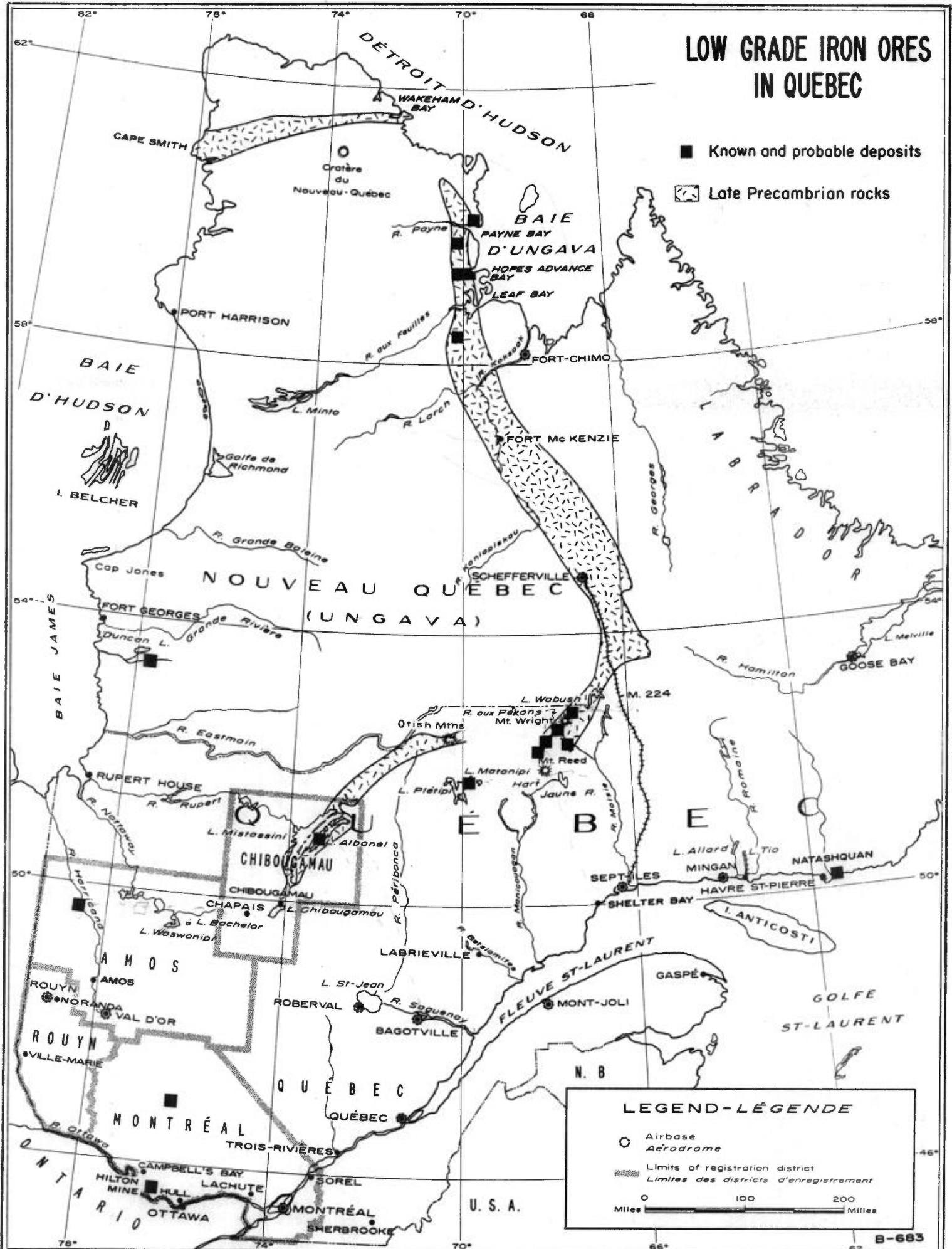
District of Lake Mistassini

Iron formation, a unit of the Mistassini series, is exposed southeast of Lake Albanel about 10 miles southeast of Lake Mistassini. The earliest geological work in the area was done in reconnaissance fashion by Richardson (2), Low (3), and Barlow (4). Norman (5) visited the district in 1938. Areas east and northeast of Lake Mistassini have been mapped for the Quebec Department of Mines by Wahl (6), Neilson (7, 8, 9), Neale (10).

