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SPECIAL REPORT ON THE IRON DEPOSITS OF THE PROVINCE OF QUEBEC

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DEPARTMENT OF MINES

MINERAL DEPOSITS BRANCH

SPECIAL REPORT

ON

THE IRON DEPOSITS

OF THE PROVINCE OF QUEBEC

COMPILED

BY

H. W. McGERRIGLE

AND

H. GIRARD

QUEBEC
1950

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SUMMARY

OF THE INFORMATION ON THE

IRON DEPOSITS IN THE PROVINCE OF QUEBEC (x)

I N T R O D U C T I O N

The following summary on the iron deposits in the Province of Quebec was prepared in view of the growing need for iron, and the consequent desirability of an inventory of Quebec's known resources in this respect. Although few of the occurrences are reviewed exhaustively, this volume is intended to list all and to give the salient information on each according to the available literature.

The references on which the information in this summary is based are listed at the end of the summary. Abbreviated references (e.g. Ells, 1888-89, p. 46), which are given throughout the text, serve as keys to the complete references.

(x) Prepared by H.W. McGerrigle, with additions in 1950 by H. Girard.

IRON DEPOSITS

IN THE

PROVINCE OF QUEBEC

PART A.- Eastern Townships Deposits

Ascot, R. IX, lot 8. Belvedere mine. Located near the summit of the ridge lying south of Sherbrooke and to the east of the Belvedere road two miles from Lennoxville station.

Magnetite occurs "in irregular veins in chlorite schist, distributed over several acres and ranging in thickness up to ten or twelve feet. Some portion is a hematite". Assays have given 28.39% and 49.48% of metallic iron; no titanium. No determination made for phosphorus and sulphur. (Ells, 1888-89, p. 20K).

"The general grade of this ore does not appear to be very high, on account of its mixture with the country rock, but the quantity is abundant and the vein", has "an exposure approaching 6 feet thick" (Obalski, 1889-90, p. 21).

"In places along a zone a few feet in width, chlorite schists have been partially replaced by magnetite" (Bancroft, 1915, p. 253).

Ascot, R. VI, lot 21. Smith mine. Adjoining and opposite the city of Sherbrooke.

"The ore consists of slates....impregnated with magnetic mineral for a thickness of 10 to 15 feet. Some work has been done and several hundred tons taken out". Analysis showed no titanium and 1.512% of phosphoric acid. (Obalski, 1889-90, p. 21-22).

According to Ells (1888-89, p. 20K), the thickness and extent of the deposit were not known, but a "considerable quantity of ore" had been extracted. Analyses showed:-

Metallic iron	54.074%
Phosphorus	0.660%
Sulphur	0.024%

Bancroft (1915, p. 215) reported, "Although specimens may be selected in which the iron content is quite high....the deposit as a whole is so very low in grade and of such small dimensions that it cannot be worked profitably. The shaft probably is 100 feet or more in depth".

Bolton, R. XIV, lot 2. Two miles east of Orfond pond.

Magnetite analysing 37.79% of metallic iron was obtained here. The deposit apparently continues into Orford, R. XV, lots 21, 22. (Ells, 1888-89, p. 17K).

Brome, R. III, lot 1. In this lot there is "a very considerable (hematite) deposit....in several bands, varying from three to ten feet in thickness". A sample analysed 41.46% iron and 24.16% titanic acid. The deposit shows also discontinuously in Brome, R. III to V, lots 2 to 6, where analyses have shown 28.63%, 30.97% and 37.91% of metallic iron. (Ells, 1888-89, p. 17K).

Thicknesses from one to twenty feet are claimed by Obalski, who also stated that "A little ore has been mined on lots 5 and 6 of the IVth range". It was stated that these veins extended from occurrences in Sutton (see below) (Obalski, 1889-90, pp. 19, 20).

Chester, R. II, lots 11, 12. Veins and lenses of hematite up to 2 feet thick in dolomite occur here. The quantity of ore in sight, exposed in three pits, is estimated at about 50 tons maximum. The hematite has analysed from 56% to 69% iron, and the dolomite from 2% to 5% iron. (McGerrigle, 1941) (Obalski, 1895, p. 49; 1896, p. 156).

Cleveland, R. XIII, lot 21.

Hematite occurs here in limestone. 60 tons of ore were shipped to Drummondville (Obalski, 1902, p. 5).

Dunham, R. I, lot 5.

Hematite occurs in irregularly distributed masses and occasionally in veins up to two feet thick. The quantity of ore in sight is not large. An analysis showed:-

Fe	69.49%	
SiO_2	1.32%	
Sulphur	0.10%	
Phosphorus	0.08%	(Obalski, 1907, pp. 5, 6).

Leeds, R. IV, lot 9.

"In the bed of a small creek which traverses lot 9, range IV, Leeds township, there is a lens of magnetite about twelve inches thick which strikes east-west and dips to the north at 45°. The portion of the lens exposed in the creek bed is three feet long. Within a radius of twenty or thirty feet there are a number of magnetite boulders of various sizes lying on the ground. Dip-needle observations indicate that this lens of magnetite has little if any extension beyond what can be seen in the creek bed. (Waddington, 1942).

Leeds, R. V, lots 7a, 7b. One and a half miles from Kinnear's Mills and seven miles from Leeds. The ore consists of "fine grained magnetite, more or less mixed with micaceous iron ore" in three "tolerably regular beds....of six, four, and three feet in width respectively". Analysis gave:-

Metallic iron	67.09%
Phosphorus	0.206%
Sulphur	0.038%

(Ells, 1888-89, p. 19K).

Obalski (1903, p. 5) reported the following analysis:-

Metallic iron	62.52%
Sulphur	0.166%
Phosphorus	0.164%
Titanium	nil

According to Dulioux (1912, pp. 100-105), the deposit consisted of a series of layers of magnetite with lenticular expansions in the schists. The lenses were up to 7 feet by 80 feet. The "proportion of siliceous gangue in the run of mine ore would be very great".

In 1917, the following was reported: "A magnetometric survey by B.F. Haanel confirms the pockety character of the ore, and gives no encouragement of finding any ore-body of economic importance. The average value in iron of the lenses ranges from 45 to 55 per cent of metallic iron, a very low phosphorus and sulphur content". (Lindeman and Bolton, Vol. 2, 1917, p. 146).

In 1937, it was reported that the lenses were up to 7 feet by 200 feet, but that the ore was "diluted with considerable silica in small grains, so that it is not of commercial grade" (Cooke, 1937, p. 12) (See also Obalski, 1889-90, p. 18; 1910, pp. 6-7; Haanel, 1909, p. 110).

Orford, R. XV, lots 21, 22. The magnetic iron of Bolton (R. XIV, lot 2) is apparently continued into Orford (Ells, 1888-89, p. 17K).

Riguad-Vaudreuil Seigniory. St. Charles and Block ranges. Titaniferous magnetite deposits show over a length of three miles, between the Callway and des Plantes rivers (Dulieux, 1912, pp. 94-100).

"A great bed of magnetic iron ore, or more properly ilmenite, forty-five feet thick....is described by Dr. Hunt" as giving 48.6% of titanic and 40.7% of iron (Ells, 1888-89, p. 18K) (See also Obalski, 1889-90, p. 22).

Obalski (1907, p. 6) speaks of a mass of ore 100 feet long and up to 35 feet wide "at the northern corner", and adds, "At certain points the ore is essentially magnetic, occasionally really becoming loadstone and then containing very little titanium".

According to Dulieux (1912, p. 100) "no very encouraging results have been obtained... The mineralized masses in the St. Charles range are very limited....

"The mass in the "Block" (range) is perhaps of some importance, but it is by itself insufficient for industrial operations.

"Moreover it would be difficult to utilize owing to the percentage in titanium".

A plan of the workings in both the Block and St. Charles ranges is provided by Dulieux.

A description of these deposits is given by MacKay (Mackay, 1921, pp. 85-86), largely following Dulieux. He concluded that the "limited dimensions of these lenses, their irregular occurrence, and the high percentage of titanium generally present make them of little commercial importance".

Saint-Armand East, S.E. Corner, Lot 45, West Half.

Five feet of ore shows here, mostly red hematite or specular schist, mixed with chlorite to some extent. Analyses gave 34.73% and 37% of metallic iron. (Ells, 1888-89, p. 16K).

South Ham, R.I., lot 21a. Northwest side of Nicolet Lake. "A large and apparently excellent vein of magnetite ore....occurs in serpentine with a width of six feet at the surface, increasing to eleven feet in a shaft twelve feet deep" (Ells, 1888-89, p. 19K). (The range and lot numbers given by Ells are in error).

What appears to be the same deposit is described by Obalski (1889-90, p. 22) as being in R. I, lot 21, on the north side of Nicolet lake. Obalski speaks of a vein 6-13 feet thick and traceable for 200 feet. The ore is "imbedded in the fissures of a green carbonate of copper.... From a 12 foot pit, 100 tons of good ore were extracted, the vein at the bottom showing a thickness of 9 feet".

Haanel (Haanel, 1909, pp. 109-110) described the ore as a pocket of titaniferous magnetite of no economic value. A magnetemetric survey indicated no extension of the ore away from the workings. Analysis gave 46.5% metallic iron and 26.5% TiO_2.

In 1931, B.T. Denis (1931, pp. 93-94) reported that the "only working is a small pit....about 90 yards from the shore and two miles from the northeast end of the lake....

"The ore is solid magnetite, and although insufficient work has been done to permit estimation of the extent of the deposit, it seems probable that the body of ore is large". An analysis gave:-

SiO	0.96%
TiO_2	19.85
Al_2O_3	8.42
Cr_2O_3	10.81
Fe_2O_3	24.83
FeO	28.22
MgO	2.31
CaO	1.20
	96.60%

According to B.T. Denis (personal communication), a cross trench had been opened in 1941 about 150 feet to the east of the pit, and it seemed that there were two bands or lenses of the ore. The ore exposed in the main pit was about 5 feet wide, and about 8 feet wide in the trench; about 20 feet to the south, in the trench, an 18-inch band parallel to the first was exposed.

V.L. Eardley-Wilmot reported (Pers. comm. to B.T. Denis, 1941) two analyses, as follows:-

	Dump of Main Pit	Veins in Trench
Fe	41.30	43.50
TiO_2	17.20	19.48
Cr_2O_3	9.70	8.60
V	0.23	0.23

Spaulding, R. VIII, lot 6; R. IX, lot 14. Three miles from Megantic. "The Megantic Iron Ore Company has done some....stripping and trenching on the property.... The ore is a hematite mixed with jasper bands". (Denis, T.C., 1910, pp. 30-31).

Spaulding, R. VIII, lots 10-11.

The deposit is described as quartzitic rock impregnated with grains of magnetite and hematite which in some cases concentrate either in patches or on the joint planes. "At times the enrichment in magnetite grains is such that real siliceous ore can be obtained". The "discoveries are rather poor". (Dulieux, 1912, pp. 105-106).

"The greatest length of moderately mineralized rock is about 15 feet. The workings consist of numerous scattered shallow trenches, none of which shows any ore-body of economic importance.... A magnetometric survey of the property by B.F. Haanel confirms the pockety character of the ore". (Lindeman and Bolton, Vol. 2, 1917, p. 145) (For a detailed description see: Wilson, A.W.G., 1909, pp. 79-80).

