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REPORT ON MINING OPERATIONS IN THE PROVINCE OF QUEBEC DURING THE YEAR 1911

Province of Quebec, Canada

DEPARTMENT OF COLONIZATION, MINES AND FISHERIES

MINES BRANCH

Honorable C. R. DEVLIN, Minister; S. DUFAULT, Deputy-Minister;
THEO. C. DENIS, Superintendent of Mines.

REPORT

ON

MINING OPERATIONS

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PROVINCE OF QUEBEC

DURING THE YEAR 1911

QUEBEC
PRINTED BY L. V. FILTEAU,
Printer to His Most Excellent Majesty the King,

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PROVINCE OF QUEBEC

DEPARTMENT OF COLONIZATION, MINES, AND FISHERIES

To the Honourable C. R. DEVLIN, M.L.A.,

Minister of Colonization, Mines and Fisheries,

QUEBEC, P.Q.

SIR,—

I have the honour to transmit herewith the Report of the Superintendent of Mines, on the Mining Operations in the Province of Quebec, during the year ending December 31st, 1911.

I remain,

Your obedient servant,

S. DUFAULT,

Deputy Minister.

Quebec, May 3rd, 1912.

PROVINCE OF QUEBEC

DEPARTMENT OF COLONIZATION, MINES, AND FISHERIES

MINES BRANCH

MR. S. DUFAULT,

Deputy Minister Colonization, Mines and Fisheries,

QUEBEC, P.Q.

DEAR SIR,—

I beg to transmit herewith the Annual Report on the Mining Operations in the Province of Quebec for the year ending December 31st, 1911.

As in previous years, this report was preceded by a short Preliminary statement, published in February, which gave statistics of the Mineral Production. The figures were given subject to revision. They are now presented as finally established, and this report therefore supersedes the Preliminary statement.

I remain,

Yours obediently,

THÉO. C. DENIS,

Superintendent of Mines.

Quebec, May 3rd, 1912.

MINING OPERATIONS

IN

THE PROVINCE OF QUEBEC

DURING THE YEAR 1911

STATISTICAL REVIEW.

According to the returns received by the Quebec Mines Branch from the producers, the mineral production of the Province during the year 1911 reached a total value of $8,679,786. This represents an increase of $1,356,505 as compared with the previous year, when the value of the mineral production was $7,323,281. It is gratifying to note that the last ten years present an unbroken record of yearly increases, which shows that our mineral industry is on a well established basis and although no spectacular discoveries of new mining districts have been made, the development has been continuous and steady and is likely to progress for a long time to come.

The following table gives the total value of the mineral production of the Province of Quebec for each year since 1899 :—

Year.	Value
1899	$2,083,272
1900	2,546,076
1901	2,997,731
1902	2,985,463
1903	2,772,762
1904	3,023,568
1905	3,750,300
1906	5,019,932
1907	5,391,368
1908	5,458,998
1909	5,552,062
1910	7,323,281
1911	8,679,786

Table of the Mineral Production of the Province of Quebec in 1911

	Number of Workmen	Salaries	Quantities	Value	Value in 1919
Asbestos, tons......	2,911	$1,228,971	102,224	$3,026,306	$2,677,829
Asbestic, tons......	....	....	25,733	19,802	17,612
Copper & Sulphur Ore, tons........	178	100,130	38,554	240,097	145,165
Gold, oz..........	....	....	590	11,800	....
Silver, oz..........	....	....	23,000	11,500	....
Bog Iron Ore, tons.	48	6,400	931	4,041	4,406
Ochres, tons.......	50	15,518	3,612	28,174	33,185
Chromite, tons.....	13	3,085	197	2,469	3,734
Mica, lbs..........	186	48,101	....	76,428	51,901
Phosphate, tons....	5	....	595	5,832	3,182
Graphite, lbs.......	274	64,535	753,405	33,613	15,896
Mineral Waters, gals.	36	5,645	168,489	65,648	68,155
Titaniferous Ores, tons............	26	724	3,789	5,684	5,292
Slate..............	25	7,522	....	8,248	18,492
Cement, bbls.......	627	443,842	1,588,283	1,931,183	1,954,646
Magnesite, tons....	8	3,194	885	6,416	2,160
Marble............	170	105,739	....	143,457	151,103
Flagstone, squares..	2	500	6	500	890
Granite...........	423	239,704	....	308,545	291,240
Lime, bushels......	226	118,171	1,284,914	284,334	279,306
Limestone	1,255	569,818	....	1,128,402	503,173
Bricks, M..........	1,280	362,663	176,532	1,129,480	906,375
Tiles, Drain & Sewer Pipe, Pottery, etc.	21	3,922	....	142,223	197,526
Quartz, tons........	....	....	500	1,125	2,013
Feldspar, tons......	....	....	30	600	....
Peat, tons.........	12	3,000	175	700	....
Glass Sand.........	2	413	440	1,179	....
Sand...............	68	34,206	....	62,000	....
Totals.........	7846	$3,365,803	....	$,8,679,786	$7,323,281

PROGRESS OF THE MINING INDUSTRY.

For the years previous to 1899 the statistics collected by the Quebec Mines Branch are incomplete. If we compare the total for 1899 with that of the past year 1911, we see that the increase in twelve years has been 316%, a very creditable showing indeed.

In this conection, it may be interesting to compare the progress of the mineral industry in Canada and in the other provinces during these twelve years, from 1899 to 1911. For the sake of uniformity in the comparisons, the figures, as established by the Federal Department of Mines, are taken as basis. It may be said that these figures are always higher than the ones given by the Provincial Departments of Mines, owing to different methods of computation of value of the metallic substances, but this does not affect the relative proportions.

COMPARISON OF THE VALUE OF THE MINERAL PRODUCTION, 1899-1911.

	Production in 1899	Production in 1911	Proportional Increase in 12 years.
Canada	$49,234,005	$102,291,696	107.7%
Ontario	9,819,557	42,672,904	334.5%
British Columbia	12,653,860	21,237,801	67.9%
Nova Scotia	6,996,041	15,354,928	119.5%
Quebec	2,585,635	9,087,698	251.5%

We see by the above table that the proportional progress of the mineral industry of the Province of Quebec has only been exceeded by Ontario. The production of the Cobalt camp is responsible for this remarkable increase in our sister province. There are in Northern Quebec and more particularly in Northwestern Quebec, large tracts of country which have been explored only in the most superficial manner. The geological conditions in these regions appear to be very similar to those which accompany the metalliferous deposits of Cobalt, Porcupine and Sudbury. Should similar resources be discovered on the Quebec side, the future proportional increase would rise considerably.

UNPROSPECTED AREAS IN THE PROVINCE OF QUEBEC.

The Province of Quebec, until lately, comprised an area of about 352,000 square miles. On May 15th, 1912, the superficies of the Province was more than doubled by the addition of Ungava. Of this vast territory of more than 708,000 square miles, an area of approximately 50,000 square miles is settled and comparatively well known from the standpoint of its mineral resources. It is a remarkable fact that these colonized agricultural regions are wholly responsible for the total of our mineral production and that the unsettled parts of our province have not yet contributed to it. When we consider the remaining hundreds of thousands of square miles which are practically unprospected, and which are fraught with mineral possibilities, a great future can safely be predicted for our Mineral Industry.

RAILWAYS IN NORTHERN QUEBEC.

Within a comparatively short time, trains will be running on the National Transcontinental Railway from Quebec City to Lake Abitibi. A railway line along the Quebec side of Lake Temiskaming, connecting the agricultural settlements of Northern Temiskaming with the main line of the Canadian Pacific Railway, is practically an assured fact. This line will, in all probability, be extended northward to the Transcontinental Railway. Another railway is projected to connect the mouth of the Nottaway, on James Bay, with Montreal. These are apart from the numerous branch lines which always are a natural consequence of main lines, and which act as feeders.

RAILWAYS AND THE MINERAL INDUSTRY.

The building of all these railway lines rests primordially on the agricultural and forest resources of the regions traversed, and as means of transportation to connect Western Canada with the East, but it is very probable that the mining industry will eventually greatly contribute its share to the success of the railways. There have been many precedents in this respect. In our own

Province, the Quebec Central Railway, connecting Sherbrooke and Quebec, was built to afford transportation along the rich agricultural valleys of the Chaudière and St. Francis Rivers, but at present the asbestos mines of Thetford and Black Lake, which were discovered on the railway line during construction, are the main freight contributors. In Ontario the Temiscaming and Northern Ontario Railway was built to colonize that part of the Province to the north of the Canadian Pacific Railway. The mines of Cobalt, which were discovered during construction, and the mining district of Porcupine, are now by far the main sources of revenue of this railway. It may also be mentioned that the nickel-copper mines of Sudbury were discovered during the construction of the main line of the Canadian Pacific Railway. All of which goes to show that, although it would be unwise to rely exclusively on the undeveloped mineral resources of a region as a justification to build a railroad, yet the mining industry often proves to be an important contributor to a railway's success, and agriculture, mining, forestry and railway construction all help to each other's development and ultimate success.

MINING LAWS

No changes or amendments have been introduced in the Quebec Mining Law during the last session of the Provincial Legislature, but in the last three years our mining laws have undergone such radical alterations that it is permissible to again quote a paragraph of our last year's report which gives a short résumé of the principles now in force.

The amendments assented to by the Quebec Legislature in May, 1909, replaced the Prospecting Permits, which were then in force, by the Miner's Certificate; this is the equivalent of the Free Miner's Certificate of British Columbia, and to the Miner's License of Ontario. This certificate, issued on payment of $10.00, gives the right to prospect for minerals on all lands, of which the mining rights belong to the Crown, without giving exclusive rights over a large territory, as did the Prospecting or Exploration permit. The bearer of a Miner's Certificate is allowewd to stake five claims of forty acres each, or a total maximum area of 200 acres. This may be held for six months without having any payment to make. At the end of the six months the holder has to take out a Mining License, which is practically a leasehold, for which he has to pay a yearly rental of 50 cents an acre. Assessment work on the claims staked has to be performed to the amount of 25 days' labour during the first six months following the staking, and 25 days a year afterwards on each forty acres.

Mining lands can also be acquired by purchase, at the rate of $10.00 an acre, for lands situated 20 miles or more from a railway, and $20.00 for lands nearer than 20 miles. Moreover, in case of purchase, all money paid as yearly rental on the mining license goes towards the purchase of the mining lands.

PROPOSED AMENDMENTS IN UNITED STATES MINING LAWS.

The United States Government has lately studied the question of amending its "public land laws" with the object of encouraging the systematic and rational development of the mineral resources, with due regard to the principles of sound conservation of these resources. Commissions have been appointed to study the mining laws of various countries, and in this connection it is most interesting to quote from the report of Dr. George Otis Smith, the distinguished director of the United States Geological Survey.

In his last annual report, Dr. Smith very ably discusses the question of amendments to the United States Mining Laws, and the principles which he advocates as being the soundest for promoting the development of the mineral resources are as follows:— (Thirty-second annual report of the Director of U. S. Geological Survey).

SEPARATION OF SURFACE AND MINERAL RIGHTS.

" The first step, both in principle and practise, in any amend-
" ment of the land laws, appears that of making possible by
" legislation, the separation of surface and mineral rights when-
" ever the two estates have values which can be separately util-
" ized.

COMPULSORY ASSESSMENT WORK.

" Most important, perhaps, in any amended mining law, " would be provision for enforced development work, a principle " expressed, it is true, in the present United States Law, but " not made effective in its workings. A requirement of actual " use as a condition of occupancy of mineral land cannot be re- " garded as either novel or radical. As regards the large acre- " age of undeveloped land in many mining camps (in the United " States) to which patent has already been issued, it is perhaps " true that the situation is without relief, unless the Western " Australia plan is adopted, whereby the government steps in, " and permits mining under a lease, the proceeds of which are " assessed, collected and paid over to the owner. The principle " invoked seems to be that no property owner can rightfully " oppose the development of the resources of the State.