Description of the rocks and of the ore zones

The Mistassini series southeast of Lake Albanel consists of three principal formations: the Lower and Upper Albanel formations and the overlying Temiscamie formation. In the course of recent work within the area the Temiscamie has been subdivided into five units, one of which is the iron formation proper. This unit is generally composed of the following lithologic

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types, in ascending order: ferruginous chert; nodular, cherty iron carbonate; jaspery iron carbonate; banded siderite and chert. These types are gradational in many exposures.

The rocks of economic interest are found in magnetite-rich zones in the iron formation. They either occur in the lower part of the formation as zones of granular, thick-bedded or massive magnetic, hematitic and sideritic cherty rocks, or are associated with the jaspilitic facies of the iron formation where magnetite and jasper are present in nearly equal proportion accompanied by minor amount of chert and siderite. Magnetite occurs as irregular aggregates of more or less euhedral grains and as irregular patches with borders partly altered to hematite.

Bed-rock structure

The structure of the Mistassini group is relatively simple. The regional strike is N.10°E. to N.45°E., and the dips are usually low to the east or southeast. However, deformation of the sedimentary rocks of the group increases as their contact with granitic rocks to the southeast is approached. Thus, the structure of one of the ore zones is an overturned anticline pitching to the northeast. Numerous faults in this zone have produced an intricate arrangement of slices dipping steeply to the southeast.

Search for iron ore

A number of mining companies have searched for iron deposits in the Lake Mistassini district. The most active companies in the area are Canadian Cliffs, Limited, and M.J. O'Brien, Limited, which jointly control more than 500 claims in a belt about 30 miles long. The first mentioned company is a wholly-owned subsidiary of Cleveland-Cliffs Iron Company, which has had experience in the treatment of low grade iron ores in the Marquette Range in Michigan. Exploration work was initiated in 1952 and included considerable detailed geological mapping, trenching and stripping, surface sampling, ground geophysics including dip needle traversing, and a limited amount of diamond drilling. A number of deposits have been located as a result of this work. Metallurgical tests were performed on the low grade iron-bearing material.

An average crude analysis of eighteen samples taken in two ore zones gave roughly 31% iron, 50% silica with low sulphur, manganese, alumina and titanium dioxide. A Davis magnetic tube test with a 100-mesh grind gave a concentrate averaging 66% iron and 8% silica.

The iron ores of the Lake Mistassini district are low grade but have good concentration characteristics. If a large tonnage is available, the probable future accessibility of these ores with the improvement of transportation facilities, (most of the deposits are located less than 100 miles from the town of Chibougamau), could make this area an important source of iron ore.

District of Mount Wright-Mount Reed

Location

Mount Wright is at approximately latitude 52°45' and longitude 67°21'; Mount Reed, at approximately latitude 52°04' and longitude 68°08'.

Mount Wright is within the basin of Aux Pékans river 180 miles north-northwest of Sept-Iles and Mount Reed within the basin of Hart-Jaune river 150 miles northwest of Sept-Iles.

Description of the rocks

The area is underlain by metamorphic Precambrian rocks, mainly gneisses, iron formations, quartzite, and dolomite. The generalized sequence of formations is as follows: one or two bands of iron formation overlain and underlain by a sequence of quartzite, dolomite and gneisses. The quartzite or the dolomite, or both, might be missing in some places. Amphibolites, gabbros and pegmatites occur in many places within the metasedimentary series.

Granitic gneisses, quartz-garnet-sillimanite-biotite gneisses and pyroxene-hornblende-garnet gneisses underlie the greater part of the area. Meta-dolomite, in thicknesses up to 500 feet, is common and, in many places, an almost pure coarse quartzite underlies and overlies the iron formation. This quartzite forms many of the high ridges and hills in the area. In places it is ferruginous but rarely contains more than 10% of iron.