Sutton, R. IX, lots 4, 5.- Hematite shows here. (Ells, 1888-89, p. 17K).

Sutton, R. IX, lot 6, S.E. corner.- Hematite up to 7 feet thick (Ells, 1888-89, p. 17K).

Sutton, R. IX, lot 6, S.W. corner.- Hematite up to 6 feet thick, yielding 22.98% and 23.86% iron (Ells, 1888-89, p. 17K).

Sutton, R. IX, lot 7.- Hematite ore similar to that in Saint-Armand East, in greater quantity but in varying quality: assays gave from 15.91% to 27.55% of iron; 5-8 feet thick. (Ells, 1888-89, p. 16K). According to Obalski (1889-90, p. 19) 100 tons of ore were taken from this deposit.

Sutton, R. IX, lot 8. Analysis of ore given (Obalski, 1889-90, p. 20): metallic iron, 39.14%; titanic acid, 29.86%.

Sutton, R. IX, lot 9, north half.- Magnetite ore "occurs in a 12-foot band of dolomite which also contains a vein of hematite to 2 feet thick".

The dolomite analysed: "carbonate of lime 40.10%
carbonate of magnesia 20.20
carbonate of manganese 7.65
carbonate of iron 10.65
insoluble ..... 21.40".

"The vein is calculated to contain 56% of magnetic ore equivalent to 36% of metallic iron". (Obalski, 1889-90, p. 20).

Sutton, R. X, lot 7. Two beds of specular ore occur (Ells, 1888-89, p. 17K).

Sutton, R. XI, lots 7 and 9. Iron is stated to occur on these lots. (Ells, 1888-89, p. 17K). Analysis of the ore on lot 9 gave 40.87% iron and 27.2% of titanic acid. (Obalski 1889-90, p. 20).

PART B.- Gaspé Deposits

Newport Township.

On Pembroke creek, about a mile from the junction with West river, a bed of "very ferruginous sandstone" lies in grey schists. Ferruginous cement forms beds of hematite in some places along certain fissure planes". A sample gave 46.76% of iron oxide - "Say metallic iron....32.73%. (Dulieux, 1912, pp. 122-123).

Pabos Seigniory, R. I, lots 69-72, on the Shore.

According to Dulieux, (1912, pp. 120-122) veins or beds a few inches thick and some 10 feet long, consisting of a "mixture of jasper and hematite", and with an "abundance of silica" were noted. About three-quarters of a mile

east of the wharf of L'Anse à l'Ilet a 2-foot band of conglomerate occurs. Hematite nodules up to 2 feet in dismeter are present and at one place they join to "form a compact rock of jasper and hematite, measuring 16 inches at its greatest thickness". A vein a jasper, containing hematite in insignificant quantity, is located inland from the above, 200 feet N.W. of the railway and one mile from the Pabos Centre crossing. A sample of hematite gave 59.79% of metallic iron.

On lot 70, about 500 feet from the shore, there are two exposures 35 feet apart, parallel, 3 and 5 feet thick respectively. In the shore cliff there is an outcrop of 3 feet of ore, about on strike with the exposures inland. Average sample analysed 23.57% metallic iron, 0.33% sulphur, a trace of phosphorus. (Que. Dept. of Mines, Office record, 1916).

In 1935, it was reported that East of Chandler are schists with ferruginous bands from $\frac{1}{8}$ to 1 inch thick and arenaceous beds in which are scattered fragments of red argillite and hematite". (Alcock, 1935, p. 9).

"Lenses and bands of siliceous hematite to jasper and hematitic sand are scattered through the rocks of the Macquereau group eastward along the shore for about one-half mile from the Chandler wharf. The largest mass seen is at 320 feet northeast of the shore end of the wharf, within and near the west end of the race track oval. The iron bearing rock here is jaspery or siliceous hematite. It shows across an area of 62 feet (N. 52 W.) by 20 feet. The material is hard, and is cut by many quartz veins. The true strike of the exposures may not correspond with the lengthwise direction (N. 52 W.), and this could not be checked, owing to the fact that no true "country rock" was exposed. The strike along the shore is generally east-west in this vicinity. At the shore base of the wharf hematitic bands up to six inches thick, but generally less than four inches thick, were noted. These two occurrences, at the wharf and 320 feet inland, constituted the principal showings on the Caldwell and Harrison claim; reported on by Dr. T.C. Denis, Sept. 8, 1916. An analysis of a lump sample from the showing 320 feet inland shows:-

Fe	30.89%
SiO_2	53.49
P	0.06
S	0.01
Ti	0.00

At 1,200 feet east of the wharf on the shore hematite occurs in short lenses or nodules up to one and a half feet thick in a band up to four feet wide. 300 feet farther east hematite shows in small lenses and broken bands up to 4 inches thick in a zone about 30 feet wide, and about 200 feet still farther east similar occurrences were noted. And, about 400 feet eastward of the last, or 2,200 feet from the wharf, the iron was noted again. Here the hematite shows in two closely spaced lenses, each with maximum expansion of two feet. One lens is about 30 feet long and shows some close folding. The other lens was seen over a length of 12 feet. In addition, numerous small lenses or nodules were seen here, and, a little to the east, bedding is shown by thin hematitic layers. An analysis of a sample from the main lens here shows:-

Fe	29.01%
SiO	53.58
P	0.29
S	0.01
Ti	0.10

None of these occurrences seems to be of economic importance, even at the present time, in view of the limited 'showings' and apparently siliceous nature of most of the hematite. The largest mass is that 320 feet northeast of the wharf. (McGerrigle, 1942).

Deslandes Township

Siderite (iron carbonate) occurs on the Madeleine river, about 3,900 feet below the crossing of the trail to Madeleine lakes, on the north side, and about 600 feet further downstream, on the south side. "The carbonate appears to be of sedimentary origin and is associated with beds of slate, limestone-grit, calcareous quartzite, and possibly some ankerite". The main showing is that on the south side of the river. Here, "the carbonate and rusted rock are exposed for a thickness of at least four feet near the top of the steep bank. Similar material may be seen under the tree roots on top of the bank over a width of about 80 feet, but all this zone may not be made up of the same rock". An analysis of the siderite gave 40.30% iron.

"Two one-foot blocks of massive magnetite, and some blocks of altered sedimentary rock smeared with specular hematite, were observed on the roadside near the southwest corner of the map-area. They have not been transported from far...." (Jones, 1932, p. 31).

PART C.- North Shore, Saint Lawrence River Area

1.- Saint-Urbain deposits (Charlevoix County). Saint-Urbain is about 9 miles north of Baie Saint-Paul, and about 60 miles below Quebec. The deposits are of titanic iron, all in anorthosite, and usually in irregular masses. The three largest masses of ilmenite lie on a north-northeast - south-southwest line about one mile in length.

A) Saint-Urbain range, lot 312, Glen Prospects. A mass of ilmenite 35 by 30 feet was exposed. Overburden deep. An analysis gave:-

SiO	1.68%
FeO	55.36
TiO_2	38.29
S	0.041
Ph	traces
Metallic iron	43.06%
Titanium	23.00

(Dulieux, 1911a, pp. 83-85).

In 1924, 1,408 tons ($3,771) were mined by the Baie St-Paul Titanic Iron Ore Co., and shipped to the Titanium Alloys Co., Niagara Falls.

B) Saint-Jérôme Range, lot 622, J. Bouchard Mine. The mine consisted of a cut 15 by 15 by 100 feet long. It was worked during 1910 when 800 long tons of ore were shipped to the Titanium Alloy Co., Niagara Falls. It was abandoned because of the other more extensive and more easily worked deposits in the vicinity. An analysis showed 36.64% od titanic acid, or 20% of metallic titanium. (Dulieux, 1911a, pp. 85-86).

In 1927, Mawdsley reported that "A dyke of ilmenite here cuts anorthosite. Quarrying operations have removed practically all the visible ore". (Mawdsley, 1927, p. 50).

C) Saint-Urbain Range, lot 319, Coulombe Mine. The work consisted of two open cuts about 500 feet apart. In one cut (the western) a mass of ilmenite about 85 by 60 feet was exposed. In the other a mass of ore up to 40 feet wide and at least 200 feet long was exposed. Borings between the two cuts showed titanic iron under the clay at various points "and it is probable that the masses... form part of a single mass which would thus extend over a length of 600 feet". If so, a tonnage of 4,000 tons per foot of depth is indicated. Analyses showed:

SiO	2.64	3.12	2.68
FeO	51.54	55.14	52.98
TiO_2	41.00	35.46	38.40
Ph	0.04	0.044	0.041
S	0.041	0.04	0.04
Met. iron	40.09	42.89	41.21
Titanium	24.62	21.30	23.06

(Dulieux 1911, pp. 86-91).

In 1938, it was stated that the western cut and strippings expose a body of ilmenite 140 feet by 90 feet. A face of ilmenite 88 feet long and 6-10 feet high showed at the west end of the deposit. This deposit is calculated to have a reserve of 1,685 short tons per foot of depth. The eastern workings showed more irregular ore and less well-defined boundaries, so that an estimate of ore reserve was not possible. The average ore in the western workings contains 41.13% of TiO_2. (P.E. Bourret, 1938).

D) Saint-Urbain Range, lots 321, 325. General Electric Company Mine.

In 1911, the main workings consisted of two open cuts about 160 feet apart. In one, a mass of ore about 50 by 60 feet was exposed, which appeared to enlarge downward, and in the other, a mass 30 by 50 feet was exposed. Ore also showed between the two main cuts, and, if continuous, a minimum tonnage of 1,700 tons per foot of depth was indicated. Analyses gave 44.52% of metallic iron, 24.98% of titanium, 1.10% of SiO, and traces of sulphur and phosphorus. (Dulieux, 1911a, pp. 91-94).

Mawdsley (1927, p. 49) reported that "the ilmenite body has been attacked at various points over a length of 300 and a width of 150 feet.... A number of the different pits and strippings are separated from one another by blocks or masses of anorthosite".

Most of the production from the Saint-Urbain area has come from this mine, with shipments going in part to Niagara Falls, N.Y., and in part to plants of the General Electric Co. in the United States. Production figures follow (Que. Bur. Mines, Ann. Repts.):-

Years	Tonnage	Value
1927	2,029	$ 8,980
1928	2,244	6,732
1929	2,748	7,359
1931	1,509	10,261
1934	2,023	14,161
1935	2,288	16,400
1936	2,566	18,318
1937	4,229	26,432
1938	207	1,449
1939	3,694	21,267

(General Electric and Coulombe Mines).

E) Saint-Urbain range, lots 352, 361. Fourneau or Furnace Mine.

The Canadian Titanic Iron Co. erected many buildings here in 1871-72, including blast furnaces. No work has been done since 1873. A face of titanic iron 75 feet wide shows in one pit, and an elliptical face of 120 feet in another pit. Analyses by the Geological Survey gave (in part):-

Iron	36.25%;	37.21%
Titanium	29.16%;	24.00%
SiO_2		1.91%

(Dulieux, 1911a, pp. 94-96).