" In the case of unpatented claims, a remedy should be " sought for what has been termed "the paralysis of mining " districts," and the rigid requirement of annual assessment " work should be made active and effective by inspection and " supervision, in order to put an end to the present procedure of " allowing a claim to be idle for practically two years after its " location, not to mention the many localities where claims are " held year after year with only perfunctory compliance or even " without any performance of assessment work.

LEASEHOLD SYSTEM.

" The remedy, then, for the existing evil of idle mining prop- " erties must be sought in the adoption of leasehold, under which " the government can enforce operation, a system which fully " attains the desired end of promoting mining development in " Australia and New Zealand, or in the thorough revision of the " present system......

" The greatest advantage of the lease system to the operator " directly, and the public indirectly, is relief from the large " capital outlay now required in the acquisition of the large " acreage absolutely necessary for a medium mine (this applies " more particularly to coal). This argument advanced against "the present policy of valuing the public coal lands at even con-"servative prices, thus becomes an argument for a leasehold "law."

OIL AND GAS LANDS.

"The most urgent need of legislation (in the United States) "for the disposition of mineral deposits, is in the case of oil and "gas. First, the new law should authorize the issue of ex-"ploratory permits, granting to individuals or associations the "exclusive privilege of occupation, the sole condition of such a "grant being diligent and adequate prosecution of development, "measured by the expenditure of fixed sums within certain "periods, with possibly the payment of a small fee to the gov-"ernment in lieu of expenditure during the first six months. In "the second place, the law should provide that upon discovery, "the holder of the permit be given a leasehold title, with a "royalty varied to meet the local needs and actual conditions."

COMPARISON OF THESE PRINCIPLES WITH THE QUEBEC MINING LAW.

The present Mining Law of the Province of Quebec practically embodies the above principles. By the mining law, sanctioned on July 24th, 1880, a separation of the mining rights from the surface rights was definitely effected. In all grants and patents issued since that date, they constitute two separate and independent properties, each subject to distinct separate regulations. In all patents issued before that date, the gold and silver mines were always reserved and still belong to the Crown, except in cases where these minerals have been specifically alienated.

A definite amount of assessment work is definitely exacted, to be performed on all unpatented mining claims, and the yearly renewal of the Mining License is made subject to the performance of that work.

Patents of claims are issued subject to a yearly performance of work to the amount of $200, or to an annual acreage tax of 10 cents an acre in the case of non-performance of the work.

Our Mining License is practically a leasehold system at a fixed yearly rental per acre. If, after having worked and developed a claim, the Mining License holder wishes to obtain a patent, he can do so by paying $10 or $20 an acre, according to distance from a railway. It has been objected that these purchase rates are high, but it must be considered that the patent need not be applied for until the license holder has ascertained beyond all doubt the value of the mining claim, and in the case of a developed and proved mineral claim, these prices are insignificant relatively to the value of a mining property. Moreover, it is to be remembered that all monies paid in as yearly rentals go towards the purchase price when the patent is granted.

The remarks of Dr. Smith regarding the oil and gas lands apply to the Province of Quebec. Our mining laws do not well apply to these substances, and they should be amended accordingly. There is at present a case in point of a possibly valuable gas-field which would benefit by more rational regulations.

The Mining License as issued by the Department of Colonization, Mines and Fisheries, constitutes an absolutely secure title when the conditions, as set forth in the Mining Law, are fulfilled. These conditions are not at all onerous, and are very easy to comply with, and when this has been done, the Department is bound to renew the license; practically no discretionary power is left the authorities in this case. A certain amount of uneasiness seems to exist due to the fact that the license expires yearly and is renewed for one year only, but such a feeling is quite unjustified. However, to allay it, it might perhaps be advisable to amend the law, permitting the issuance of longer leases, say 20 years, subject to the performance of the yearly conditions.

FIELD WORK.

During the summer of 1911, two field-parties were sent out by the Mines Branch. One of these, in charge of Dr. J. A. Bancroft, Professor of Geology at McGill University, mapped out the geology of an area south of the National Transcontinental Railway, in the vicinity of Keewagama Lake. Dr. Bancroft paid particular attention to the district of Keekeek and Wabaskus Lakes, where reported discoveries of gold caused quite a rush of prospectors last spring. Dr. Bancroft's preliminary report is given further on. He will continue this same work to the east of the map sheet which he covered last year, and a fuller and more detailed report embodying the results of the two campaigns will be issued later.

Another party, in charge of Prof. E. Dulieux, of Ecole Polytechnique, of Montreal, began an investigation of the iron resources of the Province of Quebec, with special reference to the deposits of titaniferous ores, of which very extensive occurrences are known in several localities. During the summer of 1911, Professor Dulieux investigated the deposits of the North shore of the Lower St. Lawrence. These investigations will be continued this year.

During the fall, Mr. J. H. Valiquette, of the Mines Branch, visited the quarries in Montreal and surroundings, and it is thought that his notes, which are given in this report, will prove useful, and will show the importance of the Stone Industry in that district.

TECHNICAL STAFF OF THE MINES BRANCH.

The permanent technical staff of the Mines Branch is as yet very small, consisting of the Superintendent of Mines and one Assistant, Mr. J. H. Valiquette. As the latter accompanied Dr. Bancroft's party during the whole of the field campaign, and moreover, spent some time in Montreal, on his return from the field, to help in the working up of the results, and in the preparation of the maps, it devolved on the Superintendent of Mines to do the inspection of the mines, to investigate several reported mineral finds, to prepare the annual report and seeing both the French and the English editions thro' the press; to seeing to the publication of the reports of the Chibougamau Commission and of the report on the Geology of Fabre township; to carry on the technical correspondence and answer numerous enquiries on our mineral resources, and to keep in touch with the mining industry of the Province. Besides, he had to devote some time in cooperation with the Deputy Minister and the Secretary of the Mines Branch to the settlement of various questions arising from disputes on mining claims, which, in some cases, required investigations in the field.

ASBESTOS.

The shipments of asbestos from the various producing centers: Thetford Mines, Black Lake, Danville, East Broughton, all in the Eastern Townships, reached a total of 102,224 tons valued at $3,026,306, the highest sales yet recorded. This is a substantial increase as compared with the previous year 1910, when the shipments were 80,605 tons, valued at $2,667,829.

For the purpose of comparison, we give the details of last year's production as well as this year's:

PRODUCTION OF ASBESTOS FOR YEAR 1911.

	SHIPMENTS.			STOCK ON HAND	
	Tons	Value	Average value per ton	Tons	Value
Crude No. 1.........	1,400	$ 388,224	$277.30	1,358	$ 360,304
Crude No. 2.........	3,382	382,980	113.68	3,368	431,548
Mill Stock No. 1....	6,340	415,559	65.54	3,794	207,403
Mill Stock No. 2....	35,991	1,091,684	30.33	12,272	379,523
Mill Stock No. 3....	55,111	747,759	13.57	12,959	204,298
Totals	102,224	$3,026,306	29.60	33,751	$1,583,076

Quantity of rock mined during year 1911, tons 1,759,064.

PRODUCTION OF ASBESTOS FOR 1910.

	SHIPMENTS			STOCKS ON HAND on Dec. 31st, 1910.	
	Tons	Value	Value per ton	Tons	Value
Crude No. 1..........	1,817	$ 471,649	$259.57	1,763	$ 447,227
Crude No. 2.........	1,612	196,382	121.82	3,181	440,884
Mill Stock No. 1....	10,313	627,635	60.88	4,938	313,053
Mill Stock No. 2....	44,793	1,141,374	25.48	24,417	612,065
Mill Stock No. 3....	22,070	230,789	10.46	6,920	99,694
Totals	80,605	$2,667,829	$ 33.10	41,159	$1,921,923

Quantity of rock mined during year 1910, tons 2,035,705.

Quantity of asbestos as stock on hand Dec. 31st, 1909, tons 20,921.*

The whole of the rock mined does not go to the mills. A proportion of about 25% is considered too poor to be treated economically and is thrown on the waste dumps.

It must be understood that, from the figures above given, only general average yields can be calculated ,and the results obtained in individual mines may greatly diverge one way or the other from these average yields.

We therefore see from the above figures that the general average value per ton of the total asbestos marketed in 1911 was $29.60; in 1910 the average price had been $33.09.

The classification which we have adopted in the detailed tables is arbitrary in the extreme. The division between crude and mill-stock is of course a well established one. The "Crude" is long fiber asbestos which is cobbed out of the rock by hand by means of sledges and cobbing hammer. The mill-stock varieties are the products of the mechanical treatment of the rock in mills specially constructed and equipped.

For the purpose of compiling the statistical tables, we have adopted the following grouping according to values:—

Crude No. 1.—Hand-cobbed asbestos, valued at $200.00 a ton and over.

Crude No. 2.—Hand-cobbed asbestos, valued at less than $200.00 a ton.

Mill Stock No. 1.—Product of mechanical separation, valued at $45.00 and over.

Mill Stock No. 2.—Valued at between $45 and $20.

Mill Stock No. 3.—Valued at less than $20.00.

During the whole of the year 1911, the asbestos industry laboured under unfavourable conditions as regard markets and prices. The output was lower in 1911 than in 1910, as shown by the quantity of rock mined, which was 13.10% less in 1911 than in 1910. However, the shipments were higher, as a proportion of these were drawn from stock on hand. Owing to the over-production which had taken place in 1910, the market was congested and a fall in prices resulted. There is still a consider-

*Figures of the Federal Mines Branch.

able quantity of stock on hand, but the balance between output and shipments is slowly readjusting itself and there is a notable improvement in the general commercial situation of the asbestos market.

A new important company began operations at Thetford during 1911. This is the Martin-Bennett Asbestos Co., Limited, which in March ,1911, acquired the old Ward-Ross property, situated between the Johnson mine and the King mine, for the sum of $710,000. This alone is indicative of the faith of men, well versed in the matter, in the future of the asbestos industry. The mine had been lying idle for some sixteen years owing to litigation. A large mill was erected on the property during 1911 and has just begun operation.

Both at Thetford Mines and at Black Lake, the mines were worked actively, and the number of days in operation during the year are practically up to the average, except in the case of the Dominion Mine at Black Lake, which was closed down.

In the Robertson district the B. & A. mines and mill and the Berlin Asbestos Co.'s plant worked fairly steadily.

In the East Broughton district, only the Ling Asbestos Co. operated during the year.

The following table illustrates the growth of the asbestos industry during the past twelve years:

Year	Tons	Value
1900	21,108	$ 719,416
1901	33,466	1,274,315
1902	30,634	1,161,970
1903	29,261	916,970
1904	35,479	1,186,970
1905	48,960	1,476,450
1906	61,675	2,143,653
1907	61,985	2,455,919
1908	65,157	2,551,596
1909	63,965	2,296,584
1910	80,605	2,667,829
1911	102,224	3,026,306

ASBESTOS IN OTHER COUNTRIES.

The latest statistics available showing the world's production of asbestos cover the year 1909. The following table is compiled from the Report on Colonial and Foreign Statistics of the Home Office, England :—

WORLD'S PRODUCTION OF ASBESTOS.

(Apart from Quebec.)

	Metric Tons	Value
Russia	11,911	£ 92,180
Cape Colony	1,519	24,922
United States	2,799	12,855
Cyprus	156	1,407
Rhodesia	247	2,725
Australia	3	154
	16,635	£134,243

These quantities are equal to 19,342 short tons, valued at $653,761.