The iron-bearing rocks of the area consist of two main lithological types: the quartz-specularite-magnetite facies and the quartz-iron-silicate-magnetite-carbonate facies. In the first type, by far the most common, specularite is present as small discontinuous lenses in the quartz, or as minute crystals disseminated throughout the rock. Narrow magnetite-rich layers are present locally, and iron oxides make up from 20% to 50% of the rock. The second type may consist of massive bands composed mainly of quartz and grunerite with some magnetite; or of interbedded thin layers of quartz and of quartz, grunerite, hypersthene, and magnetite; or of dolomitic bands with minor quartz, grunerite, and magnetite.

Many of these rocks are similar to rocks of the Grenville province, and this fact has brought many workers in the area to correlate them, at least temporarily. But the distribution of the localities where iron formation has been found in the Mount Wright-Mount Reed area, and the similarity of these rock types with those existing in the metamorphosed portions of the Labrador Geosyncline or Labrador Trough strongly suggest that the metasedimentary rocks of the Mount Wright-Mount Reed district belong to the southwestward extension of the geosyncline.

Search for iron ore

Three main companies have been actively searching iron ores in the area. These are Bellechasse Mining Corporation, Quebec Cobalt and Exploration, Limited, and Cartier Mining Company, Limited.

Bellechasse Mining Corporation staked claims in the Mount Wright area in 1952. This was followed in subsequent years by detailed geological mapping, dip needle surveying and diamond drilling. The company reports that this exploration work has indicated roughly 100 million tons of ore grading about 30% iron. A preliminary study of concentration techniques has shown that a commercially acceptable concentrate could be produced. In 1956, the company granted an option on its Mount Wright property to W.S. Moore Iron Company, which will continue the exploration work on these claims.

As a result of an air-borne magnetometer survey done early in 1955, Bellechasse Mining staked a group of 60 claims in the Midway Lake area approximately 25 miles southeast of Mount Wright. Exploration work, consisting mainly of detailed geological mapping, trenching, surface sampling, and dip needle traversing, has indicated possibly 300,000,000 tons of iron-bearing material grading 30% to 31% iron. Preliminary concentration tests have shown that a concentrate grading 68% to 69% iron and 5% silica could be obtained. In the spring of 1956, the company granted an option on its Midway property to Midway Iron Company, a subsidiary of Pickands Mather Company.

Quebec Cobalt and Exploration, Limited, has outlined a large tonnage of iron-bearing material grading 32% iron. The iron oxides are mainly coarse hematite with minor magnetite. Jones and Laughlin Steel Corporation acquired an option in the spring of 1956 on this large, low grade, iron deposit. Drilling and other testing of this deposit was started during the 1956 season and will be continued in 1957.

Cartier Mining Company, Limited, a subsidiary of United States Steel Corporation, explored the Matonipi Lake area, approximately 60 miles east of Mount Reed in 1951. Exploration work started in the Mount Wright-Mount Reed area in 1952, when many groups of claims were staked. The company did a great amount of diamond drilling, detailed geological mapping, prospecting, and geophysical surveying between 1951 and 1956. Many deposits containing a very large tonnage of iron-bearing material grading approximately 30% iron were outlined. Cartier Mining has recently announced its decision to bring its deposits into production. This undertaking involves: the building of a concentration plant in the Mount Reed area with an annual capacity of 10 million tons of high grade pellets; the organization of open pit mines capable of producing up to 25 million tons of low grade ore annually; the construction of a railway joining Shelter Bay, on the north shore of the St. Lawrence river, to Mount Reed, a distance of 150 miles; the erection of a hydroelectric power plant on the Hart-Jaune river; the erection of a mining town in the Mount Reed area; and the organization of docking, loading and storage facilities at Shelter Bay.

District of Ungava Bay

Following the discovery of direct shipping ore in the Scheffer-ville area, many mining companies have searched for similar material north of the holdings of Hollinger North Shore Exploration Company. No high-grade ore was found, but a huge tonnage of concentrating grade, iron-bearing material has been disclosed within the sedimentary iron formation of the northern part of the Labrador Geosyncline or the Labrador Trough. The Trough is a folded unit of sedimentary and volcanic rocks intruded by mafic sills and extending from the Mount Wright-Mount Reed area to almost the northwest tip of Ungava bay. Iron formation is known to occur throughout most of the length of this belt.