Mawdsley (1927, p. 49) reported: "The ilmenite outcrop has an area of 250 by 100 feet, but is much cut by slippage planes and involved with anorthosite which in part, apparently, is in the form of displacement blocks surrounded by ilmenite".

Bourret (1938) stated that an estimate of tonnage could not be made owing to the state of the workings. A sample gave 41.27% TiO_2.

F) Brassard Deposit, Unsubdivided Portion of Charlevoix County, East Bank of Northeast Fork of Gouffre River.

"The nearest point to the deposit is the village of St. Agnes. From here a good gravel road leads northwest to Desales Post Office, a distance of six and a half miles. The ilmenite deposit is ten miles beyond Desales.

The deposit is on the west slope near the top of a 300-foot hill. It consists of pockets of ilmenite occurring in anorthosite. The ore is massive and in appearance quite similar to the ilmenite found in the Saint-Urbain area; it is however generally slightly more magnetic than the latter.

The workings at the time of our examination consisted of two open-cuts and three trenches. A few stringers of ilmenite can be seen in the open-cuts and in the northern portions of the trenches. Near the southern end of the middle of the trench a body of massive ilmenite is exposed for a length of eight feet. It is two feet wide at the western end of the exposure and four feet wide at the eastern end.

Another mass of ore eight feet by five feet is exposed in the next trench, thirty-five feet to the East. These two exposures may be separate orebodies or they may possibly be two parts of the same orebody which has been separated by faulting.

Five samples were taken from the outcrop. Analyses gave:-

Iron	44.13	43.00	44.60	43.94	42.45
Titanium	38.88	38.07	36.60	36.09	36.14
Vanadium	0.14	0.15	0.16	0.16	0.14

The claim numbers are Q-30242 and Q-30510. (Bourret, 1941, 1942; Waddington, 1942).

G) Saint-Jérôme Range, lot 608, Bignell Electric Co's Workings. A "dozen" small prospect pits were put down and some reached titanic iron. (Dulieux, 1911A, pp. 96-97).

H) Saint-Jérôme Range, lot 619. In 1930-31, the E.I. Dupont de Nemours Company acquired a part of lot 619, after dip-needle and diamond-drill exploratory work, where "it was reported that an important and hitherto unknown body of ilmenite was discovered". (Que. Bur. Mines, Ann. Rept., Part A, 1931, pp. 21).

I) Saint-Thomas Range, lot 641. A small lens occurs. (Dulieux, 1911a, p. 97).

J) Decharge Range, Left Bank of the Gouffre River, Gilbert's Workings. A lens 6-7 feet wide occurs. (Dulieux, 1911a, p. 97).

K) Beaupré Seigniory, Seminary's Outcroppings. Apparently relatively small lenses are reported. (Dulieux, 1911a, pp. 97-98).

2. Bay of Seven Islands. 340 miles below Quebec.

A) Des Rapides River Deposits.

1. Cran de Fer Falls, W.M. Molson Mine. At the second falls upstream from the mouth of the river.

The ilmenite occurs associated with anorthosite and gabbro. On the whole this deposit "may be defined as a very large mass of a titaniferous magnetic iron containing, in its pure parts, from 50 to 52 per cent of metallic iron and from 12 to 15 per cent of titanium. The rock immediately associated with this ore is a fine-grained gabbro, charged with titano-magnetite, frequently to such an extent that it might pass for iron ore itself.... An estimate of the tonnage....may be put at a minimum....of from 300,000 to 400,000 tons of rich ore". (Dulieux, 1911a, pp. 108-114). According to Faessler (1938), an analysis of the best ore gave: 51% iron, 22.78% TiO_2, 4.04% P_2O_5, and 0.85% sulphur. This "rich ore is found only here and there in bodies of very small dimensions". In general, Faessler considered that the ferriferous gabbros were much more important economically than the titaniferous magnetite, for the reason that, while low in iron, they were present in great volume. They analysed between 15% and 20% iron. "The marginal portion of the anorthosite intrusion of the Sept-Iles district is composed, over long distances, of such a ferriferous gabbro", and there is "every reason to believe that there are almost inexhaustible supplies of this low grade ore in an area of about 20 square miles". (Faessler, 1938).

2. Gagnon Deposit. "The whole of the quadrilateral between the mouth of the Rapid river to the level of the lower rapids and the portage road consists of a black gabbro which in some places is so charged with grains of titaniferous magnetite that one might be tempted to take it for true ore". Analyses gave:-

Iron	25.81%	28.37%
Titanium	11.18	8.79

"Such rock cannot be shipped as iron ore and it cannot be used unless works are installed for magnetic concentration after crushing".

"Such rock cannot be shipped as iron ore and it cannot be used unless works are installed for magnetic concentration after crushing". (Dulieux, 1911a, pp. 114-115).

3. Outarde Falls Deposit. About 100 feet below the falls, and for a length of 60 feet, the gabbro is so charged with magnetite that it is an ore. There is comparatively little pure ore. Ore occurs also in a low outcrop 100 feet west of the river. The size of the deposit as a whole was not determined, but it "seems to be of some importance", and, "some samples give very good percentages in iron, while comparatively not very rich in titanium". Analyses gave:-

FeO	70.70%	33.11%
TiO_2	18.12	17.54
P_2O_5	0.075	-
S	0.08	-
Metallic iron	50.99	25.75
Titanium	10.88	10.53

No. 115 was from the ore 100 feet west of the river, and 116 was from ferriferous gabbro.

Mining of the ores here would present no serious problems, as 6,000 horsepower could be developed at the Great Falls (30 chains above the Cran de

Fer Falls), transportation to Sept Iles wharf would be about 8 miles, ant at the wharf vessels drawing 15 feet could moor at low tide. (Dulieux, 1911a, pp. 115-116).

B) St. Marguerite River, Clarke City Deposits.

The iron deposits are near the falls of Clarke City. Below Clarke City lenticular masses of ore up to 15 feet long occur in the anorthosite. The whole mineralized mass is not more than 40 feet by 140 feet. The quantity of available good ore here is estimated at about 10,000 tons. Above Clarke City (about one-half mile above the falls) a quarry exposed ore that probably measures 30 to 70 feet by 150 feet, not all of which is true ore.

Analyses gave results corresponding to:

	Below Clarke City		Above Clarke City
	211	213	220 (average?)
Iron	55.10	53.03	38.86
Titanium	12.42	9.84	9.06
Phosphorus	0.049	0.013	0.08
SiO_2	1.52	7.88	15.96

(Dulieux, 1911a, pp. 119-125).

C) North Shore from Seven Islands to Hâvre St-Pierre.

1. Deposits at the Chaloupe River and at Cap Rond.

Generally these deposits are "titano-magnetites with feldspathic gangues" in the shape of lenses or veins. Their thickness generally is between one and three feet and seldom exceeds 10 feet; a single lens, at Cap-Rond, is 16 yards wide. "These thicknesses are not maintained and often drop to little or nothing". In the immediate vicinity of the sea shore, the only part examined, there does not appear to be any iron deposit of economic importance between the Chaloupe river and two or three miles east of Cap Rond. (Dulieux, 1911a, pp. 125-132).

2. Thunder River. One and three-quarter miles northeast of the village, a mass of titanic iron 50 by 35 feet crops out. Analyses gave:-

Metallic iron	49.75%
Titanium	21.20

(Dulieux, 1911a, p. 133).

3. Saint-Jean River. About 13 miles up the river, on the top of a mountain, some small pockets of titanic iron occur in anorthosite (Dulieux, 1911a, p. 134).

4. Allard Lake Deposits, Romaine River.

"Recent developments on the ilmenite deposits in the Allard lake district of Quebec indicate the probability of a major industry, and one which may make Canada the world's greatest producer of titanium pigments and, ultimately, of titanium metal.

The presence of ilmenite in this district was first reported by the Quebec Department of Mines following a reconnaissance shore-line geological survey in the year 1941. The ensuing report by Retty describes the occurrence of a number of small ilmenite lenses about the shore of Allard lake and along two smaller lakes in the vicinity.

The general geology of the area has been well described in various reports published by the Quebec Department of Mines.

In 1946, a major exploration programme was conducted in the area by Kennco Exploration Limited. This work resulted in the discovery of a number of ilmenite bodies, among which was the large mass of ore lying between Allard lake and Puyjalon lake, known as the Lac Tio deposit. This deposit was recognized as being of major importance and active development work has been proceeding almost continuously since that time. It is presently being carried out on a large scale by the Quebec Iron and Titanium Corporation, wholly owned subsidiary of Kennecott Copper and the New Jersey Zinc Company.

Railway construction to the Lac Tio deposit was commenced less than two and a half years after its discovery.

In general, the ilmenite deposits of the Allard Lake district occur as dykes or lenticular bodies within the main anorthosite mass, from 2 to 15 miles west of its northeastern contact with the granite.

Estimates of grade and indicated tonnage in the main orebody disclosed that there is upwards of 100,000,000 short tons of ilmenite ore averaging 32 per cent TiO_2 and 36 per cent Fe. Possibilities for exploitation of this orebody are excellent and further lateral exploration will no doubt reveal much additional ore". (Hammond, 1949).

The Allard Lake deposits are situated in the Romaine River district, about twenty-five miles north of Hâvre St-Pierre on the north shore of the Gulf of St. Lawrence. By the end of 1947 the diamond drilling consisted of 61 holes totalling 21,776 feet.

PART D. Terrebonne-Argenteuil Area

a. Terrebonne County.

1. Beresford Township, R. V, lots 37W, 38, Ivry Mine.

One and a half miles southwest of Ivry station; 67 miles north of Montreal. Titanic iron occurs in masses in the "Morin" anorthosite. The ore

apparently lies in a mineralized zone trending W.N.W. to E.S.E. for at least 750 feet, and possibly 1,100 feet, and up to 120 feet wide. The quantity of ore was not estimated but it was judged sufficient to justify mining being started. The deposit is favourably situated as regards both mining and shipment of ore. Analyses gave:-

Metallic iron	48.05%	47.86%
Titanium	18.18	19.00

(Dulieux, 1912, pp. 66-71).

According to Osborne the ore consists of an intimate intergrowth of hematite and ilmenite. Three separate orebodies are indicated by the magnetometric surveys of Professor D.A. Keys, McGill University; one is nearly vertical while the other two are flat or dipping gently to the north (Osborne, 1935, pp. 76-85).

Prior to 1922 a total of about 16,000 tons was shipped from this mine, mostly to Niagara Falls, United States. In 1926, 200 tons ($600 was shipped to England for experimental purposes.

2. Beresford, R. VI, lots 39-41. Near Desgrosbois station, and about 5,000 feet north of the Ivry Mine.

The ore is titaniferous magnetite occurring as segregated masses in anorthosite. The masses are less clearly defined than in the Ivry deposit, and in the mineralized zone the rock is often impregnated with ore while the ore in the masses frequently encloses feldspars and pyroxenes. The ore is magnetic, and portions of the richly mineralized zone might be mined and high grade ore be obtained by rapid magnetic concentration on the spot. Analyses gave:-

Iron	40.76%	42.85%	46.59%	44.04%
Titanium	4.49	6.73	18.09	5.09

This mine will not become really valuable unless larger masses are discovered and unless other tests show that a higher percentage can be obtained by concentration. (Dulieux, 1912, pp. 72-78). According to Osborne, this deposit is magnetite with associated ilmenite. The ore outcrops in several places, and is strongly magnetic. A dip-needle survey of the deposit was made, and a chart showing the presumed outlines of the orebodies accompanies Osborne's report. (Osborne, 1935, pp. 85-88).