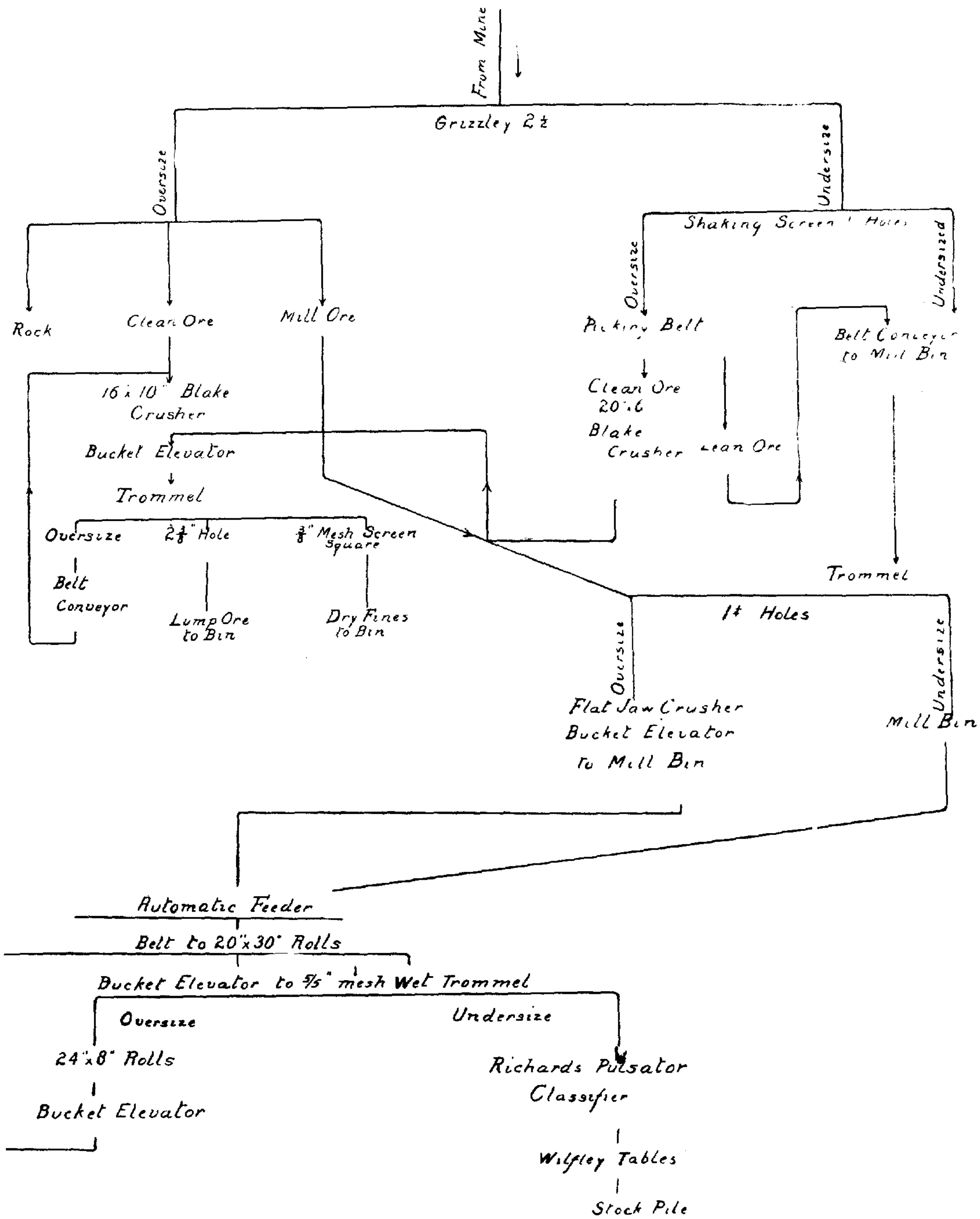
J. S. Diller, in the Mineral Resources of the United States, gives the production of that country during 1910 as 3,693 tons, valued at $68,357.

Rhodesia reports a production of 1,114½ tons valued at £12,-904 for 1910.

Unofficial figures for Russia give a production of 15,540 metric tons of asbestos in 1911.

The first report of the Mines Department of the Union of South Africa for seven months ending 31st December, 1910, mentions that asbestos mines have been worked, and contributed to the mineral output, in Transvaal, Cape Colony and Natal. It is from the Cape that the principal production comes, 680 tons, valued at £10,598.

No recent statistics are available from Portuguese South Africa concerning asbestos, but a few years ago a substantial shipment of asbestos of high grade was effected.



FLOW SHEET, EUSTIS MINING COS MILL

COPPER AND SULPHUR ORE.

The shipments of pyritous copper ores show a substantial increase as compared with the previous year. The quantity shipped amounted to 38,554 tons, and is the highest recorded since 1899.

Apart from a small trial shipment made from Eastman, two mines are responsible for the output. They are the Eustis Mine at Eustis, a few miles south of Sherbrooke, and the McDonald Mine, operated by the East Canada Smelting Company, situated at Weedon, some 35 miles north of Sherbrooke.

During the year 1911, shipments from the Eustis mine were not as large as in 1910, as some of the ore went to the stock piles. This part of the output does not appear in our figures of production, as only shipments actually made are included.

The Eustis mine is the deepest in the Province. The slope is now nearly 3,000 feet. The deposit consists of a succession of lenses in depth, and the workings do not extend far laterally. The extreme horizontal distance between the easternmost point, which is on the 19th level, and the westernmost, on the 27th, is only 400 feet.

The management took advantage of the lull in the demand for the ore to do further development work and improve the mine generally. There is now two years' ore blocked out. The ore shipped contains between 40 and 50% sulphur and 2½ to 5% copper, with low values in gold and silver.

The ore is treated in a very complete and efficient concentrating mill, of which the flow sheet is given. The management is looking into the advisability of installing the Elmore oil concentration process.

The McDonald mine at Weedon is now shipping steadily. The deposit which is worked here is lenticular in shape, but appears to have considerable dimensions. Two inclines have been put down, about 250 feet apart. The main incline (45 deg.) was down over 200 feet in December, 1911. There is a total length of drifts of 900 feet. The ore shipped averages over 42% sulphur and 5% in copper. There is also a small quantity of gold and silver, the value of which is almost negligible at present.

The mine has quite a large quantity of ore developed, and it is shipping at the rate of over 2,000 tons a month. The haul to the Quebec Central Railway is 4½ miles and is done by team, the cost being 80 cents per ton.

The company has ordered an aerial tramway from the Trenton Iron Co., the installation of which will be completed this summer. It is expected that this will reduce haulage to about 5 cents per ton.

Some prospecting was done at the old Ives Mine, near Eastman, by Mr. N. S. Parker, who uncovered a rather promising looking vein, high in chalcoyrite.

Work was continued at the Suffield Mine by Mr. A. O. Norton. A depth of 400 feet has been reached and several hundred feet of drifting have been done at various levels. No ore was shipped, however.

Mr. Norton also unwatered the Marrington mine, two miles from the Suffield Mine and ½ mile from Capelton. The depth of the incline is 260 feet and a good vein ten feet thick is said to have been observed at the bottom.

Prospecting for assessment work was done in several other places on copper showings, but without giving definite results.

A considerable amount of work was done to the northeast of the McDonald Mine on several claims situated on the same belt of rocks, which are mineralized in numerous places, more especially on lot 8, range VI, of Stratford, where four diamond drill holes were put down and some stripping done on a lens of pyritous ore. An incline shaft was also driven on this deposit to a depth of 45 feet. The results did not come up to expectations as regards contents in copper.

In the region of Lake Megantic, on lot 1, range II of Marston, a shaft was put down 28 feet on a well mineralized zone, containing pyrite and chalcopyrite. This zone, which was uncovered by stripping over a distance of 250 feet, appears to be shattered and impregnated with quartz and sulphides.

GOLD AND SILVER.

Gold appears in the statistical table for a value of $11,800. The greater part of this gold was produced from the operations of the Dominion Gold Fields, Ltd., the name of which was recently changed to the Champs d'Or de Rigaud-Vaudreuil. A short description of the plant and mode of operation on Desmeules Creek, near Beauceville, was given in the report on the Mining Operations in the Province of Quebec during 1910. Some modifications have been introduced in 1911. The electrically driven elevator and stacker for the tailings has been replaced by a hydraulic elevator, worked by a monitor, this being cheaper, and also another lake has been brought in, to supplement the water supply from Lake Fortin.

Before introducing these changes the company had two trial runs which gave very satisfactory results as to the gold values in the gravel. During the first run, which lasted only a few days, 2,400 cubic yards of gravel were passed through, which yielded, at the clean-up made on July 16th, somewhat over $900, or an average of 37c. per cubic yard of material treated.

The second clean-up, made on August 15th, after a run of nearly one month, gave $8,000, from 16,800 cubic yards treated, or an average of about 47c. With the changes introduced, it is claimed that the gravel can be treated for less than 10c. per cubic yard for working costs. Operations are to be resumed in the early spring of 1912.

LODE DEPOSITS IN RISBOROUGH TOWNSHIP.

During the fall of 1911, some reported finds of gold-bearing quartz in Risborough township caused some excitement. Two of these finds on lots 10 and 11, range XV, and lot 2, range X, Risborough, were investigated by the Superintendent of Mines. The quartz deposits occur in the schists and slates which constitute the country rock, near the contact with diabasic intrusions in one case and apparently porphyrites in the other. Some of the quartz veins are 10″ to 20″ thick and in the immediate vicinity of these large veins, the rock shows a net-work of smaller quartz veins. In all cases the quartz is very white, occasionally mineralized by a few specks of pyrite. None of the assays show more than a mere trace of gold and the greater number show negative results.

The total production of silver, which appears in the returns for a value of $11,500, comes from the treatment of the cupriferous pyrite ores of the Eastern townships, which ores are also responsible for the balance of the gold.

In the northwestern part of Quebec, a reported discovery of gold quartz near Lake Keekeek, to the southeast of Lake Keewagama, caused quite a rush of prospectors. The reported occurrences were examined for the Quebec Mines Branch by Dr. J. A. Bancroft, and the results of his investigations are given further on, in his Report on the Geology of the region east of the Kinojevis River.

The Union-Abitibi, working a claim north of Lake Opazatica, report good progress in their development work. A shaft is now down 153 feet and some 500 feet of levels have been driven. A power-house and a stamp-mill are being installed. They have not yet reported any production of precious metals, however.

CHROMITE.

The shipments of chromite, which amounted to 197 tons, valued at $2,469, were all made from stock-piles which were left from previous operations in the Coleraine-Black-Lake district. There have been no mining operations for chrome for the last two years, but it is said that some of the mines will be re-opened in 1912.

The chrome ore shipped was sent to paper and pulp manufacturers, in the Eastern townships, presumably as refractory material for furnace lining.

The Chrome and Asbestos Mines, Limited, report the shipment of a small sample lot of chrome ore to a manufacturer of ferro-chrome at Niagara Falls. This company is at present altering and re-modelling their concentrating mill near Black Lake and expect to start work in the spring of 1912.

IRON.

The Drummondville charcoal furnace, of the Canada Iron Furnace Company, was the only one in blast during 1911.

The iron ore industry of the province has in the last few years shown a serious decline. The bog iron ore deposits of the St. Maurice and of Drummond County, which have been the main source of supply of the charcoal blast furnaces of Radnor and Drummondville, seem to be passing away and so far no other iron ore deposits have been brought into prominence to replace them.

The following material was charged into the Drummondville furnaces during the year 1911 :—

Quebec iron ore	1043	tons
Ontario and other ore..........	768	"
Charcoal	1185	"
Limestone	187	"

The pig iron produced by the furnace amounted to 655 tons valued at $17,280. Of the Quebec iron ore charged, 931 tons were produced during the year. The balance apparently came from stocks on hand.

The Radnor furnace was not in blast during the year.

During the season of 1911, Professor Dulieux, of Polytechnic School, was commissioned by the Quebec Mines Branch to make an examination of the titaniferous iron ore deposits of the north shore of the St. Lawrence. His preliminary report is given further on. Professor Dulieux will go on with this work this year and a complete report of his investigations will be published as soon after as possible.

It may be mentioned that the Electric Reduction Company, of Buckingham, is manufacturing small quantities of ferro-phosphorus. In 1911 they reported a production of 25 tons. This company for some years also manufactured other ferro compounds, such as ferro-silicon, ferro-chromium, but have abandoned this to devote themselves almost exclusively to the manufacture of phosphorus.

ZINC AND LEAD.

During 1911 considerable work was done on the zinc and lead deposits of Calumet Island by the Canada Metals Company.