Description of the rocks

North of Koksoak river, the sedimentaries of the Labrador Geosyncline consists mainly of sandstone, quartzite, iron-bearing rocks, arkoses, argillites, siltstones, dolomite and shale. The upper part of the sequence has intercalated lava flows and gabbro sills. Within the geosyncline, the

rocks become progressively more metamorphosed from the Koksoak river northward and also from west to east. These rocks have been described by Bergeron (11, 12, 13, 14) and Sauvé (15, 16, 17). Thus, only a short description of the iron formation needs be given here.

In the Leaf Bay area, the iron formation consists mainly of two members: the interbedded carbonate and chert facies, and the hematite-magnetite chert which usually is the ore member. The latter facies is composed of massive cherty bands rich in hematite with some magnetite and with local interbeds of chert and jasper. Important changes occur in these rocks with the increase in grade of metamorphism. The carbonates are replaced by iron silicates and iron amphiboles, the proportion of magnetite to hematite increases, and hematite is largely replaced by specularite. Hematite and specularite are usually the most dominant iron oxides, but locally magnetite is the dominant one. The ore zones are found in places where the iron content is higher than the average for the formation and where the dips are low or the apparent thickness of the iron formation has been increased by folds and faults.

Search for iron ore

Four main companies hold mineral exploration licenses and claims in the northern part of the Labrador Geosyncline. These are: Consolidated Fenimore Iron Mines, Limited; Oceanic Iron Ore of Canada, Limited; International Iron Ore, Limited; and Atlantic Iron Ore, Limited.

Consolidated Fenimore Iron Mines, Limited, holds two blocks, one on Larch river about 20 miles west of Kaniapiskau river, the other in the vicinity of Leaf bay. Exploration of the iron formation included detailed geological mapping, representative sampling, surveying, prospecting, and approximately 30,000 feet of diamond drilling. The company reports that one billion tons of concentrating-grade ore have been indicated. More than 90% of this is within 25 miles of tidewater. Fenimore also has made extensive studies concerning beneficiation techniques and the location of docks, mill site and town site. However, early in 1956, the company announced its intention to delay a final decision as to production until all available information had been gathered and investigated. The North Finger lake deposit would be the first one worked. This contains about 200 million tons of ore and is located some 20 miles south of Leaf bay. The initial annual production would be one million tons of concentrate. The best process available would be a straight magnetic separation with flotation cells for concentrating the tailings. During the 1956 season the company started building an airstrip south of Leaf bay.

Oceanic Iron Ore of Canada, Limited, which is controlled by the Rio Tinto Mining Company of Canada, holds two blocks and claims in the area south of Payne river. Following a preliminary investigation of the area in 1954, the company carried out an extensive programme of exploration in 1955 and 1956. This included surface exploration, detailed geological mapping, surveying and diamond drilling. Most of the drilling was done at the Morgan Range, a prominent range of hills extending northwesterly some 12 miles from Morgan lake about 20 miles south of Payne bay. Mapping and drilling of a part of this range have indicated 275 million long tons of iron-bearing material grading approximately 32% iron, with an additional 85 million tons of

lower grade material underlying the principal iron band. Estimates of tonnages in adjoining driftcovered areas based on incomplete drilling results and one a magnetometer survey raise the overall total by 165 million tons. Drilling of another iron range on the south shore of Payne river was started near the end of the 1956 field season.

Payne bay is one of the best of the few potential harbours in Ungava bay. A favorable site for docks capable of handling the largest ore boats is found on Oceanic Iron Ore property. A big difficulty is the shortness of the shipping season, which extends from about July 15th to October 25th. To offset the short season, it is proposed to ship ore concentrates during the summer from Ungava bay to a storage point where trans-shipments could be made during the winter months. The coast immediately south of Godthaab, Greenland, is said to offer favorable sites for that purpose.

The production of the iron ore, or concentrates, of the Morgan Range would be hauled to Payne bay for shipment. Preliminary surveys to locate a railroad between Morgan Range and Payne bay have been completed.

Beneficiation methods have been carefully investigated, and concentration tests on the magnetic iron ores have shown that a 65% iron concentrate in the form of pellets can readily be obtained.