A small blast furnace was erected for experimental purposes in 1941.

3. Rivière-du-Nord, North Concession, 2½ miles west of St. Jerome, north of the road to St-Canut, on lots 461 to 464.

Narrow bands of magnetite occur in Morin gneisses. The Canada Iron Furnace Co. worked here in 1891-92, shipping 365 tons of ore to the Radnor furnaces. Beds or lenses up to 3 feet thick were worked. (Adams, 1895, pp. 139-141).

"The mineral deposits on this property consist of a number of irregular lenses of magnetite. These lenses vary in width from two feet down to mere stringers and appear to be restricted to a zone about fifteen feet wide. Their dip is practically vertical. The zone which contains the lenses appears to extend across the property in an east-west direction (magnetic) for about eleven hundred feet". (Waddington, 1942).

Two channel samples were taken by Bourret in 1942; analyses gave:-

Iron	61.29%	and	55.43%
Titanium	0.33	and	0.58
Vanadium	0.02	and	0.02

4. Abercrombie, R. H. A "remarkable case of local magnetic variation was observed" near the margin of the Morin anorthosite, on the road from Ste-Adèle to St-Sauveur. (Adams, 1895, p. 142).

5. Abercrombie. "A few exposures of anorthosite rich in opaque minerals were noted north of Sainte-Marguerite station. Another occurrence was seen northeast of Shawbridge". (Osborne, 1936, p. 27).

b. Argenteuil County.

1. Grenville, R. IV, lot 3, N. Half. Magnetite occurs in "deposits 6-10 inches wide.... The ore is traceable for about 400 feet, by indications on the surface, but none of them uncovered so far warrant exploitation". (Cirkel, 1909, p. 99). According to Osborne (1936, p. 28) the "deposit of magnetite here is of the contact metamorphic type.... Logan described the occurrence as 8 yards wide and 150 yards long, but the ore-zone is so covered with the debris left from exploration and mining that it is impossible to assess its merits".

2. Grenville, R. V. lot 3. "Near the centre of the south half of this lot, a number of openings have been made, on an east and west course, on what appears to be an accumulation of pockets, and lens-shaped deposits of magnetic iron ore". (Cirkel, 1909, p. 98).

3. Grenville, R. VII, lot 4. Some small bands of magnetite occur here. (Cirkel, 1909, p. 99).

4. Grenville, R. VIII, lot 5. A small winding vein of magnetic ore occurs here. (Cirkel, 1909, p. 99).

5. Wentworth, R. VI, lot 26. Magnetite is said to have been reported from here (Osborne, 1936, p. 27).

6. Morin, R. IV, lot 43. "A mass of metamorphic pyroxenite.... has been mineralized by iron. A small open-cut shows about four feet of ore, impure with sulphides, and a number of undeveloped occurrences of magnetite were noted here. The deposit is on a bench only a few hundred yards north of the railway, so merits prospecting". (Osborne, 1936, p. 28).

c. Montcalm County.

1. Rawdon, R. II, lot 2. Near Ste-Julienne.

Titaniferous iron ores occur in bands from a few inches to several feet wide in anorthosite. In most places the bands are too poor in iron to constitute proper ores. Analyses show: 38.27% to 42.29% of metallic iron and 33.64% to 35.09% of titanic acid. (Adams, F.D., 1895, p. 141).

2. Wexford, R. I, lot 7. Some iron occurs here in anorthosite. An analysis showed 20.27% of metallic iron (Adams, 1895, p. 142).

d. Labelle County.

1. Montigny, R. II-III, lots 10-14.

"Magnetite deposits have been located by dip-needle surveys on lots 10 to 14, ranges II and III, Montigny township.

Systematic dip-needle traverses were run across an area of five square miles. The traverses were so spaced that it is unlikely that any large bodies have been missed in the area covered.

The work indicated that the most important concentrations are in Z-shaped formation including two east-west zones each about half a mile long, and a northeasterly trending connecting zone. A trench made across the most promising location exposed 78 feet of magnetite, averaging 46.42 per cent Fe. Further trenching, on a very modest scale, yielded little useful information, as it was not possible to reach bed rock at the desired places.

Three diamond-drill holes were drilled and intersections obtained suggest that the bodies in the zones of magnetic anomaly are probably irregular and lenticular, but that large tonnages of material averaging between 40 and 50 per cent Fe probably are present.

"The magnetite is very low in Ti, and P. The composition suggests that no difficult metallurgical problems would be involved in treating the ore.

"The deposits are about 100 miles north of Montreal. They are less than one mile and a half from either the Montreal - Mont-Laurier highway or from the railroad joining the same two centers (Waddington, 1944).

PART E. Shawinigen Area (St-Maurice County)

St-Boniface de Shawinigan, R. VII, lots 22, 23. The "Grondin" or "Shawinigan" mine. Four miles northwest of St-Boniface, which is 6 milwa from Shawinigan Falls.

The deposits are in a mass of anorthosite or gabbro 7 miles long (north-south) and 2 miles wide. A trench 22 by 10 by 6 feet deep is in good ore, and to the eastward ore can be seen at several places. An irregular elliptical area 175 feet by 60 feet seems, by dip needle, to be underlain by ore. In an exposure in lot 23, titanomagnetite constitutes 40% to 50% of the mass over a breadth of 25 feet, and 75% over a breadth of 18 inches. An analysis gave:-

Iron	41.55%
Titanium	5.44

Some pig-iron was smelted here and shipped to Three Rivers about 1878 (Dulieux, 1912, pp. 81-84).

Examination of the above deposits was made by G.W. Waddington in 1942; he reported that the magnetite occurs as small, narrow lenses. The average of seven samples taken from five different lenses averaged 35.52 per cent iron. At the present time these deposits appear to have no value as ores of iron (Waddington, 1942).

PART F. Saguenay River Area (Between Lake St. John and Chicoutimi.)

1. Bourget (Chicoutimi County), R. I, lots 44, 45, St-Charles Mine.

About a mile and a half west of St. Charles, on the north side of, and close to, the Saguenay river.

"The ore is a titanomagnetite present in enormous segregated masses in the anorthosite. The outcrops of these masses are the most remarkable, as regards size of all I have seen in the Province". Analysis gave:

Iron	50.53%
Titanium	10.55

The percentage of phosphorus and sulphur is low, 0.21% being the highest for either of these elements. The deposits can be easily mined and they are not far from the port of Chicoutimi. It is claimed that "even without magnetic concentration, this....is a directly workable ore". (Dulieux, 1912, pp. 85-91). In Dulieux's report an estimate of probably over 5,000,000 tons of ore reserve is credited to this deposit - this is based in part on an arithmetical error that inadvertently doubled the reserve estimated for the largest body, and the total estimated reserve should have been over 3 instead of over 5 million tons (See Dulieux, 1912, p. 88).

Robinson (1924, pp. 42-54) stated that the chief exposures of magnetite are on the brow and face of the north bluffs of the Saguenay, and from here the ore can be followed inland for 2,000 feet in a zone 1,200 feet wide. The ore is of two types, first, a coarser-grained variety containing a comparatively small amount of foreign matter, and second, a finer grained, compact, tough variety mixed with considerable amounts of other minerals. Analyses gave:-

	Coarse-Grained	Fine-Grained
Iron	48.18%	33.77%
Titanium	13.45	7.44
Phosphorus	0.404	3.85

The ore reserve "may quite possibly run well up into millions of tons". It would seem to "be sufficient to keep a small plant in operation for a good many years". (Robinson, 1924, pp. 42-54) (See also, Denis, B.T., in Mining Operations in the Prov. of Quebec, Bur. of Mines, 1924, pp. 84-88).

The Saguenay Expedition, 1923, (C.P. Berkey, p. 20). reported that this deposit might have "some value under special conditions.... The occurrence is....not at all of uniform character, even within the body as mapped in earlier reports.... Any work...with it could involve some sort of milling separation to remove the non-metallic constituents and would involve also the diffioulty of handling a titanium-bearing magnetite ore". Analyses of 6 samples from the St Charles area, R. I, "lot 42" showed from 44.4% to 48.9% iron and from 13.3% to 15.2% titanium.

G.W. Waddington made a dip-needle survey in 1942 of the southern halves of lots 44 to 48, range I, Bourget township. The area surveyed was north of that investigated by Robinson. In 1944, Waddington extended his survey northward to a point two and one-half miles from the Saguenay, and westward into the adjoining township of Taché. In summary, Waddington reported that in Bourget and Taché townships a large number of magnetite deposits were known, most of them distributed irregularly in a zone 1,200 feet wide and extending northward 6,000 feet from the Saguenay. He believed that a large tonnage could be developed here. (Waddington, 1942).

2. Kenogami Township.

a) Range II. On the railway line, between Ratière and Larouche stations; four miles from Ratière station. The deposits so far descovered are of slight importance. The rock is anorthosite. (Dulieux, 1912, pp. 91-93).

b) Range A, lots 44, 45 and 46.

"Boulders of magnetite, some of them weighing several tons, are found strewn over a considerable area on the south bank of the Saguenay river, opposite the St. Charles magnetite deposits. They are most abundant on lot 44, range A north, Kenogami township. No magnetite has been found in place on this lot. At a point 1300 feet west of lot 44, and 300 feet south of the present shore line, there is an outcrop of magnetite which forms a small bluff 12 feet high and 30 feet long. One sample, which was taken from this outcrop, assays 44.08 per cent iron. Dip-needle observations indicate that this deposit is not more than 20 feet wide by 100 feet long. Numerous observations taken at other points along the south shore of the river on lots 44, 45 and 46 failed to indicate the presence of other deposits of magnetite (Waddington, 1942).

3. Alma Island Township, R. II, lot 36. In the outlet of Lake St. John, 800 feet north of the east-west trans-island road, in anorthosite, a series of lenses of magnetic iron occur; the largest is 15 by 30 feet. An analysis gave:-

Iron	53.07%
Titanium	11.94

(Dulieux, 1912, pp. 93-94).

Four samples from the Quebec Development Co. property on Alma Island are reported by the Saguenay Expedition (1923) to have analyses from 48.8% to 57.4% iron and from 10.3% to 19.5% titanium.

4. Taché Township, R. V, lots 13-14. Mine lake. Two samples taken from magnetite in anorthosite yielded:-

Iron	46.3%	and	53.5%
Titanium	13.5	and	13.9

(Saguenay Expedition, 1923, Analyses p. 13).

5. The Saguenay Expedition, 1923, (pp. 20-21) recorded that field men of Price Brothers' staff reported that magnetic instruments are disturbed materially in the vicinity of Lake au Poivre, east of the Shipshaw river. The possibility of this indicating a more extensive body than at St. Charles was suggested. "Because of the failure of our party to reach this ground and because of the nature of the reports made by Price Brothers' men, it seems to deserve an examination". (p. 27).