Calumet Island is formed by two channels of the Ottawa River and is situated some fifty miles above the city of Ottawa.

Geologically, the rocks are the typical gneisses and crystalline limestones of the Laurentian, intruded by numerous bands and masses of later igneous rocks, often basic, and of various textures. There are also characteristic dykes of pegmatite.

Some mining was carried on in the island in the early nineties, when several tons of ore were extracted on lots 10 and 11, range IV. This ore was a mixture of galena and zinc blende.

In 1897 and 1898, the Grand Calumet Mining Company went on with the work, and several hundred tons of ore, mined from lots 9 and 10, range IV, were shipped to Belgium.

In 1907 some exploratory work was carried on by a United States syndicate. The old workings on lot 9 (Bowie pit), were pumped out and the mine sampled. The option, however, was not exercised.

In 1910 the Canada Metals Company resumed work and carried it on more or less regularly throughout 1911, mainly on the Bowie mine, lot 9, range IV. A small concentrating plant was built to treat the ore and a trial shipment of concentrates was made to the Balbach smelter, of Newark, New Jersey. The products are of two kinds: a lead concentrate which assays 66% lead and a zinc concentrate of 42% zinc.

The deposits of galena and zinc blende of Calumet Island are essentially irregular and pockety, but nevertheless by careful and judicious management, and by keeping development work well ahead of the actual mining, they could probably be the source of a successful local industry.

A considerable amount of work was done on a deposit of galena and zinc blende situated on lots 37 and 38, range I., of the Township of Montauban, near Notre-Dame des Anges, county of Portneuf.

This deposit is being developed by Mr. Pierre Tétreault, of Montreal, who has an arrangement with the owners of the mining rights.

The rock which gives rise to this deposit is very coarse grained and is apparently a pyroxenite cutting through Laurentian gneisses. The ore does not occur in veins, but is more of the nature of an impregnation. The proportion of galena and zinc blende varies much. There are pockets and zones quite highly mineralized separated by barren rock.

At the time the deposit was visited by an Officer of the Mines Branch, the work done was not sufficient to enable to judge of the ultimate results. Some six to ten men were working during the greater part of the year.

MICA.

Returns of shipments of Mica have been received from eighteen producers. Owing to an improvement in the mica market, figures for 1911 show a substantial increase as compared with the previous year. The value amounted to $76,428, or $24,527 more than the previous year. The prices ruling during the year for thumb-trimmed mica were as follows:—

Size inches.	Price per lb.
1 x 1	4 to 6c.
2 x 1	8 to 14c.
3 x 1	14 to 22c.
3 x 2	35 to 50c.
4 x 2	60 to 65c.
5 x 3	75 to 80c.
6 x 4	$1.00

Practically all the mica produced in the Province of Quebec is mined in the region north of the Ottawa between the valleys of the Gatineau and the Lièvre Rivers.

Most of the mica is shipped in the state called thumb-trimmed. This consists of a rough preparation comprising the cobbing of the mica crystals, to remove the adhering rock. The mica is then cleaved into plates of one-eighth to one-sixteenth of an inch thick by means of a stout short-handled knife. The plates are roughly trimmed by hand and graded according to the size of the rectangular plate which can be cut out of it. The various grades are then packed in barrels containing about 300 lbs. and shipped to manufacturers or to trimming works.

OCCURENCES AND USES.

The mica mined in the Province of Quebec occurs in dykes and masses of pegmatite which cut the gneisses of the Laurentian formation. These pegmatites are practically very coarse-grained granites, of which the dark micas (biotite and phlogopite) constitute the principal ferro-magnesian elements. Some of the individual crystals are very large, sometimes reaching two feet in diameter and three to four feet long. Mica deposits, however, are very irregular in their nature, and in their exploitation it is very difficult to block out reserves in advance. Therefore it is not usual to have elaborate mining plants, but simple methods are followed which permit of abandoning a deposit for another when there are signs of exhaustion.

The main industrial application of mica is in the manufacture of electrical apparatus. Mica is a perfect insulator and as it splits into thin sheets it finds its place in numerous parts of switchboards, motors, dynamos, sockets, etc. Owing to its refractoriness, it is used where transparency and resistance to fire are needed, as in furnace and stove doors, lamp chimneys, as supports to candle and lamp-shades.

The refuse from the trimming into sheets and plates is powdered or ground and mixed with oils in the manufacture of lubricants.

The great majority of our mica is exported to the United States, England and Germany.

PHOSPHATE.

In 1911 the returns received by the Quebec Mines Branch show the phosphate shipments for the year to be 595 tons valued at $5,832.

The figures of production of phosphate in the Province of Quebec are a striking illustration of the rise and decline of what was once one of our leading mining industries.

The phosphate industry of Quebec dates from 1871, when a few tons were mined near the Little Rapids, on the Lièvre River. From that year on, the production increased steadily and in 1885, the banner year, the shipments reached 28,535 tons valued at $190,331. This phosphate is in the form of apatite occurring in masses and dykes of pyroxenites which cut the Laurentian gneisses of the region lying to the north of the Ottawa River. For several years after this, the industry held its own, for in 1892 the production was still 10,000 tons, valued at $141,221. The following year this fell to 5,748 tons, and in 1895 it was practically dead, as the shipments for that year were only 250 tons. The cause of the decline was the discovery of the extensive phosphate deposits of Florida and Tennessee, which are much more easily worked than our apatite deposits.

At present the only phosphate produced in the Province of Quebec is as a by-product of the mica mines.

GRAPHITE.

There has been a marked increase in the shipments of graphite from the Buckingham district this year. They amounted to 753,405 lbs. valued at $33,613. This is more than double the quantity shipped during the year 1910, and is by far the highest production recorded to date.

The following table gives the value of the annual production since 1898:—

Year	Value
1898	$ 8,500
1899	14,257
1900	9,464
1901	4,690
1902	2,160
1903	Nil
1904	2,300
1905	No report
1906	8,330
1907	5,000
1908	165
1909	10,339
1910	15,896
1911	33,613

From all appearances the graphite industry is now on a satisfactory basis. The principal cause which militated against a rapid development was the difficulty experienced in concentrating the graphite, which occurs in gneisses and other complex rocks in a disseminated state.

The graphite produced was marketed at an average price of 4.46c. a lb. The best qualities of flake-graphite, in large quantities, are quoted at 10c. a lb., whereas the graphite dust sells as low as 1¼c.

A full description of the graphite mines of the Province of Quebec was given in the Report on Mining Operations in the Province of Quebec for the year 1910.

PEAT.

Only one peat machine was in operation in the Province of Quebec during part of the year 1911. This was operated by Peat Industries, Limited, Imperial Bank Chambers, Montreal, on the peat bog situated between Farnham and St. Brigide Road.

The peat machine used is of the same type as the Anrep machine, which is the most successful in Europe. Some modifications, however, have been introduced to render the excavating more automatic and dispense with some labour which is higher in Canada than in most European countries.

It is expected that this bog will be worked on a much larger scale during 1912.

BUILDING MATERIALS.

Although some of the items of structural materials show decreases as compared with last year, the total figures for cement, lime, limestone, brick, marble and granite, show an increase of more than 20% as compared with 1910. In 1911 their combined value was $4,925,401, an increase of $839,538.

Marble.—The Dominion Marble Co. at South Stukely are now producing. A railway spur has been built to the quarry, which is well equipped. This is situatel on lot 8, range II, Township of South Stukely.

The operations of the Missisquoi Marble Co. were carried on actively throughout the year.

A new marble company, The Pontiac Marble Stone Co., is opening a quarry of white marble at Portage du Fort. The quarry is now being prepared for work and the plant is being installed. A gas engine will give the power for the diamond saws, and other machinery for the dressing works.

KAOLIN.—The St. James Construction Co. is preparing to work the Kaolin deposits of Amherst township. They are constructing a mill and a washing plant. The kaolin will be shipped to potteries and to paper manufacturers.

CEMENT.—The cement manufactured in the Province of Quebec is the product of three mills, situated at Hull, Longue Pointe and Pointe-aux-Trembles, respectively. They are all operated by the Canada Cement Company, Head Office, St. James Street, Montreal. The production in 1911 was 1,588,283 barrels, of 350 lbs. each, valued at $1,931,183, or an average of $1.22 per barrel.

GLASS SAND.—A small quantity of glass sand was produced from a quarry at West Shefford and sent to the Diamond Flint Glass Company at Montreal. The results were not satisfactory and operations were abandoned.

SANDSTONE.—Some stone was extracted from the quarry on lots 18, 19 and 20, range I, of Guigues Township, on the shore of Lake Temiskaming, and used for buttress capitals, coping stone, etc., for the new Presbyterian Church at Haileybury.

This stone is quarried from a rim of the Niagara formation which rests directly on the Pre-Cambrian, and which outcrops from Piché Point, on Lake Temiskaming, northward for a distance of about three miles. The stone is of a pleasing buff colour and dresses easily.

FELDSPAR.—A few tons of feldspar were mined from the deposit of this substance on Manicouagan Bay, near Washeeshoo River, opposite the Island of Anticosti. This feldspar was sent to potteries in Trenton, New Jersey, and to London, England, for trial. The deposits are controlled by the Canada Feldspar Co., 199 Bishop Street, Montreal.

MAGNESITE.—A deposit of magnesite was discovered some ten years ago on lot 18, range XI, of Grenville Township, Argenteuil County. For some time this deposit did not attract much attention, but in 1907 it was acquired by the Canadian Magnesite Company, who began operating on a small scale. The deposit is about 12 miles from the Canadian Pacific Railway, the nearest station being Calumet.

On the surface the product seemed to be rather high in lime, (from 10 to 19% carbonate of lime), but as work proceeds in depth the quality improves perceptibly.

Development work was actively pushed on the property during 1911 and it is claimed that there is now a quantity of over 100,000 tons of merchantable magnesite blocked out.

A calcining kiln, of a capacity of 12 to 15 tons of finished product per 24 hours has been installed on the property, as well as a grinding plant. It is expected that shipments of calcined magnesite will begin in May, 1912.

The demand for magnesite is said to be quite active.

LIST OF THE PRINCIPAL MINERAL PRODUCERS IN THE PROVINCE OF QUEBEC.

ASBESTOS.

The Amalgamated Asbestos Corporation, Ltd.,
R. P. Doucet, Secretary, 263 St. James Street, Montreal.

The Asbestos & Asbestic Co., Ltd.,
James R. Pearson, Manager, Asbestos, P.Q.

The B. & A. Asbestos Co.,
G. C. Pharo, Superintendent, Robertsonville, P.Q.

The Bell Asbestos Mines.
W. H. Smith, Local Manager, Thetford Mines, P.Q.

Martin, Bennett Asbestos Co.,
Thetford Mines, P.Q.

Berlin Asbestos Co.,
W. G. Rumpel, Manager, Rumpelville, P.Q.

Black Lake Consolidated Asbestos Co.,
J. M. Forbes, General Manager, Black Lake, P.Q.

The Jacobs Asbestos Mining Co. of Thetford, Ltd.,
W. R. Kerr, Managing Director, Thetford Mines, P.Q.

Johnson's Co.
Andrew S. Johnson, Thetford Mines.

Ling Asbestos Co.,
J. J. Penhale, Manager, East Broughton, P.Q.

Frontenac Asbestos Co.,
East Broughton, P.Q.

Robertson Asbestos Mining Co.,
Thetford North, P.Q.

Belmina Consolidated Asbestos Co.,
H. H. Williams, Manager, Coleraine, P.Q.

OCHRE.

Thos. H. Argall,
P. O. Box No. 2, Thre Rivers, P.Q.

Champlain Oxide Co.,
Three Rivers, P.Q.

Canada Paint Co., Ltd.
Jos. Bradley, 572 William Street, Montreal, P.Q.

SILVER.

The Eustis Mining Co.,
L. M. Adsit, Manager, Eustis, P.Q.

East Canada Smelting Company,
L. D. Adams, Superintendent, Weedon, P.Q.

COPPER.