During the summer of 1956, Oceanic Iron Ore had a number of independent consultants and specialists examine its properties south of Leaf bay in order to determine the methods of producing iron concentrates at a profit. Plans call for an open pit mine, a processing plant, a town site, an airport, a seaport, storage facilities and as already mentioned a trans-shipment port. All this would represent a minimum expenditure of \$100,000,000. The initial annual production rate has not been announced yet. It will probably be at least 2 million tons of pellets.

Atlantic Iron Ore, Limited and International Iron Ore, Limited, obtained in 1953 two mineral exploration licenses on the west coast of Ungava bay. These two companies, controlled by C.S. Eaton, are owned by Consolidated Premium Iron Ore, Limited, a Canadian investment company.

International Iron Ore holds a license on 600 square miles north of Payne river. In the vicinity of Robert lake (latitude 60°25' N. and longitude 70°30' W.), and particularly at Kayak bay near the mouth of Payne river, detailed geological mapping, sampling and drilling have indicated large tonnages of concentrating grade iron-bearing material.

Atlantic Iron Ore's license covers about 160 square miles in the Hopes Advance Bay area. In the vicinity of the bay and north of Ford and Red Dog lakes, 16 and 8 miles west-northwest of it, exploration work has indicated large tonnages of iron-bearing rocks of concentrating grade.

Production studies are now in progress and a final decision should come within a few months. The construction of an airstrip was completed last fall. Concentration tests have shown the possibility of obtaining high-grade iron pellets. A transshipment point, roughly 660 miles from Hopes Advance bay has been selected by the company at Rype island near Godthaab, Greenland. Plans call for shipping 10 million tons annually from

Hopes Advance bay, starting between 1958 and 1960. The overall cost of the project would be in the neighborhood of \$100,000,000.

Other Low Grade Iron Ore Deposits in Quebec

Aconic Mining Corporation holds an extensive magnetite sand deposit located at Natashquan on the north shore of the St. Lawrence, about 530 miles northeast of Quebec city. The company estimates the probable reserve to be between 15 and 18 billion tons of magnetite-bearing sand grading approximately 4% iron. The annual current iron concentrate production is about 40,000 tons, but the company expects to increase this to 100,000 tons by April 1957, and to 1,100,000 tons by 1959.

The Hilton mine, formerly known as the Bristol mine, will soon produce iron pellets. This mine is located about 20 miles northwest of Ottawa and is now equally owned by Stelco Mines, Quebec, Limited, and by Bristol Quebec Mining Company. The latter, in turn, is owned by Jones and Laughlin Steel Corporation and Pickands Mather and Company. The ore will come from a low grade magnetite deposit which was discovered in 1870 and worked between 1872 and 1894. It has recently been decided to reopen the mine and build a concentrating plant for an annual production of 600,000 tons of pellets grading about 66% iron. Mining will be done by open-pit methods.

Magnetic iron ore grading 32% to 35% iron was discovered a few years ago near Duncan lake, about 56 miles southeast of Fort George on James bay. Preliminary exploration carried out by J.C. Honsberger has indicated at least half a billion tons of ore to a depth of 600 feet. This estimate still has to be proven by diamond drilling. Preliminary concentration tests have been very satisfactory.

Recently it was reported that diamond drilling done by Atlin-Ruffner Mines indicates the probable existence of an important low grade iron deposit in Montgolfier township, about 80 miles north-northwest of Amos. The grade of the deposit is approximately 30% iron, according to the limited amount of assaying done to date.

Another large low-grade iron deposit has recently been discovered in Houded township, Pontiac county. This property is located about 32 miles west of a point on the Mont Laurier- Val d'Or highway 70 miles northwest of Mont-Laurier. The deposit consists of magnetite-rich material grading 28% to 30% iron in quartz-plagioclase gneiss. Concentration tests have shown that a 65% to 68% iron concentrate with a recovery of 90% can be obtained with a 60-mesh grind. In January, 1957, O'Leary Malartic Mines, Limited, which held the major interest in the property, accepted an offer from Holanah Mines, Limited, to take over and develop its iron property, ways will be found to make even the most remote deposits pay off.

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