PART G. The Hull-Gatineau Area.

The iron ores of this area are magnetite, hematite, and a mixture of the two. "They are destined to play an important part in the future development of the country, as soon as their economic value is fully appreciated, and modern concentration and smelting methods are adopted". (Cirkel, 1909, p. 32).

1. Hull Township, R. VII, lot 11, Forsyth Mine.

About five miles northwest of Hull. The ore is magnetite mainly, with some hematite.

From 1854 to 1858, 8,000 tons of ore was shipped from this mine to the United States; the average content of metallic iron was 60.7%. A blast furnace was operated during parts of 1867 and 1868, producing 1,040 tons of pig iron, representing a yield of 54.5% from the ore treated. The quality of the iron manufactured was excellent, but the composition of the charge of the furnace was poorly calculated, and this alone appears sufficient to explain the failure to produce profitably. Ore and flux occur together here, but fuel was not handy and transportation facilities were lacking.

The main part of the workings was an open cut 735 feet long, 10-80 feet wide, and 25-50 feet deep. (Cirkel, 1909, pp. 37-49).

Dulieux, (1912, pp. 114-119) did not consider this deposit to be of economic importance, inasmuch as it appeared to be "merely a lens, some 30 feet wide at the most".

In 1917 it was recorded that "Diamond drilling is reported to have proven the existence of orebodies which would yield 430,000 tons of concentrates (R.H. Flaherty) of the following analysis:-

Iron	57.29%
Silica	10.67
Sulphur	0.62
Phosphorus	0.017
Lime	1.47

(Lindeman and Bolton, 1917, Vol. 2, p. 147).

2. Hull Township, R. VI, lot 14. Baldwin Mines.

The deposits here are on the westerly continuation of the formation in which the Forsyth mine is located, and about 2,000 feet from the Forsyth. The ore deposits are found over a length of about 1,100 feet in pockets and lenses of irregular shape. Veins occur in a few places. Analyses of 5 samples gave:-

Metallic iron	56.69	to	63.87%
Siliceous matter	5.36	to	15.38
Sulphur	0.054	to	0.263
Phosphorus	0.006	to	0.018

(Cirkel, 1909, pp. 50-53).

Dulieux, (1912, p. 119) stated of these deposits: "No mass of any extent has been uncovered...; pure ore is seldom met over a continuous length of several feet".

3. Hull Township, R. VII, lot 14. S.W. The Lawless Mine.

This deposit is northwest of the Baldwin. The principal opening is 15 by 15 by 30 feet deep. No solid orebody of extent can be seen on the surface, only small pockets and lenses, and disseminations in the limestone. (Cirkel, 1909, p. 53).

The Forsyth, Baldwin, and Lawless mines are grouped by Cirkel, (1909, pp. 53-60) in the "Hull Iron Range". The main ore is magnetite with some hematite. It is assumed that the average grade shipped would have been about three-quarters magnetite, sometimes with hematite, and one-quarter gangue. The total extent of the range is put at about 6,800 feet long by 40 to 100 feet wide - in

which area iron ore is visible at scattered localities. Cirkel believes that a "large quality" ore could be mined here and that "40,000 tons of ore can be readily mined" between the eastern end of the long cut and the shaft (Forsyth mine).

4. Hull Township, R. XI, lot 1 (lot 28 in Dulieux, 1912).

Templeton Township, R. VI, lot 27, 28. The Haylock Mine.

The deposits are on the Hull-Templeton line. The principal deposits, and those worked to some extent, are in the N.E. corner of the south half of lot 28, R. VI, Templeton. The ore is specular iron with considerable magnetite. Apparently the quality was good but the quantity was lacking to warrant continuing the extensive operations carried out in 1873-74. The deposits apparently are in small lenses and pockets. Analyses of 15 samples from the Hull-Templeton line locations showed:-

Metallic iron	47.23%	68.49%
Titanic acid	0.9	16.8
Phosphoric acid	trace	0.409
Sulphur	trace	0.07

(Cirkel, 1909, pp. 61-67).

Dulieux, (1912, pp. 119-120) reported that he saw no mass of ore of any importance here.

5. Gatineau river. Many scattered deposits of minor importance occur in the townships bordering the Gatineau. Among the more important of these are:-

A.- Wakefield, R. VI, lot 23. Lenses of magnetite occur. (Cirkel, 1909, p. 74).

B.- Cameron (Ottawa Co.,) R. II, lot 30. Lenses of magnetite, much of which is mixed with pyrite, occur. (Cirkel, 1909, p. 75).

C.- Hincks (Gatineau Co.), R. VI, lots 1 to 4. "The hematite deposits occur on the north slope of a ridge facing Henry lake, and also under the bed of this lake. At a distance of about 400 feet south of the lake shore, a long trench exposed a hematite lens nearly 300 feet long, with a maximum width of 20 feet". (Bourret, 1948). About 7,000 feet of diamond drilling was done here in 1947 by the Kazabazua Corp., Ltd., (Mining Industry, Quebec, 1947) (P. 22).

An examination of this deposit was made by T.L. Tanton (1944); the analysis of five representative samples taken across the body gave: 68.53% to 80.67% of Fe_2O_3.

6. Pontiac County Deposits.

A. Bristol, R. II, lots 21, 22. The Bristol Mine. Located about two miles north of the Ottawa, 8 miles from Quyon, and 4⅘ miles from Wyman, on the C.P.R.

Systematic operations were carried out here between 1885 and 1889; the output was 125 tons per day; and, up to 1888, the total output was about 12,000 tons of high-grade magnetite. Most of the output went to Pensylvania furnaces, which produced a high-grade Bessemer ore.

The ore is a mixture of magnetite and hematite, in lenses up to 20 feet wide and in rich impregnations. The iron-bearing formation is up to about 500 feet wide and apparently about 1,500 feet long. It has been found to a depth of 200 feet in the main shaft and to 75 feet in another shaft, both shafts being bottomed in ore. Apparently the deposits contain "quite extensive ore reserves", although the tonnage could not be estimated closely. The method of mining recommended was by wide and long quarries along the stratification of the rocks.

Analyses of 13 samples show:-

Metallic Iron	43.76%	to	62.80%
Phosphorus	trace	to	0.015
Sulphur	0.310	to	2.74
Titanic acid	none	to	0.25

(Cirkel, 1909, pp. 75-90).

Dulieux (1912, pp. 107-114) reported that the ore was in pockets and lenses 40 feet wide at the most and of short lengths.

Lindeman (1910) reported analyses of five 100-pound samples of ore from five of the largest ore piles of the mine, which showed:-

Metallic iron	53.74%	to	58.18%
Sulphur	1.48	to	2.92
Phosphorus	0.001	to	0.008

He stated that the ore "consists of magnetite which in some parts of the field contains a considerable amount of hematite". A magnetometer survey indicated that the most important deposit of the field probably underlies lot 22, east of the main workings on lot 21, and that this might have an area of about 90,000 square feet. This deposit does not show on the surface. Also this survey showed two other large areas, in lot 21, in which the vertical magnetic attraction was strong - these had areas of 25,000 and 60,000 square feet. In 1910, "Ennis and Company of Philadelphia made several trenches in the areas of strong magnetic attraction, showing that the formation is not uniformly made up of magnetite, but that the orebodies constitute a series of lenticular masses or bands of magnetite" 40 feet or less in width. It "is possible that in these areas the magnetite bands are so frequent and the enclosing rocks so impregnated with disseminated magnetite that the whole deposit could be worked. In such a case special treatment would be required both for increasing the percentage of iron and for decreasing the percentage of sulphur". Magnetic concentration

experiments have shown "that a concentrate high in iron, and low in phosphorous, could be obtained. The objectionably high sulphur content of the concentrates would be reduced by the nodulizing or sintering processes required to put the concentration in suitable form for blast furnace use". (Lindeman and Bolton, Vo. 1, 1917, Vol. 1, pp. 53-54).

In 1923, M.E. Wilson made a study of these deposits. He had little information on which to base an estimate of possible reserves, but he made the following points: "The average proportion of iron contained in any of the ore masses of considerable size probably does not exceed 55 per cent and may be considerably less than this amount.

"The ore contains an average of not less than 3 per cent pyrite (equivalent to 1.52 per cent sulphur), 11.51 per cent silica, 0.16 per cent titanium oxide, and other impurities.

"The belt in which the ore masses occur has been intruded by numerous dykes of granite, so that considerable quantities of this barren rock must be removed in mining the magnetite.

"The ore masses occur as scattered lenses, the maximum width of which does not generally exceed 20 feet, so that although the total tonnage of magnetite available on the property may be large, the amount present in each single lens is small". (Wilson, M.E., 1924, pp. 107-112).

In 1917, 16,028 tons ($54,135), mostly dump ore, were shipped from the Bristol mine.

B. Bristol, R. I, lot 2. Veins of specular iron cut crystalline limestone and gneiss. Insufficient work has been done to determine the importance of these deposits. (Cirkel, 1909, p. 90).

C. Bristol, R. I, lot 22. An outcrop about two feet square shows iron ore, giving 11,78% titanic acid and 34.25% metallic iron. (Cirkel, 1909, p. 91).

D. Clarendon, R. II, lot 25. A hematite occurrence. Insufficient work done to determine its importance. (Cirkel, 1909, p. 91).

E. Clarendon, R. II, lot 26. Iron pyrites up to 12 feet thick exposed in a pit near the road. (Cirkel, 1909, p. 92).

F. Clarendon, R. VII, lot 27. Magnetite iron ore. Not much to be seen owing to the vegetation. An analysis gave:-

Metallic iron	59.94%
Titanic acid	7.23
Sulphur	0.001
Phosphoric acid	7.84

(Cirkel, 1909, p. 92).

G. Litchfield, R. I, lot 12. Impregnations of magnetite in limestone as pockets and lenses up to 4 feet in diameter - apparently not frequent enough to justify workings. (Cirkel, 1909, pp. 92-93).

H. Litchfield, R. V, lot 12. Some narrow bands, up to ½ inch wide, and one pocket or lens of magnetite. A shaft 20 feet deep was sunk on the lens. Analysis gave 55.99% metallic iron, 0.921% sulphur, 0.004% phosphorus, 13.030% titanic acid, 4.0% silica, etc.... (Cirkel, 1909, p. 93).

I. Litchfield, R. VIII, lot 10, North Half. "Magnetic ore" strikes "through concessions VIII and IX, in an east-westerly direction.... Blocks of an apparently pure magnetic ore can be seen strewn all over the hills, and in one place an outcrop of the solid ore can be noticed.... Outcrops of the magnetite have also been found....on lots 11 and 14. Samples of the ore show impregnations of magnetite in reddish feldspathic rocks". It is possible that systematic prospecting would locate large deposits. No work has ever been done on these lands. Analysis showed 53.68% metallic iron, 15.75% titanic acid, 0.005% phosphorus, 0.078% sulphur. (Cirkel, 1909, p. 94).