East Canada Smelting Co., Ltd.,
L. D. Adams, Manager, Weedon, P.Q.

Eustis Mining Co., Ltd.,
L. M. Adsit, Manager, Eustis, P.Q.

MAGNESITE.

Canadian Magnesite Co.
L. N. Benjamin, R. 704, E. T. Bank Bldg., Montreal.

CHROME.

The Dominion Chrome Co.
A. C. Calder, 86 Notre-Dame Street, Montreal.

Asbestos & Chrome Co.
Eastern Townships Bank Building, Montreal.

MINERAL WATER.

Abenakis Springs Hotel Co.
W. E. Watt, Manager, Abenakis Springs, P.Q.

Joseph DeVarennes.
861 St. Valier Street, Quebec.

Radnor Water Co.
E. H. Langmore, Mark Fisher Building, Montreal.

St. Leon Mineral Water Co.
R. W. Nebles, St. Leon, Co. Maskinongé, P.Q.

Veuillet & Frère,
St. Genevieve de Batiscan, P.Q.

Cyprien Roy,
St. Germain, Co. Kamouraska, P.Q.

A. Ferland,
151 St. André Street, Montreal.

PHOSPHATE.

Blackburn Bros.
H. T. Forbes, Manager, 21 Sparks Street, Ottawa.

Electric Reduction Co.,
Buckingham, P.Q.

R. J. McGlashan.
W. McGlashan, Manager, Wilson's Corners, P.Q.

IRON.

The Canada Iron Corporation,
Imperial Bank Building, Montreal.

GRAPHITE.

Bell Graphite Co.,
C. Kendall, Manager, Buckingham, P.Q.

Buckingham Graphite Co.,
H. P. H. Brumell, Manager, Buckingham.

Dominion Graphite Co.,
H. P. H. Brumell, Manager, Buckingham, P.Q.

Peerless Graphite Co.
H. W. Ham, Superintendent, Buckingham.

Canadian Graphite Co.
T. W. Patterson, Manager, Lachute, P.Q.

Graphite, Limited.
St. Rémi d'Amherst,
or Board of Trade Building, Montreal.

MICA.

Wm. Argall,
Laurel, Co. Argenteuil, P.Q.

Blackburn Bros.,
H. L. Forbes, Manager, 21 Sparks St., Ottawa.

H. T. Flynn,
108 Brewery Street, Hull, P.Q.

J. B. Gauthier,
Buckingham, P.Q.

Kent Bros.,
H. McCadden, Manager, Kingston, Ont.

Rinaldo McConnell,
175 Cooper Street, Ottawa, Ont.

Mica Company of Canada, Ltd.,
H. Touzin, Manager, 534 Wellington Street, Ottawa, Ont.

O'Brien & Fowler.
Bush Winning, Manager, Rideau Street, Ottawa.

Vavassour Mining Association.
T. F. Nellis, 22 Metcalfe St., Ottawa, Ont.

Wallingford Bros., Ltd.,
E. Wallingford, Perkins Mills, P.Q.

The Gracefield Mining Company.
J. A. C. Ethier, Manager. Ste. Scholastique, P.Q.

Laurentide Mica Co.,
W. Ahern, Manager, Ottawa.

T. J. Watters.
Stewart St., Ottawa.

R. J. McGlashan,
Glenlivet, P.Q.

TITANIC MINERAL IRON.

Canadian Iron Ore Co.,
Leon Coulombe, Manager, 1231 St. Valier St., Quebec.

The Loughborough Mining Co., Ltd.
G. W. McNaughton, Schenectady, N.Y.

GOLD.

La Compagnie de Champs d'Or de Rigaud-Vaudreuil.
J. R. Duckett, Manager, 107 St. James St., Montreal.

The Eustis Mining Company.
L. M. Adsit, Manager, Eustis, P.Q.

SAND.

Dominion Sand & Stone Co.
Wm. Powell, Manager, 703 Can. Exp. Bldg., Montreal.

Montreal Sand & Gravel Co.,
J. B. Galarneau, Manager, Chateauguay.

PEAT.

Peat Industries, Ltd.,
Imperial Bank Chambers, Montreal.

SLATE.

Frazer & Davies,
New Rockland, P.Q.

BRICK.

Zéphirin Beaudet, St. Jean Deschailons, P.Q.

Lucien Beaudet, St. Jean Deschaillons, P.Q.

Widow Jos. Bernier. A. Bernier, Manager, 70 Christophe Colomb Street, Montreal.

G. N. Blais, 45 Napoleon Street, Quebec.

C. Bourdon, 605 Davidson Street, Montreal .

Victor Charland, St. Jean Deschaillons, P.Q.

Eugène Chrétien, St. Jean Deschaillons, P.Q.

Eastern Townships Brick & Mfg. Co., F. G. Hoake, Manager, Lennoxville, P.Q.

D. G. Loomis & Sons, Sherbrooke, P.Q.

Montreal Terra Cotta Lumber Co., H. Desjardins , Manager, 26 Board of Trade, Montreal.

Paradis & Létourneau. Jean Paradis, Manager, Stadacona.
A. F. Richard & Son, Hull, P.Q.
F. Rinfret, Rimouski, P.Q.
Laprairie Brick Co., Ltd., T. W. McArthur, 26 Board of Trade, Montreal.
Alex. Laliberté, St. Jean Deschaillons, P.Q.
Lafontaine & Martel, O. Lafontaine, Manager, St. Tite, P.Q.

LIME.

Dominion Lime Quarry, A. F. Fraser, Sherbrooke, P.Q.
C. A. Gervais, 1460 Cadieux Street, Montreal.
Olivier Limoges, 477 Avenue Papineau, Montreal.
Sovereign Lime Works, 40 Pouport Street, Montreal.
Standard Lime & Quarry Co., Joliette, P.Q.
Jas. C. Wright, Hull, P.Q.
C. W. Trenholme, 31 Prenoveau Street, Montreal.

CEMENT.

Canada Cement, Limited, Edifice de la Banque Nationale, Montreal.

MARBLE.

Dominion Marble Co. Harry Brown, Manager, Metropolitan Building, Montreal, P.Q.
Missisquoi Marble Co. C. N. Barclay, Manager, Coristine Building, Montreal.

GRANITE.

James Brodie, Graniteville, P.Q.
Dominion Quarry Co., Ltd., 51 Salaberry St., Montreal.
Laurentian Granite Co., Ltd. John Coulombe, Manager, Roussillon, Co. d'Argenteuil, P.Q.
S. B. Norton, Beebe Junction, P.Q.
Stanstead Granite Quarries Co., Ltd., F. W. Hearle, Beebe, P.Q.
Fortunat Voyer, Rivière à Pierre, P.Q.

LIMESTONE.

Georges Chateauvert, St. Marc des Carrières, P.Q.

La Compagnie des Carrières, J. Gosselin, Manager, St. Marc, P.Q.

François Dufresne. Charles LeCailleur, Manager, Cap St. Martin.

Fleming-Dupuis Supply Co. Thos. Fleming, Manager, 343 Sparks Street, Ottawa, Ont.

Jos. Gingras, Chateauvert, P.Q.

Jos. Gravel, 488 Duluth Ave. East, Montreal.

Felix Labelle, St. François de Sales, P.Q.

Louis Labelle & Co., St. François de Sales, P.Q.

Ovide Lapierre, 830 des Carrières Street, Montreal.

Olivier Limoges. Joseph Lacroix, Manager, 477 Avenue Papineau, Montreal.

O. Martineau & Fils, Ltd., Marie-Anne Street, Montreal.

W. J. Poupore & Co., 124 Board of Trade Bldg., Montreal.

Rogers & Quirk, Neuville Street, Montreal.

Wright & Co., N. Tremblay, Manager, Hull, P.Q.

Delorimier Quarry Co. H. Lalonde, Manager, 1952 Iberville Street, Montreal.

Stinson-Reeb Builders Supply Co., Ltd., Eastern Townships Bank Building, Montreal.

Harvey Robertson, D'Arcy Leamy, Manager, Côte St. Paul, Montreal.

Maisonneuve Quarry. Jos. Rhéaume, proprietor, 907 Ave. Desjardins, Maisonneuve, P.Q.

Bishop Construction Co., Ltd. A. R. Armstrong, Manager, 906 Eastern Townships Bank Bldg., Montreal.

David Brault, St. John's, P.Q.

La Compagnie de Brique de Québec. Hector Desjardins, Manager, Ramsay Street, Quebec, P.Q.

Laurin & Leitch, 5 Beaver Hall Square, Montreal.

Otis Quarries, Limited, R. K. Otis, Manager, Grande Ligne, P.Q.

POTTERY.

Canadian Trenton Potteries Co., Ltd. W. A. Campbell, Manager, St. John's P.O.

Standard Drain Pipe Co., Ltd. W. C. Trotter, Manager. St. John's, P.Q.

ACCIDENTS IN MINES.

(By J. H. Valiquette).

Numerous accidents have been reported to the Mines Branch, but fortunately most of them were not very serious. We note with great satisfaction a decrease of fatal accidents as compared with the previous year.

According to statistical returns received direct from operators of mines and quarries, 7,846 men were employed in the mineral industry during 1911. Of these, 3,686 were employed in metalliferous, asbestos and mica mines, and 4,160 in quarries, clay-pits and brickyards, as will be seen in the table given on page .

Four accidents resulted fatally, four lives being lost through their occurrence. Three of these occurred in the asbestos mines and one in the stone quarry of Messrs. Rogers & Quirk, of Montreal.

Only one fatal accident occurred in a mine; this was in the pit of the Asbestos and Asbestic Company, at Danville, where Emile Bord got his glove caught in a hoisting block as a box of rock was being raised. He was hoisted about fifty feet in the air and fell from that height. Of the other fatalities, one occurred in the Stone Dressing Works of Rogers and Quirk, when Théophile Viau struck his head against a revolving wheel. Another occurred in the mill of the Asbestos and Asbestic Company, when Oscar St-Louis, a machinist, went into a cyclone defiberizer without throwing the belt off the pulley; a slight movement of the machinery put the beaters of the cyclone in motion and he was crushed to death. The fourth accident occurred at the Kings Asbestos mine, when Pierre Huard was struck on the head by asbestos-rock car.

Therefore of the 3,686 men who worked in the mines, outside of the stone quarries and clay pits, only three were killed, which gives a proportion of 0.77 per thousand employed. Among the 4,160 men who worked in the stone quarries and clay pits, only one fatality occurred, giving a proportion of 0.24 per thousand. These figures compare very favourably with those of last year, when they were 2.26 and 1.14 respectively.

These results are gratifying and show that mine operators are careful of the security of their men. Nevertheless there is room for improvement, and as we remarked last year, these results are, to some extent, to be ascribed to luck, rather than to good management.

There certainly has been a marked improvement in the methods of handling, using and storing explosives, but there are still points on which carelessness prevails. There is a practice followed in the Asbestos mines which may some time result in accidents. This concerns the regulations of firing the blasts. The morning's work in the mines stops at 11.30 a.m., and one hour is allowed for dinner. During that hour the blasting is done and the shot-lighters usually hasten through this work in order to have more leisure after this work is done. As a result blasts are sometimes set off two or three minutes after the gong or bell for knocking off work has rung, leaving very little time for workmen to get away. It is true that the shot-firer usually ascertains that no one is in the danger zone before he lights the fuses, but we think that it would be safer to delay the lighting for 15 minutes after the gong or bell-signal has been given, which would leave more time to the workmen to get away. There would be nothing lost by the delay, as it would only affect the shot-firer.

It is of course most important for the man in charge of the blasting to inspect very carefully each of the shots, after blasting, to make sure that there has been no misfires, and such an examination should not take place within less than three quarters of an hour after the shots have been fired. The shot-firer should therefore give more time to his work.

We give a tabulation of the accidents which have been reported to the Mines Branch. As a rule, the operators have conscientiously complied with the regulations of the Mining Law, which requires that all accidents, involving a loss of ten days' work on the part of the victim, should be reported forthwith to the Department. Nevertheless in some cases there has been dilatoriness and sometimes reports are made without giving names of victims, cause of accident, and other details required by the law.