J. Litchfield, R. X, lots 4, 5. Titaniferous magnetite ore occurs on the line between these two lots. Large blocks of clean ore are obtainable, but not enough work has been done to show the extent of the deposit. Analysis gave 47.92% metallic iron, 15.44% titanic acid, 0.004% phosphorus, 0.084% sulphur. (Cirkel, 1909, p. 96).

K. Leslie Township, at Otter Lake. Samples from here showed small pockets of magnetite in pegmatite. (Cirkel, 1909, p. 94).

L. Calumet, R. VII, lot 13. Several outcrops of what appear to be hematite occur; apparently the ore is in a vein or veins. Analysis gave 52.670% metallic iron, 22% silica, 0.038% sulphur, 0.010% phosphorus, etc.... (Cirkel, 1909, pp. 94-95).

M. Calumet, R. IX, lot 2. Magnetite ore occurs near the Ottawa river, as impregnations and small bands and pockets - in general it occurs as "small lens-shaped, or veinlike bodies, from a few inches, up to 2 and 3 feet in width, irregularly distributed through the rock". (Cirkel, 1909, pp. 95-96).

N. Sheen, R. VI, lot 12, 13. Bands and lens-shaped deposits of magnetite occur, and also networks of veins of impure magnetite. Little work has been done on these deposits. (Cirkel, 1909, pp. 96-97).

PART H. Abitibi-East County

1. Cadillac Township, N.E. Part.

Bands of impure magnetite up to a foot across occur in a zone about 1,300 feet wide; they are "more or less abundant within a zone about one hundred yards wide, extending...about two miles". Towards the eastern end of the belt, in two zones 14 and 28 feet wide, respectively, "the magnetite-bearing

bands are closely packed together". The wider zone was estimated to contain 35% metallic iron, and the narrower 25%-30%. One sample gave 68% and another 30% of metallic iron; these samples were free from titanium and very low in sulphur and phosphorus. The deposits are sedimentary in origin. Nothing definite could be said about the economic possibilities of the iron formation. However, "it is possible that a large body of low-grade ore may be found". (Bancroft, 1911, pp. 205-207).

Iron formation has been referred to by various authors since 1911 (Bancroft), but never considered as of economic value. According to Gunning (1937, p. 9): "Iron formation is an important constituent of the Cadillac sediments.... There are two main types. In one, beds of magnetite a fraction of an inch to several inches, and occasionally a few feet, in width are intercalated with normal greywacke. Individual beds of magnetite tend to be lenticular and discontinuous, but zones or beds often persist for considerable distances.... Some narrow beds are very pure, but in many there is a large proportion of quartz and other impurities.

"The second variety is more strictly iron formation. In this case widths of from a few feet to an exceptional 150 feet consist of a beautifully banded assemblage of magnetite, specularite, jasper, and greywacke. Greywacke is often entirely absent across widths of 10 feet or more.... As a general rule magnetite is much more abundant than specularite".

2. Ligneris Township, Lots 21 to 28, R. VI, lots 17 to 24, R. V, lots 18, 19, 20, R. IV.

"In general it appears that the rocks in the Ligneris township area are of sedimentary origin, and for the most part, strike North 60° East with vertical dip. They consist of alternate beds of thin bedded grey slate and bobbed fine grained cherty carbonate intercepted with occasional beds up to about 31 feet in thickness of magnetic slate with very fine grained structure. The carbonate contains some iron as indicated by its rusty weathering, but the percentage appears to be very low. Carbonate occurs both in thin bands and also in somewhat massive structure with granular arkose". (V.D. Johnston, 1948).

Analyses of five samples showed:-

Metallic iron	21.37%	to	30.95%
Silica	48.67	to	67.73
Phosphorus	0.03	to	0.23
Sulphur	0.01	to	0.04

(Babcock, 1949).

PART. I. Témiscamingue County

1. Guillet Township (Mud Lake Area).

An iron formation occurs also east of Lake Témiscamingue. "Thin bands of iron formation interbedded with basic lava flows are fairly common throughout

the area.... The bands are seldom more than 40 feet, and generally less than 20 feet, in width.... The rock consists of bands of black, cherty quartz, rich in magnetite and up to ½ inch or more in width, which alternate with wider bands of cherty, blue quartz and occasional bands of chlorite or hornblende schist". (Hendersen, 1936, p. 11).

2. Gendreau Township, Kipawa Lake.

"On the west shore of Lake Kipawa, two miles north of the Kipawa railway station, an iron formation extends for several hundred feet along the lake shore. It is made up chiefly of ultrabasic rocks, but contains a few thin steeply dipping beds of hematite. The best-looking hematite observed was in a bed about six inches thick. Samples taken from this bed gave an assay return of 40.44% iron". (Waddington, 1942).

PART J. Mistassini Area

According to G.W. Norman (1940), "Mistassini Lake just beyond the Hudson Bay - St. Lawrence divide, 300 miles northwest of Quebec City, is one of the several places in the Canadian Shield east of Hudson Bay in which late Pre-Cambrian clastic, carbonate and iron-rich sediments occur.

Mistassini geology has been briefly discussed by James Richardson, Walter McOuat, A.P. Low, and A.E. Barlow.

The iron formation outcrops on a few islands in Lake Albanel at the mouth of Temiscamie River, along a northwesterly facing cuesta between Lake Albanel and Temiscamie River and at a few places along Temiscamie River. Its thickness is probably between 100 and 200 feet. The complete succession of the formation is not exposed nor is its contact with the underlying dolomites. The lower part of the formation consists of rusty-weathering ferruginous chert consisting of very fine-grained quartz and ferruginous carbonate, probably siderite, intimately mixed together in nearly equal proportions. The strata exposed between Lake Albanel and Temiscamie River are ferruginous cherts containing 10 to 15 per cent magnetite in places; there the carbonate is almost entirely altered to limonite. Along Temiscamie River cherty iron-carbonate rocks crop out at a few places, but the characteristic rocks of the formation there are dark slate, ferruginous slate, and beds consisting of interbanded magnetite and cherty silica in layers ½ inch or less to 1 inch or slightly more in thickness. Some of the beds contain nearly 50 per cent magnetite chiefly in rounded or slightly irregular granules in a cherty matrix".

In 1947, W.G. Wahl, made a study of the Temiscamie River area, in Mistassini territory. According to Wahl (1947), "The banded iron formation that underlies a considerable part of the area between Albanel lake and Témiscamie river resembles the formations of the important iron producing areas of the Lake Superior region. Hematite, which is the principal ore-mineral in that region, has been observed in the present area, but, as yet, not in sufficient concentration to be called 'ore'. It must be pointed out, however, that much of the area underlain by iron formation has still to be examined and that much of the surface

is covered by a heavy mantle of drift. Furthermore, unless it is of the so-called 'hard ore' variety, it is a rare occurrence for a hematite deposit to be found outcropping in a glaciated country. The same is true of the large 'soft ore' deposits of Michigan and Minnesota in the Lake Superior region.

As at least some of the hematite in the producing fields is believed to have resulted from the oxidation of iron carbonate and from the leaching out of silica, it is worthy of note that alteration of this type has been observed in some parts of the present map-area, such as along the faults northeast of Kallio Lake. These faults, as well as others which might be found traversing the iron formation, are deserving of attention, especially as it is known that, in the Marquette and Menominee districts of Michigan, some faults have acted as channel ways and barriers for solutions to effect concentration of the ore.

Iron is also present in the area in the form of magnetite, which as previously mentioned, is found in a magnetite-rich zone in the lower part of the iron formation. This zone outcrops near the crest of the cuesta on the southeast side of Albanel lake, and, even though it is not traceable in surface outcrop, the zone is readily discernible by the deflection of the compass needle and the high angle of inclination of the dip needle. The magnetite-rich zone is also exposed on the northwest side of Témiscamie river, near the mouth of Kallio creek and opposite the mouth of Te-Te-Pisca river. In all the exposures observed, the magnetite occurs either as relatively pure layers up to four inches thick between layers of bright red jasper of the same thickness or as finely disseminated grains in a ferruginous chert or jasper".

Mapping of the iron formation by Neilson in 1948 for the Quebec Department of Mines in the area south from that mapped by Wahl in 1947 has shown that the iron formation exposed in the area is the southwestern portion of a more extensive formation which occurs immediately northeast of the map-area between Albanel lake and the Temiscamie river. (Neilson, 1948).

PART K. Northern Quebec Area

1. East Coast of Hudson Bay.

A. Nastapoka Islands.

a) Spathic iron-stone ores are found throughout the islands and form a band not less than 20 feet thick. "The band is divided into layers of a few inches in thickness.... All the beds may not be equally rich but the greater part of them on all the islands visited appear to be sufficiently so to constitute a valuable ore for the manufacture of spiegeleisen. The enormous abundance of the ore is its great feature". (Bell, 1877-78, p. 21).

b) A generalized section, made from detailed measured sections, of the rocks of the islands is given by Low (1900, p. 11). This shows that the iron ores occur in the upper part of the unmetamorphosed sedimentaries of which the islands are made up. The ores consist of hematite, magnetite, and ankerite. The hematite occurs with jasper; "where the ore is poor, the jasper rock predominates and encloses lenses of hematite, while where the hematite is most plentiful

it encloses similar lenses of jasper". There is here "an immense amount of hematite", best developed on Gillies and Taylor islands along with considerable magnetite.

c) Mickel (1902, pp. 256-264) "In places.... there is a very large development of jasper rock, the beds being sometimes 40 ft. thick, and even up to about 100 ft.

"Besides the jasper, two types of iron-bearing rocks exist.... viz.: a hard stratified hematite magnetite siliceous ore, and manganiferous iron carbonate; both of these appear to occur as local enrichments or concentrations of metal in the rock in certain layers.... These concentrations.... sometimes covered large areas, such as about a quarter mile by half a mile, in one place, or 500 ft. by 600 ft. in another. In the largest areas discovered about three-quarters was rock, and in the best from one-third to one-half rock". The following analyses are from "what appeared to be the best bed of ore of the carbonate type":-

	I	2	3	4
Manganese	3.47	3,35	3.97	3.41
Iron	33.35	30.82	33.76	34.07
Silica	23.05	23.20	22.94	21.98
Phosphorous	.024	.031	.091	.018

"Unfortunately, even allowing the best prices quoted for the manganese and iron, these rocks are too low grade to work, being ruined by the high silica contents".

B. Sheal Harbour.

Mica-granite, mica-schist, and some foliated trap with "much iron in the form of magnetite, pyrite and pyrrhotite, and some of the bands are sufficiently rich to be considered ores". (Low, 1900b, p. 59).

C. Long Island.

"Along the landward side of Long Island for three miles from its southwestern extremity, highly ferruginous beds, varying from ten to fifty feet thick, some of which may be valuable as ores of iron" occur. (Bell, 1877-78, p. 21).

D. Richmond Gulf.

Low grade iron deposits are reported to occur in the islands and on the southern shores of Richmond Gulf. (Low, 1900b, p. 51, and 76-77).

E. Hopewell Islands.

Carbonate ores are found on all the islands of the Hopewell chain, but apparently are low grade. (Low, 1900b, p. 51).

F. Payne River; Kyak Bay.

"Large quantities of iron ore" are reported by Low (1898, p. 20) from a locality identified as Kyak bay (Lindeman and Bolton, Vo. 2, 1917, p. 157).

"These deposits are reported to extend over an area larger than that of the great Mesabi range and to contain several hundred million tons of iron ore of low grade". (Scientific and Industrial Research Council, Rept. No. 14, 1924. Report of the Sub-Committee on Iron Ores).

W.C. Martin (1929) reported that bands of interbedded chert and ferruginous dolomite "are common throughout the area. Some of the bands are very long and persistent. One of the most prominent bands occurs on the east side of Kyak bay, about half a mile from the shore.... In this band the dolomite occurs" and in places "contains considerable magnetite, but it is generally free from iron....

"Greywacke: Banded greywacke occurs in contact with the granite gneiss northeast of Kyak bay.... A few of the bands contain considerable magnetite, but across the whole width of the greywackes the percentage of magnetite is very low. The total width of the greywackes is about 400 feet.... The total magnetite content across the 400 feet would not be more than 15 per cent. There is a little specularite present with the magnetite but the amount is not sufficient to appreciably affect the iron content". The greywackes are exposed for about 4 miles along the northeast side of Kyak bay. In general summary, "No iron ore of importance was seen in the area".

G. Belcher Islands.

These islands are 300 miles from Moose Factory. "Mr. R.J. Flaherty reports finding hematite on one of these islands in 1914. Some of the samples show iron formation or low grade ore, while one or two are hematite of excellent quantity". (Lindeman, E. and Bolton, L.L., 1917, Vol. 2, p. 155).

The iron formation of Belcher Islands has been reviewed in considerable detail by Young (1921) and, earlier, by Moore (1918; 1919; 1920) and Flaherty (1918).

Young showed that the iron formation occurred in five bands, with a total length of outcrop of 110 miles. Two or more highly ferruginous zones 10 to 50 feet thick were found in each band. These zones consisted almost wholly of silica and iron oxides; "the silica is largely in the form of quartz, the iron oxides in the form of magnetite and hematite, but a small proportion of the silica and iron oxides is combined as an iron silicate. Four representative samples gave the following results:-

Silica	32.52	46.48	42.12	38.60
Iron oxides	62.04	50.05	53.84	54.62
Metallic iron	44.95	35.42	37.80	39.10

"The individual zones consist of distinct beds, almost all alike in general characters but varying as regards their iron content. In general, about

20 per cent of the volume consists of thin, discontinuous, highly siliceous, very lean layers. If by hand-picking these layers were removed, the metallic iron content could be raised to 50 per cent and more, but the silica content would still be 20 per cent or greater. The more purely siliceous layers are tightly welded to the other rocks and do not form zones that could be eliminated as one body, hence hand-picking would be a heavy charge against the ore produced".

Young's general conclusion was that "No iron ore deposits of commercial value under existing conditions were seen after traversing in all 40 miles of the various bands".

2. Koksoak River (drains to Ungava Bay).

"The bedded iron ores are first met with in descending the Koksoak River, on the south bank, just below the Shale Chute, or a few miles below Cambrian Lake, where a thin section of jaspery magnetite is overlain by twenty feet of cherty limestone containing large blotches of carbonate of iron". Analyses gave:-

	Jaspery Magnetite	Carbonate Ore (Ankerite and Magnetite mixed)
Metallic iron	31.28%	33.62%
Insoluble matter	55.71	4.99
Titanic acid	nil	nil

" For the next ten miles, to the mouth of the Swampy-bay River, exposures of the iron-bearing rocks are almost continuous, and the amount of ore in sight must be reckoned by hundreds of millions of tons. The ore is not everywhere high-grade, and probably a large proportion of it would be unprofitable to work, but there is certainly an almost inexhaustible supply of high-grade ore.... Two miles below the last-mentioned exposure, the rocks were found to consist of a twenty-five-foot bed of jaspery ore, composed largely of magnetite with a small admixture of hematite, underlain by ten feet of siliceous, ferruginous limestone, holding spathic ore in bands and nodular masses up to several hundred pounds in weight. A great part of the magnetite is nearly pure and contains little jasper. The beds are exposed along the right bank of the river for more than a quarter of a mile".

Three and a half miles farther downstream "only the cherty carbonates were found; but half a mile below, the river passes close to a high hill on the west side, where fifty feet of red granetiferous siliceous, ferruginous shale and jasper are overlain by 200 feet of jaspery ore, composed chiefly of magnetite and coloured by an admixture of hematite". Analyses gave:-

	Garnetiferous Rock	Jaspery Ore
Metallic iron	19.14%	48.29%
Insoluble matter	72.86	30.62
Titanic acid	nil	nil

"On the same side, half a mile below, the section exposed on the hillside shows 400 feet of jaspery ore....overlain by fifty feet of cherty carbonate ore. A specimen of the jaspery ore containing a large percentage of hematite gave:-

		Per cent
(5)	Metallic iron	54.35
	Insoluble matter	16.03
	Titanic acid	none".

Near the mouth of Swampy-bay River the Koksoak turns eastward and cuts across shale and siliceous limestone, "so that the iron-bearing members are not again seen along its banks". (Low, 1895, pp. 270-271; 283-285).

2A. Larch River (a branch of the Koksoak).

Large angular blocks of jaspilite, "or a mixture of jasper and iron ore" have been found along the Larch river. In many of the blocks "the jasper is not abundant and the blocks are almost pure magnetite, or a mixture of magnetite and hematite, forming a valuable ore". (Low, 1896, p. 31).

3. Quebec-Labrador Deposits; The Labrador Trough.

Cherty carbonate rocks are well developed around the lakes from Birch lake to Menihek lake on the Ashuanipi branch of the Hamilton river. Faulting has caused repetition of these measures in four ridges.

"The concentrated magnetite and hematite ores were first met with.... at the discharge of Dyke Lake, where two beds each about five feet wide were found associated with cherty carbonate and a siliceous trap ash-rock. At the narrow into Lake Petitsikapau, over twenty-five miles beyond along the same ridge, the ores again come out on the shore for 200 feet, with a width of twenty feet". Analysis of this gave:-

Metallic iron	30.43
Insoluble	51.22
Titanic acid	none

"At the head of the middle northern bay of Astray lake, there is a low hill where 150 feet of jaspery magnetite and hematite are seen. Some of the ore beds are two feet thick between the jasper partings. Fifty feet of similar ore are exposed on the shore of the northeast bay, about two miles from its head".

Large blocks of jaspery magnetite at the outlet of the Menihek lake analysed:-

Metallic iron	40.72
Insoluble	29.90
Titanic acid	none

The deposits on the Hamilton river are said to be widespread, and it is predicted that "the ores will be found in practically inexhaustible quantity". (Low, 1895, pp. 285-286).

"The most southerly exposure of iron formation, so far found, lies near the west shore of Chibougamau Lake, approximately 200 miles in an air line from the Gulf of St. Lawrence. The most promising deposits lie 320 miles in an air line from the Gulf and about 400 miles by the route which would probably be chosen for rail transportation". Reconnaissance surveys covered a total area of about 800 square miles, and aerial surveys, with ground work at intervals, covered a total of 12,000 square miles.

The sedimentary series including the iron formations "forms a clearly defined belt extending from the headwaters of the Hamilton system to Koksoak river and beyond..., a length of over 100 miles. At the Koksoak the width of the belt is about 45 miles and southeastern portions of the belt investigated are at least this wide". The iron formation consists "typically of alternating thin layers of jasper and hematite, but including some siderite-rich beds and cherty layers with siderite or ankerite nodules.... Separation of... (layers of hematite or magnetite) from the interbanded chert or jasper could be very easily effected and a clean high-grade concentrate produced.... The iron formations...(are) in general too low in grade to come into question as iron ores in their original state. While this statement is true in general, it is still possible that in certain parts beds may be found rich enough to be worked". Along the west arm of lake Chibougamau (Shabougama), a part of the section, "apparently representing several hundred feet of original sediments, is exceptionally high in iron, mainly as specularite". (James and Gill, 1929).

According to information extracted from the Report on the Mining Industry 1948, issued by the Department of Mines of the Province of Quebec, the vigorous exploration programme which began in the southern part of the Labrador Trough in 1936 disclosed important quantities of iron ore.

The Hollinger North Shore Exploration Company, Limited and the affiliated Labrador Mining and Exploration Company, Limited acquired concessions covering the southern part of the Trough, which here overlaps the Quebec-Labrador boundary. Some forty-eight deposits are now known in the concessions mentioned and are comprised in a belt ninety miles long by three miles wide. Each of these deposits contains a substantial quantity of ore. The total quantity of ore outlined to the end of 1948 was 323,828,000 tons.

The quantity and quality of the ore located as recorded in the reports of the companies are given in the following table:-

TABLE - Proven Ore at the End of 1948

I - Hollinger North Shore Exploration Company, Limited

Gross Tons (2,240 lbs	Category	Fe %	Mn %	P %	SiO_2
132,955,000	Bessemer	60.63	0.33	0.028	7.98
62,023,000	Non-Bessemer	57.13	0.58	0.108	8.10
27,796,000	Manganiferous	50.38	7.74	0.092	5.71
222,774,000					

II - Labrador Mining and Exploration Company, Limited

Gross Tons (2,240 lbs	Category	Fe %	Mn %	P %	SiO_2
53,572,000	Bessemer	60.84	0.21	0.029	10.08
36,884,000	Non-Bessemer	58.88	0.52	0.119	7.40
10,598,000	Manganiferous	49.85	7.53	0.129	8.38
101,054,000					

GRAND TOTAL at the end of 1948: 323,828,000 gross tons.

During the summer of 1948, the Norancon Exploration Company (Quebec), Limited, mapped an area eight by thirty-six miles on the west side of the Company's mineral concession, which is situated to the north of that of the Hollinger North Shore Exploration Company, Limited.

The similarity of the rocks, their alteration, their structure, as well as the general topography, are such that one is jus tified in expecting the discovery of deposits of iron in this district.

In the month of September, 1947, Quebec Labrador Development Company, Limited, obtained a mineral exploration license covering an area of 1,000 square miles in the northern part of the Labrador Trough. The northern limit of the lands in question is approximately eighty miles southeast of Ungava bay.

Geological surveys on the areas considered the most favourable for the occurrence of iron ore have been carried out during the last two years. According to the reports of the Company, diamond drilling has indicated the presence of ore containing from 53 to 57 per cent iron. One sample in particular has returned 56.53 per cent of iron, 0.38 per cent of silica, 0.07 per cent of phosphorous, 1.70 per cent of sulphur, 3.20 per cent of alumina, and traces of manganese.

During the course of 1948, the Company undertook the geological survey of a portion of fifty square miles situated in the iron-bearing formation. This portion forms a part of a tract of land comprising two hundred square miles that has been investigated by means of traverses made at intervals of one mile each. During this survey, numerous occurrences of limonite carrying a high tenor of iron were outlined in the northeast of the concession. These occurrences were scattered over an area of one-third of a mile in width by three miles in length.

In August and September of 1947, Fort Chimo Mines Limited, carried out an aerial reconnaissance of its mineral concession of 1,000 square miles granted in 1947.