ACCIDENTS IN MINES IN THE PROVINCE OF QUEBEC IN 1911.

DATE 1911.	NAME OF THE MINE.	NAME OF INJURED.	OCCUPATION.	NATURE OF INJURY.	CAUSE OF ACCIDENT.
13th February	Amalgamated Asbestos Corporation (Beaver Mines)	L. Carrier		Leg bruised	
15th "	Amalgamated Asbestos Corporation (Brit. Canad.)	J. Morin		Eye injured	
17th "	The Asbestos and Asbestic Co., Ltd	Emile Bord	Laborer	Killed	Caught by hook of hoisting rope in quarry, was hoisted up 30 feet and fell.
25th "	Amalgamated Asbestos Corp. (King's Mines)	F. Laundry		Side bruised	
3rd March	Amalgamated Asbestos Corp. (Beaver Mines)	C. Jamask		Back injured	
21st "	Amalgamated Asbestos Corp. (King's Mines)	G. Hughes		Knee injured	
31st "	Bell Asbestos Mines	Ed. Verville	Laborer	Second and third toe of right foot broken	He was prying down rock from the face of the cut when a piece of rock fell from seven feet above and struck his right foot.
5th April	Bell Asbesbos Mines	J. Couture	Blacksmith	Right eye burnt badly.	He was forging a piece of red hot iron when a piece of the iron flew up in his right eye.
15th "	Bell Asbestos Co.	Art Huot	Blacksmith	A big cut on the right wrist	Cut made by a piece of broken swedge in sharpening drill bit.
17th "	Amalgamated Asbestos Co., Ltd. (Standard Mines)	D. Manseau			

DATE 1911.	NAME OF THE MINE.	NAME OF INJURED.	OCCUPATION.	NATURE OF INJURY.	CAUSE OF ACCIDENT.
18th April.....	Asbestos and Asbestic Co., Ltd. (Jeffrey Mines)......	Oscar St. Louis...	Millwright........	Killed..............	Went into a cyclone machine without removing the belt and was struck by beater when machine started.
21st "	Amalgamated Asbestos Corp. (Standard Mines).........	J. Gregorvitch....	....	....	
10th "	Amalgamated Asbestos Corp. (King's Mines)...........	O. Graham.......	....	Finger crushed.......	
15th "	Amalgamated Asbestor Corp. (King's Mines)...........	L. Proulx........	....	Head Cut...........	
26th "	Johnson's Co..............	Arsene Duplessis.	....	Bone broken in the arm	Struck with a sledge which slipped.
27th "	Bell Asbestos Mines.........	Henri Fecteau....	Mill-hand.........	Bruises on back of head and leg.......	Fell from 10 feet high on a crusher.
28th "	Missisquoi Marble Co., Ltd..	One Italian unkn'w	Laborer..........	One leg broken......	Stone fell over his body.
29th "	Bell Asbestos Mines........	D. Thibaudeau....	Tinsmith.........	Left eye injured......	Piece of galvanized sheet iron flew up into his left eye.
29th "	Amalg. Asb. Corp. (Standard)	P. Boienic........	....	....	
1st May.......	Bell Asbestos Mines.........	Art. Poulin.......	Pit Laborer.......	Right jaw hurt and two teeth broken...	Struck by a crowbar in prying a stone.
3rd "	Amalg. Asb. Corp. (B.C.)....	G. Fortier........	....	Rib fractured........	
4th "	Amalg. Asb. Corp (Standard)	J. Fortier........	....	....	
5th "	Black Lake Consolidated Asbestos Co...............	John Blanchette...	....	Right leg and left heel broken, left side bruised and small cut in head........	Struck by a drill and fell in the pit which was about 40 feet deep.

6th May	Amalg. Asb. Corp. (King's)	J. Lemay		Leg bruised	
8th "	Amalg. Asb. Corp. (King's)	J. Lachance		Foot bruised	
9th "	Amalg. Asb. Corp. (C.B.)	G. Gosham		Fingers crushed	
10th "	Missisquoi Marble Co., Ltd.	Alf. Mactioli		Foot bruised	Struck by a block of marble when the piece lipped.
11th "	Amagamated Asbestos Corp. (King's Mines)	A. Lapointe		Foot bruised	
19th "	Amalgamated Asbestos Corp. (King's Mines)	F. Lapointe	Miner	Ankle bruised	Right ankle struck by a stone.
20th "	Amalgamated Asbestos Corp. (King's Mines)	G. Blais	Miner	Finger fractured	Struck on left hand while dumping boxes in cars.
23rd "	Asbestos and Asbestic Co.	Art. Blanchette	Laborer	Left leg broken	Struck by falling earth.
24th "	Amalgamated Asb. Corp	G. Gagnon		Elbow dislocated	
25th "	Asb(stos and Asbestic Co.	E. Leroux	Laborer	Bone above ankle fractured	Struck by rolling rock striking leg.
26th "	Amalgm. Asb. Corp	M. Marachon			
27th "	Asbestos and Asbestic Co.	David Rosam	Driller	Right leg fractured	Struck by falling rock.
29th "	Amalgm. Asbestos Corp.	C. Hangeluk			
1st June	Champs d'or Rigaud, Vaudreuil	G. Bernard	Laborer	Leg broken	Struck by rolling stone.
1st "	Amalg. Asb. Corp. (Can. B.)	A. Boucher		Ankle fractured	
2nd "	" " " "	G. L. Almand		Hip bruised	
9th "	Bell Asbestos Mines	F. Bolduc	Dryer-hand	Sole of left foot lacerated	Stepped on a rusty nail which was sticking up through a piece of board on the floor near dryers.
10th "	Amalg. Asb. Corp. (B.C.)	P. Foeard		Leg fractured	
12th "	" " " "	A. Dellsiseo		Finger crushed	
15th "	" " " "	E. Doucette		Arm bruised	
13th "	" " " "	A. Duplessis		Hip bruised	
19th "	" " " "	A. Tardiff		Finger crushed	
20th "	" " " "	E. Bomanfaut		Eye injured	
20th "	Bell Asbestos Mines	O. Gilbert	Pit Laborer	Last finger of left hand bruised	Struck by a piece of rock.
23rd "	Amalg. Asb. Cor.p (B.C.)	G. Berry		Finger bruised	
24th "	" " " (Standard)	J. Fanick			
24th "	" " " (King's)	G. Camden		Ankle brnised	

ACCIDENTS IN MINES IN THE PROVINCE OF QUEBEC IN 1911.

DATE 1911.	NAME OF THE MINE.	NAME OF INJURED.	OCCUPATION.	NATURE OF INJURY.	CAUSE OF ACCIDENT.
2nd July	Amalg. Asb. Corp. (Beaver)	D. Shank		Leg and arm bruised	
7th "	Missisquoi Marble Co. Ltd.	Wm. O'Neil		Leg bruised	Hurt by slabs unloading the car.
8th "	Amalg. Asb. Corp. (King's)	J. Vachon		Finger bruised	
9th "	Height of Land Mining Co.	Felix Westburg	Miner	Drowned	Upsetting of canoe and inability to swim.
13th "	Amalg. Asb. Corp. (Standard)	W. Vivchear			
13th "	" " " "	M. Barabuck			
15th "	Black Lake Consolidated Co.	E. Darabas	Laborer	Right leg so badly injured that it had to be amputated	Car running over his leg.
18th "	Amalg. Asb. Corp. (Standard)	N. Demian			
23rd "	The Berlin Asbestos Co. Ltd.	Louis Cyr	Shaft Foreman	Struck in groin which caused an abscess	Hit by a hook.
31st "	Amalg. Asb. Corp. (Standard)	P. Malereck			
3rd August	Amalg. Asb. Corp. (B.C.)	F. Bosenberry		Arm cut	
12th "	" " " "	A. Grouin		Finger crushed	
12th "	" " " "	O. Digle		Finger crused	
15th "	" " " "	L. Drause		Knee bruised	
15th "	" " " (King's)	F. Heman		Hand bruised	
18th "	" " " (C.B.)	A. Cyr		Finger crushed	
19th "	" " " (King's)	W. Griffith		Leg bruised	
21st "	Rogers & Quirk	F. Varin	Foreman	Fracture of skull	Striking his head against revoiving wheel, driving a stone crusher.
21st "	Richard & Cie	J. Nicholas Mathieu	Laborer	Fall of ground	
28th "	Amalg. Asb. Corp. (Beaver Mine	G. Richet	Laborer		
30th "	Amalg. Asb. Corp. (Beaver Mine)	J. Vachon		Hand crushed Knee injured	

30th August....	Amalg. Asb. Corp. (King Mine)....................	A. Spenard.......	....	Head injured........	
31st "	Amalg. Asb Corp. (King Mine)	N, Marachan.....	Laborer..........	Driving car which dumped prematurely................	
7th September.	The B. & A. Asbestos Co...	G. Delisle........	....	Collar-bone broken...	
7th " .	Amalg. Asb. Corp. (B.C.)....	A. Tremblay......	....	Eye injured..........	
7th " .	" " " "	W. Mateaur	....	Eye injured.........	
14th " .	" " " (Standard)	A. Marcoux.......	....	....	
26th " .	James Brodie..............	W. Croston.......	....	Finger crushed.......	
1st October....	Bell Asbestos Mines........	A. Lamontagne ...	Mill-hand.........	Right arm crushed and amputated 6 inches from shoulder......	Was caught in a pair of crushing rolls in mill.
3rd "	Canada Cement Co. Ltd.....	B. Tremblay......	Quarryman	Head slightly cut and he was suffering from internal pains......	Bucket was accidentally lowered on him.
4th "	Amalg. Asb. Corp. (B.C.)....	G. Murray........	....	Leg bruised.........	
6th "	" " " "	C. Hatch.........	....	Finger crushed.......	
9th "	" " " "	J. Ferland.......	....	Finger crushed.......	
13th "	Amalg. Asb. Corp. (B.C.)....	J. Jervaise.......	....	Leg bruised........	
15th "	" " " "	A. Couture.......	....	Leg bruised.........	
19th "	" " " (King's)..	P. Huard.........	....	Killed..............	Struck on the head by a dump car whilst crossing the track.
20th "	Amalg. Asb. Corp. (B.C.)....	J. Poulin.........	....	Nail pulled off.......	
20th "	" " " "	N. Baker.........	....	Foreign body in eye..	
22nd "	Missisquoi Marble Co. Ltd...	G. A. King.......	....	Hip-bone fractured...	The crowbar gave way, he fell from the ledge a distance of about 20 feet.
30th "	Amalg. Asb. Corp. (B.C.)....	E. Provencal......	....	Finger crushed.......	
30th "	Canada Cement Co. Ltd.....	J. Lutak.........	Quarryman......	Third finger nail of right hand torn off.	
2nd November.	Amalg. Asb. Corp. (King's).	A. Lemieux.......	Laborer..........	Hand bruised........	
2nd .	" " " (B.C.)...	E. Rousseau......	....	Scalp wound.........	