No occurrences of commercial value were reported as a result of the explorations made in 1947 and 1948, but two districts in particular have presented a certain interest for their iron-bearing formation. One of these districts, covering an area of about two square miles, is situated to the south and to the west of Hematite lake; the other, having an area of approximately three square miles, lies between Hematite lake and Kaniapiskau river, to the south of Iron creek. Although the trenches that were dug have not indicated the presence of commercial ore deposits, some hematite was discovered in the first area which assayed about 57 per cent iron, whereas the other area showed some high-grade fragments from the iron-bearing formation. Analyses of these samples indicated a high percentage of silica.

Fenimore Iron Mines, Limited, also carried out during 1948 a geological survey on its mineral concession, situated towards the northern end of the Labrador Trough. This concession is made up of two blocks of land separated from each other by the northern section of the territory being explored at the present time by the Quebec Labrador Development Company, Limited. The western block covers an area of approximately 325 square miles along the Larch river, whereas the eastern block comprises an area of about 123 square miles along the Koksoak river.

In the course of the expedition that was carried out from the 27th of June to the 6th of September, 1948, a sample that was gathered from one of the mineralized sections indicated especially the presence of limonite, the limonite containing from 25 to 50 per cent of iron.

The results of the explorations carried out in 1948 have been considered sufficiently encouraging to warrant the continuation of the investigation.

4. Mount-Wright Area.

The Mount-Wright area is continuous with the Quebec-Labrador boundary, between latitudes 52°30'N. and 53°00'N. and longitudes 67°00'W. and 68°00'W. United Dominion Mining Company, Limited, prospected this territory during the summers of 1947 and 1948, under the direction of W.A. Hesse.

F.C. Kruger (1949) reported the existence of repeated occurrences of quartzitic iron formation, along a Northeast-Southwest striking belt, extending a distance of at least 30 miles. Some of these occurrences are fairly strong and wide as, for example, that between Lac Moiree and Mount-Wright, which attains an uninterrupted length of almost four miles and, locally, a width of up to 600 feet.

Three small concentration of ore grade were found: two lenses of high-grade specular hematite, measuring 50 feet by 25 feet and 80 feet by 20 feet, respectively, in a band of iron formation on the West shore of the base Camp lake, and one body of siliceous hematite, approaching ore grade, about 40 feet thick and of unknown extension, on the West side slope of Mount-Wright.

5. Mouchalagan Branch of the Manicuagan River.

There is "a remarkable development of bedded iron ore" on the shores and the small island adjoining the outlet of Little Matonipi lake, "The sections exposed give a thickness of over two hundred feet or ore, which varies from a pure mixture of magnetite and hematite to a highly quartzose, ferruginous gneiss". (Low, 1895, p. 244).

"Large masses of similar ore were also seen on the Mouchalagan River, so that it appears that this deposit may be traced more than forty miles along the strike.... The quantity of ore seen is very great, as the band is more than 100 feet wide". (Low, 1895, p. 286).

At the summit of the hill on the long portage road leading northward from Lake Matonipi "two small exposures of the ore rise above the drift". These are in strike with the ore near the outlet of Little Matonipi lake.

The "burning mountain" mentioned in the Relations des Jésuites, and stated to be near the headwaters of the Manicuagan river "is in all probability a large development of the iron ore in a cliff face - "information obtained from our guide is to the effect that a shining mountain lies about twenty miles to the westward of the portage and directly on the course of the strike of the iron gneiss". (Low, 1895, p. 245).

6. Ashuanipi Lake.

R.B. Daigle, of Toronto, reported making a prospecting exploration of the territory of Ashuanipi lake and height of land during the summer of 1914. He went by way of Moisie river, Nipissis river, and Piokapoo.

He reports the presence of large bodies of hematite and magnetite just west of the discharge of the lake, near the height of land. Analyses gave:-

1.	Magnetic	31.87% iron
2.	Highly magnetic	52.15 "
3.	Mixture of hematite and magnetite	61.42 "
4.	Magnetic	53.78
9.	Metallic iron	37.76
	Insoluble and silica	22.29
	Titanium	None
	Phosphorus	0.061
	Sulphur	0.171
	Manganese	present

No. 9 is a composite sample from a very large body. According to Daigle, the average of the body should be higher than this (R.B. Daigle, Personal Communication to Quebec Bureau of Mines, 1916).

7. Lake Pletipi Area.

Lake Pletipi is at the head of the Bersimis river; the region examined including the area around this lake, around the lakes at the head of the Outardes river, and a part of the Mouchalagan river. The examination was made in 1938; A.E. Walker, of the M.S. Hanna Co., was the geologist.

"Some very large bodies of iron were found, but were of too low grade to be commercial. A few scattered, smaller bodies of high-grade hematite iron ore were found, but they have not the size necessary to warrant the heavy cost of providing railway transportation.

"The low grade deposits were found to be very extensive, some of them being several thousands of feet long, and 200 to 300 feet thick".

The deposits have been "severely deformed by the metamorphism of a vast intrusive granite".

"Field tests showed the ratio of magnetite to hematite, in the specimens used, to be about one to five, or twenty per cent. There is enough magnetite so that these deposits may be located easily with a dip needle".

"It was noted that where there is a zone fairly rich in iron, possibly 6 or 8 feet across (the largest seen), it almost always contains a considerable amount of white vein quartz introduced by igneous intrusion. This quartz increased the silica content high enough to spoil the material for iron ore". (Gilman Exploration, Limited, 1939).

MAGNETIC SANDS

"At a number of places along the north shore of the Gulf of St. Lawrence, accumulations of black sand (magnetite and ilmenite) are found,.... Within recent years their extent and suitability....have been investigated by different parties. So far there has been no attempt to follow up these preliminary investigations by commercial operations". (Linderman and Bolton, 1917, Vol. 1, p. 17).

The deposits mentioned below are given in down river succession.

1. Champlain and Batiscan Magnetic Sands.

Near the boundary between the two parishes some magnetic sands occur, but they are stated to be of small extent. There may be enough beach black sand to be used in "extensive tests, but quite insufficient to be really utilized". Some magnetic sands occur also on the high sandy terraces; one deposit, supposed to be among the richest, was 350 feet by 30 feet by 16 inches. One sample yielded 49.2% of magnetic concentrate which contained 64.8% of iron and 1.8% of titanium. Another sample yielded 25.49% of magnetic concentrate. (Dulieux, 1912, pp. 124-130).

2. Betsiamites (Bersimis). 200 miles below Quebec City.

The deposits occur along the shore between the Betsiamites and Papinachois rivers. The largest deposit is between the Betsiamites church and Little River, two miles below Betsiamites. The iron sands form a band 5 feet wide, by 1 foot average thickness, by one and a half miles long. This equals about 20,000 cubic feet of sand. "With an ordinary magnet one may extract, in one operation, a concentrate containing:-

87.3% of magnetite
11.5% of ilmenite"

(Faessler, 1932, pp. 128-129).

This locality (Betsiamites) would not yield more than 5,000 tons of pure magnetite (Lindeman and Bolton, 1917, Vol. 2, p. 154).

3. Moisie. 330 miles below Quebec.

Dulieux estimated at 140,000 tons the reserve of tidal sands, which would yield about 26% of magnetic concentrates, or "containing from 17 to 18 per cent of metallic iron". The terrace sands here would yield "57,000 tons of concentrates, with 65.67% of metallic iron" per one mile strip, 500 feet wide, and 6 feet deep. (Dulieux, 1911b, pp. 135-151).

Judging from an examination made in 1904 in the interest of European capital, the total quantity of pure magnetite that could be separated from the beach sands is estimated at 20,000 tons. Of this quantity about 10,000 tons exist on the east side of Moisie River, where the sand is richer than on the west side (concentrated in smaller area). The dune area would carry about 5% of magnetite, and the zone immediately inland of this would carry about 0.9% of magnetite. The Moisie area would have value only as a possible auxiliary to an area of better deposits, say, Natashkwan. (Mackenzie, 1912, p. 6.

Between 1867 and 1875, the Moisie Iron Company, operating under W. Molson, smelted the concentrated iron sands with charcoal in 8 bloomeries. Some of the blooms were rolled into railway axles in Montreal, but the chief market was in the United States (See also, Faessler, 1939).

4. St. Jean river.

"The best deposits of magnetic sands (in this area) are between Long Point and the St. Jean river". Seventeen borings were made to an average depth of about six feet. Layers of black or magnetic sand above four inches thickness were rare. No estimate of reserve was made. (Dulieux, 1911b, pp. 151-159).

5. Mingan. 430 miles below Quebec.

The examination in favour of European capital in 1904 reported the quantity of magnetite here as insignificant. (Mackenzie, 1912, p. 6).

6. Natashkwan. 530 miles below Quebec.

The 1904 examination found that Natashkwan was the most promising locality and that there were about 833,000 tons of 12% (in magnetite) sand, and 6,500,000 tons of 6-6½% sand, or roughly, half a million tons of magnetite all told.

The main deposit of iron sand occurs along the shore of the Gulf from the mouth of Natashkwan river eastward for three miles to English point (Mt. Joli). This is a treeless dune area about 500 feet wide on the average. It contains "at least 500,000 tons of magnetic iron concentrate that will average 67 per cent in iron". An area inland of the dune sand area must also contain some black sand.

"From crude sand containing 14.7 per cent of iron and 4.43 per cent of titanic acid, a concentrate may be made containing 70.4 per cent of iron and 1.7 per cent of titanic acid.

"About 45 per cent of the original iron will be saved in the production of the above concentrate". (Mackenzie, 1912; most p. 43).

In the following year, Mackenzie (1912a, pages 69 to 71) returned to investigate in detail the sands at the tip of the peninsula. The area covered extended two miles east of the mouth of the river and for about 1,500 feet inland, totalling about 184 acres. In 1913, Parsons (1913) examined an area of 340 acres, stretching from Natashkwan point to Mount Joli, and extending 2,000 feet inland.

According to unpublished information in the files of the Mines Branch, Ottawa, the results of this 3-year investigation showed that between the north of the river and Mount Joli there was available a total of 27,137,690 long tons of dried crude sand containing an average of 6.54% of magnetic concentrate which would give a total tonnage of 1,776,195 tons of concentrate.

BOG IRON ORES

"Bog ores are of widespread occurrence, but are now chiefly of historic interest. Beds on the north shore of the St. Lawrence in the vicinity of Three Rivers, were worked for over 150 years, and were the source of supply for the small charcoal furnaces formely operated in that locality. On the south side of the St. Lawrence, the Drummondville furnace was run on bog ores obtained in that neighbourhood. Some of the deposits are worked out, and those that remain, while numerous, are not thought to be extensive enough to furnish much ore". (Lindman and Bolton, Vol. 1, 1917, p. 17).

"Among the better known deposits were those of Vaudreuil, of Acton in Bagot county, of St. Wenceslas in Nicolet county, and of Wickham in Drummond county, which supplied the Drummondville furnace, and best known of all, that at Lac à la Tortue, on the railway from Three Rivers to Grand'Mère, which for many years supplied the furnace at Radnor". (Idem, Vol. 2, 1917, p. 155).

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