DATE 1911.	NAME OF THE MINE.	NAME OF INJURED.	OCCUPATION.	FATURE OF INJURY.	CAUSE OF ACCIDENT.
3rd "	Johnson's Co	J. B. Ferland	Laborer	Top of little finger jammed, amputated from first joint	Caught between roll and dryer cylinder.
4th "	Amalg. Asb. Corp. (Standard)	J. Vaillancourt			
6th "	Eustis Mining Co	P. Bilodeau		Lost one eye	A piece of pyrite flew in his eye.
7th "	Amalg. Asb. Corp. (B.C.)	L. Dion		Eye injured	
7th "	" " " "	S. Gauthier		Nose cut	
8th "	H. Després	R. Després	Stone-cutter	Arm broken	Broken by winch.
13th "	Amalg. Asb. Corp. (B.C.)	N. Bablia		Scalp wound	
13th "	" " " "	L. Nadeau		Rib broken	
13th "	" " " "	E. Click		Leg bruised	
17th "	" " " (Standard)	J. Racine			
21st "	" " " (King's)	Laliberté		Scalp wound	
25th "	" " " "	A. Paré		Foot bruised	
28th "	" " " "	A. Jacques		Leg bruised	
1st December	" " " (Beaver)	N. Doyen		Rib broken	
5th "	" " " (Standard)	G. Benefaut			
9th "	Amalg. Asb. Corp. (Standard)	N. Demian	Loader	Compound fracture of left leg near ankle	Piece of rock from the wall struck him.
10th "	" " " "	J. Hingelink	Laborer	Leg fractured	Struck by a piece of rock from the wall.
9th "	" " " (King's)	J. Walsh		Ankle sprained	
11th "	" " " "	Marcoux		Arm bruised	
11th "	" " " "	A. Lapointe		Back injured	
18th "	" " " (B.C.)	H. Dubuc		Eye hit by stone	

18th December	Fleming Dupuis Supply Co. Ltd.	Furguson		Broken leg amputated resulting in his death	Falling into quarry from surface a distance of about 35 feet.
20th "	Amalg. Asb. Corp. (King's)	J. Halle		Head cut	
220th "	" " " "	P. Ray		Eye bruised	
2nd "	" " " "	J. Gagné		Leg bruised	
31st "	The Asb. and Asb. Co. Ltd.	F. Courtemanche		Second and third fingers left hand crushed	Fingers crushed by a shaft falling on them.

REPORT ON THE MONTREAL QUARRIES*

(By J. H. Valiquette).

According to instructions from the Superintendent of Mines to devote my spare time outside of my work at McGill University, while in Montreal in November, 1911, to visiting stone quarries in the vicinity of the city, I gathered all the information I could during the short leisure left me. Such information is summed up in the following notes:—

Quarrying for stone on the Island of Montreal dates back to the origin of the colony and there is no doubt that the abundance of building stone in the immediate proximity to the city has somewhat contributed to its great development. It is therefore very interesting and important to ascertain the present condition of the quarries from the standpoint of their exploitation and of their contribution to the development of other industries.

In order to follow the description of certain quarries, which will be given further on, it is essential to briefly summarize the geology of the region and to recall the main features of its formations to the reader's mind, as such considerations may perhaps help, later on, to trace the extension of the beds now being worked, and aid in locating new quarries.

As the too brief leisure at my disposal did not allow of my making geological observations at most of the interesting spots, for my work was confined to visiting quarries in the immediate vicinity of Montreal, most of the descriptions of formations given below have been taken from the following authorities:—the Geology of Canada, 1863, by Sir William Logan, etc.; Volume XI, 1898, of the Geological Survey of Canada, part J., by R. W.

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*Translated from the French by Crawford Lindsay.

Ells; Volume XIV, 1901, of the Geological Survey of Canada, part O, by F. D. Adams and O. E. LeRoy. In some places entire pargraphs have been quoted, while elsewhere the information has been compiled from various sources. The report of Messrs. Adams and LeRoy especially has served as a basis.

According to the geological map of the district, published by the Geological Survey of Canada in 1905, the principal formations found on the Island of Montreal itself are, in ascending order: the *Potsdam sandstone*, found over a very small area at Bout de l'Ile; the *Calciferous formation*, embracing the parish of St. Anne and a portion of the parishes of Pointe Claire and St. Genevieve; the *Chazy formation*, embracing the central portion of the parishes of Pointe Claire and St. Genevieve and then the *Trenton group* underlying practically the whole of the remainder of the island with the exception of two areas. One of these, rather extensive, lies to the north and northwest of Mount Royal, comprising a portion of the parishes of St. Laurent, Cartierville, Sault au Récollet and Outremont, and is underlain by the Chazy formation. The second area of different rocks, which are related to the Utica formation, is found at the southeastern end of the island and comprises a portion of Point St. Charles, of Côte St. Paul and of Montreal West. With the *Hudson river* formation, which is not represent on the island of Montreal, but is well developed in the county of Chambly, these strata form a complete succession of the rocks of the Ordovician series. Besides these stratified rocks, the important eruptive rocks of Mount Royal must be noted as well as the series of veins and sills of various igneous rocks intruding the other formations. The Mount Royal rocks are essexite, which constitutes the greater part of the intrusion, and nepheline syenite. Moreover, a series of dykes radiate from it, which are very irregular in width and strike, varying from a few inches to several feet in thickness. The layers of tinguaite (called 'Banc Rouge'' by the quarrymen) of Longue Pointe, Maisonneuve and Hochelaga, deserve mention from the twofold standpoint of their economic value and their geological relations.

To obtain an accurate idea of the relative positions of the rock formations above enumerated, it is necessary to consider the lower series and examine their relations with one another, from the archæan complex, which is the base of all the sedimentary rocks and which covers a very large area in the county of Two Mountains.

At Bout de l'Ile we find the Potsdam strata lying directly on the Laurentian. Thence, if we proceed in an east-northeasterly direction, following a straight line, to the top of Mount Royal, then turn towards the northeast as far as the northeastern end of the island, thus crossing the island of Montreal, passing by Mount Royal, and examine the rocks which we meet on the way, classifying them according to the nomenclature adopted above and referring them to the individual areas indicated, we shall have a general idea of the geology of the locality.

With the exception of the eruptives, the whole series of rocks now under consideration are stratified, and the product of marine deposition; some are characteristic of shallow water or beach deposits, such as the Potsdam sandstones, while others have evidently been deposited when the waters were deep, such as the Trenton limestones, containing a very great abundance of fossil remains of animals which must have lived in the depths of the sea. Thus at the outset of the Ordovician period of the Paleozoic age, the Laurentian plateau, as it now exists, was bordered by the seas extending southwardly over the whole plain and that mass of rock rising above the waters was worn away while subject to the ordinary erosive agents, and its debris, carried down to the sea by the processes we see at work even in our day, supplied the material for depositing at the bottom of the water the various formations we are now studying. The sea which, at that date, spread over the whole plain, owed such progress to the gradual and slow sinking of the land; it was shallow at the beginning when the Potsdam strata were formed, but, as the sinking proceeded, the sheet of water assumed oceanic dimensions, and characteristic deposits, such as the Trenton, were the result, with all the phases of transition between the two. If one may judge by the total thickness and the importance of the Trenton formation, the period of deep water lasted a long while and was a stationary era for this portion of the continent. Then came an uplift movement, causing the plain to emerge and restoring shallow water conditions which are chiefly characterized by the Utica and Hudson river formations.

POTSDAM SANDSTONE.

Let us now proceed along the line above indicated. At Bout de l'Ile we find the Potsdam sandstones and some small outcrops of calciferous sandy limestone plainly visible; the strata are lying practically horizontally. As a rule the Potsdam lies on top of the Laurentian.

"Its lowest members are beds of conglomerate, holding pebbles of Laurentian gneisses and quartzites. These beds pass upwards into evenly stratified, fine-grained, and very quartzose sandstones. It is distinctly a shallow water formation and many layers show false bedding, ripple marks, with tracks and burrows of animals, which crawled upon the shallow sea bottom or burrowed in the sand. The thickness of the formation varies from 300 to 700 feet." (Adams and LeRoy, 1901).

CALCIFEROUS FORMATION.

Proceeding now in an easterly direction, we come to the sandstone rocks of the Calciferous formation, but the point of contact cannot be definitely determined owing to the thick layer of drift covering the rock. It is considered as beginning about half a mile to the east of the end of the island and, from that point, the formation continues with a width of 4½ miles, underlying about the west third of Pointe Claire.

"The rock itself varies somewhat in character, but usually is a grayish, semi-crystalline dolomite or magnesian limestone which is generally arenaceous or siliceous and occasionally argillaceous. In many cases it holds geodes of quartz and calcite, and irregular streaks and patches of black chert." (Adams & LeRoy, 1901).

The nature of these rocks and the large number of fossils they contain show that the water was comparatively deep during their deposition, as stated above. A slow sinking of the surface was in progress from the beginning of the Potsdam period, and as a consequence the overlying formation, the Calciferous, represents deeper water conditions, which influenced the nature of the sediments, resulting in magnesian sandstones. This is confirmed by the abundance of marine fossils in these Calciferous strata. However, the sinking movement was very slow and the two formations are united by transitional beds, so that the Potsdam insensibly graduates into the Calciferous. The thickness of the latter varies from 300 to 450 feet.

CHAZY LIMESTONE.

"In Chazy time, with a farther deepening of the sea, the conditions became more truly oceanic, and there was consequently a great development of marine life, particularly of the brachiopoda. These, through the accumulation of their shells, built up extensive beds of limestone, many of the latter consisting almost wholly of the shells of a single species, *Rhynconella plena*. Rocks of this formation can be seen at Cartierville, where they are found in place, and also loose in the fields where long stone fences have been built of them. The formation is represented by granular, semi-crystalline light and dark gray limestones, made up in great part of shells and their comminuted fragments. Interstratified with the limestone beds are occasional shaly layers which indicate the influx of muddy waters into the prevailingly clear waters." (Adams and LeRoy, 1901).

The upper beds of this formation are massive and furnish good building stone. Quarries have been opened in the vicinity of Montreal, the stone of which has been used in the construction of some of the locks on the Lachine canal and of various buildings. The prevailing colour of the stone is grey, but on weathering it sometimes assumes a light brown or yellowish tint. It is usually magnesian, and at times sufficiently so to constitute a dolomite. The thickness of the upper part is sixty to seventy feet, whereas the whole formation rarely exceeds 300 feet. An outline of its distribution on the Island of Montreal has been given above.

TRENTON GROUP.

This series of strata in the State of New York has been differentiated into three subdivisions, known in ascending order as: Bird's Eye, Black River and Trenton proper. Although the Bird's Eye and Black River divisions are developed in the vicinity of Montreal, they have never been separated on the Canadian geological maps up to the present; but it is possible that future work of a more detailed nature will supply the necessary material for such classification.

As stated above, the Trenton formation underlies by far the greater portion of the Island of Montreal and the larger quarries have been opened on these strata.

"The Trenton is one of the most persistent and conspicuously marked series of strata of the Lower Silurian in North America, and judging from the abundance of the remains of marine invertebrate life, this period evidently represents long continued and truly oceanic conditions, the waters being clear and probably warm. In addition to numerous representatives of previously mentioned marine families, Trilobites and Corals flourished, the latter especially giving rise to great beds of limestone.

"The rock is usually a granular, semi-crystalline, dark gray limestone, more or less bituminous, and contains a variable amount of argillaceous (clayey) material. In many instances the limestone beds are separated by thin partings of shale, these being thicker and more pronounced at the top of the series where the Trenton passes into the Utica formation." (Adams and LeRoy, 1901).

The Trenton formation is the one of which the outcrops are the most numerous on the island of Montreal; it is even found on the very summit of Westmount and near the top of Mount Royal. This fact, combined with the presence of the shales of the Utica on the low lands near Point St. Charles and on the river opposite the city, as well as the horizontal character of the Trenton ridge to the northeast, seem to indicate the existence of a considerable break or fault on the southeast slope of the mountain itself; whereas the superposition of the limestone of Upper Chazy or Black River upon the Calciferous at the lower end of Ile Bizard also indicates a fault in this vicinity. (Ells, 1894). According to Logan, the thickness of the Trenton formation in the neighbourhood of Montreal would be about 600 feet.

UTICA SHALE.

If we proceed onward in a northeasterly direction, following the line indicated, after passing the igneous rocks of Mount Royal and the eruptive sheets of Hochelaga, to which we will refer later, we come to the northeastern end of the island, where the Trenton comes in contact with the Utica shales of the overlying formation. As stated above, these beds of Trenton limestone of the upper part of the formation are separated by thin layers of black or blackish brown bituminous shales, indicating a change in the conditions of the deposition of the debris from the erosion of the adjacent rocks. As the products of such deposition are bituminous or arenaceous shales and occasionally beds of conglomerate, sometimes containing limestone fragments, this proves that the waters were comparatively shallow. So that in the Utica period, owing to a gradual emerging of the plain, the waters partly withdrew, leaving a shallow and muddy sea in which the above mentioned rocks were deposited.

"This change of conditions was not favourable to the existence of those forms of life which flourished in the Trenton; consequently they, for the most part, disappeared, their place being taken by forms of life adapted to cold and muddy waters.

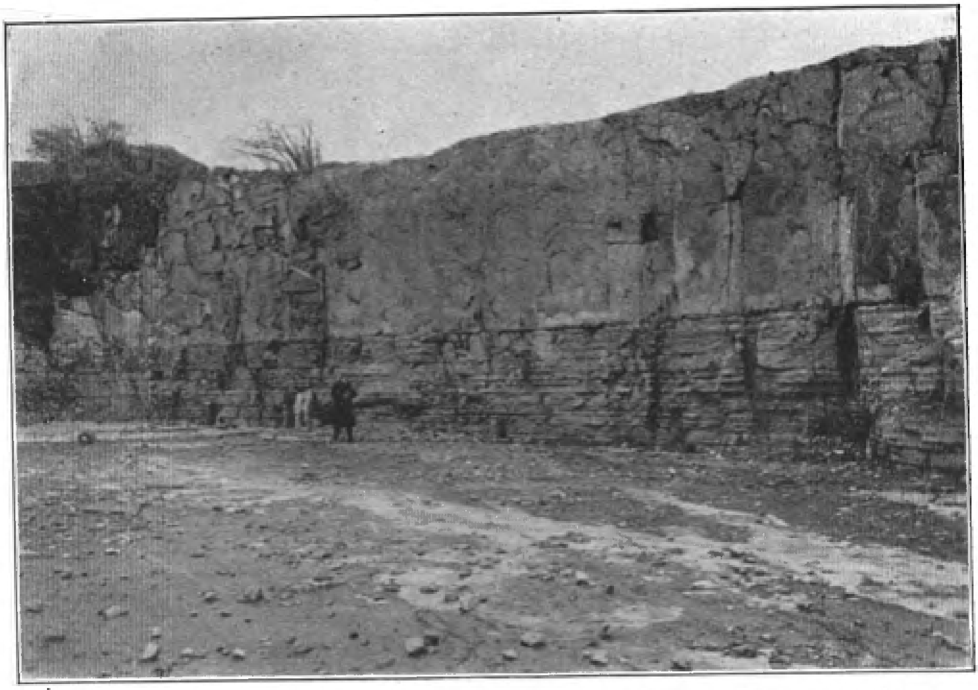
"The maximum thickness of the Utica is about 300 feet." (Adams and LeRoy, 1901).

IGNEOUS ROCKS.

"During the Devonian or Post-Devonian time, that part of the Palaeozoic plain in the vicinity of Montreal was the scene of great volcanic activity, the present evidences being the line of igneous hills which extend from Shefford to Mount Royal. These hills, greatly reduced in size and representing merely roots of the original volcanoes, or in some cases uncovered laccolites, by reason of the flatness of the plain, form striking topographic features and are locally known as mountains."

"The igneous mass of Mount Royal occupies an area of about

PLATE I.

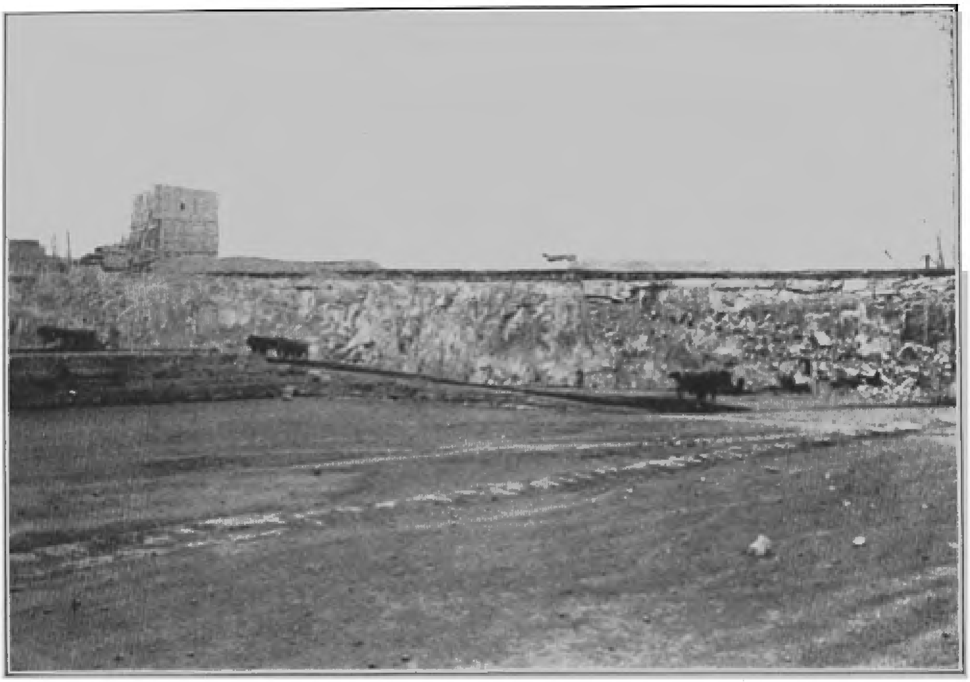


TINGUAITE SHEET (banc rouge) OVERLYING TRENTON LIMESTONE BEDS.
O. Martineau & Fils, Quarry, Delorimier Ave., Montreal.

PLATE II.

SMALL ANTICLINAL FOLD, AND DYKES CUTTING LIMESTONE STRATA.
City of Montreal Quarry, Outremont.

PLATE III.



TINGUAITE SHEET, OVERLYING LIMESTONE STRATA.
O. Martineau & Fils' Quarry, Delorimier Ave., Montreal.

PLATE IV.

DYKE CUTTING LIMESTONE BEDS.
Montreal Water & Power Co.'s Quarry, Outremont.

one and a half square miles, and is surrounded by the Trenton limestone, through which it has broken, and by which it has been in many places altered to marble. The main part of the mountain is composed of Essexite, a plutonic rock composed essentially of plagioclase feldspar, augite and hornblende, with a little nepheline. Olivine is in some places present as an accessory constituent. This Essexite was subsequently cut through by a later intrusion, consisting of nepheline syenite, a rock which is genetically related to the former and which consists essentially of orthoclase feldspar, nepheline and hornblende. It represents a more acid phase of the original magma. The nepheline syenite appears as a comparatively broad band along part of the northwest ank of the mountain. This intrusion is quarried at Outremont for road metal and is of particular interest in that it has furnished a number of rare minerals, that most recently discovered being Native Arsenic."

"Associated with these intrusions is a great swarm of dykes, that is to say, more or less steeply inclined or vertical walls of igneous rock, which cut both the essexite, nepheline syenite and the surrounding stratified rocks in all directions. There are also numerous sills or sheets of the same, intercalated between the beds of the stratified rocks."

As an illustration of this fact we refer to plate No. 1, page 61, showing a surface sheet of tinguaite resting on almost horizontal strata of Trenton limestone; also to plate II, page 62, where a small sheet intercalated between the limestone beds can be seen in the middle of the photograph.

"These dykes and sills consist of a complete series of those rarer varieties of dyke rocks which belong to the nepheline syenite-essexite magma, and which are known as bostonite, comptonite, alnoite, tinguaite, etc. They are related genetically to the former intrusives and represent the closing stage of the volcanic action. The dykes may be seen in almost all large exposures of rock in the vicinity of Montreal, as for instance, in Mount Royal Park, the Corporation Quarry at Outremont, (plate X), the Mile End Quarry." (Adams and LeRoy, 1901).

Also in quarries on Delorimier Avenue, Papineau Street, and at Mr. Rheaume's quarry in Maisonneuve.

With the view of showing how numerous these dykes and sheets are in certain places in the district of Montreal and the complicated manner in which they cut one another, some photographs are reproduced.

Plate No. I, already referred to, shows a sheet of tinguaite lying on almost horizontal beds of Trenton limestone. This photograph was taken at Mr. Martineau's quarry on Delorimier Avenue. The thickness of the sheet here is some twenty feet, but it gradually becomes thinner towards the north. It has a very slight dip towards the south, like the strata on which it rests.

Plate No. III is a view of the same quarry; it shows the southeast working face on which work is now being carried on. It would seem as if, at that spot, we were near the place where the sheet changes to a dyke, that is to say, near the fissure by which the molten magma issued to spread out in a sheet as we now see it. On the floor of the quarry one may see, in slight relief, the traces of a dyke cutting the formation.

Plate No. II is a photograph taken in the quarry of the Montreal corporation at Outremont. It shows a series of dykes intersecting one another and illustrates their irregular character. Attention is likewise called to the small sheet, about two inches thick, following the distorted beds of limestone. This photograph also shows the crumpling to which the adjacent strata were subjected when the principal eruptions took place, a small anticlinal being represented in the middle of the photograph.

Plates IV and V were taken in the quarry of the Montreal Water and Power Company at Outremont. They show the various natures of the dykes cutting one another. At that spot the dykes are sometimes distorted and assume curious shapes. Thus Mr. Morrison, the agent of this quarry, picked up a fragment of limestone cut by a small dyke, about half an inch thick, folded into the form of an M.

In contact with these intrusive rocks, the limestone became indurated and sometimes altered to marble. Vertical displacements are often noticed along the fissures through which these dykes have found their way; but they seldom exceed two or three feet. In other places the beds lying between two dykes are practically overturned, so that they are now in an almost

PLATE V.

SERIES OF IGNEOUS DYKES CUTTING LIMESTONE.
Montreal Water & Power Quarry, Outremont.

PLATE VI.

STEAM SHOVEL IN MONTREAL W. AND P. QUARRY, OUTREMONT.

vertical position. All these deformations are visible in the Outremont quarries.

PLEISTOCENE.

In conclusion of this short descriptive list of the geological formations on the Island of Montreal, we will quote Dr. Adams' notes on the superficial deposits :—

"Between the Devonian and the Pleistocene, a great gap exists here in the geological record, the upper part of the Palaeozoic and the whole of the Mesozoic and Tertiary being unrepresented.

During Pleistocene time, however, it is known that an Arctic climate prevailed and that the area was covered by the great ice sheet known as the Laurentian glacier, which gave rise to certain deposits characteristic of glacial action. These drift deposits consist of clays ("hard-pan") composed of glaciated boulders embedded in a fine clay or rock flour. This is very compact and resists erosion as readily as many of the old stratified rocks. The upper members of the drift, which are stratified clays, sands and gravels, were formed during a post-glacial submergence, which followed the retreat of the ice-sheet. In the vicinity of Montreal they are known as Leda clay and Saxicava sands and gravels. From the abundant fossil remains (shells) in these marine deposits, it is inferred that the climate was sub-arctic, as closely related species (in many cases identical) are now found living off the coast of Labrador.

"As the land slowly rose again, the sea retreated, and marked by a terrace each level at which it remained stationary for a time. In this way the series of terraces encircling Mount Royal mark the successive stages of emergence from the Pleistocene sea. These terraces are well developed at Montreal between the mountain and harbour, the most prominent ones being those on which Sherbrooke street and St. Catherine street are located, and which form striking features in the landscape along the banks of the St. Lawrence, both to the north and south of the city."

THE MONTREAL QUARRIES.

The abundance of stratified limestones, sometimes associated with the harder trap rocks on the island of Montreal, has led to the opening of numerous quarries from which every year a large quantity of stone is extracted, used in building, in paving and macadamizing roads and in making concrete so largely used today in construction work.

It is difficult to give an accurate idea of all the quarries now in operation, for although many are operated on a large scale by the owners of the land themselves, others are operated only by small contractors who work alone or employ a man or two. They rent small areas and pay a royalty to the owner. Thus, on areas where there is barely room for a well equipped quarry, one will see some ten individual operators, each working on a surface of a few hundred square feet.

QUARRY OF THE MONTREAL WATER & POWER CO.

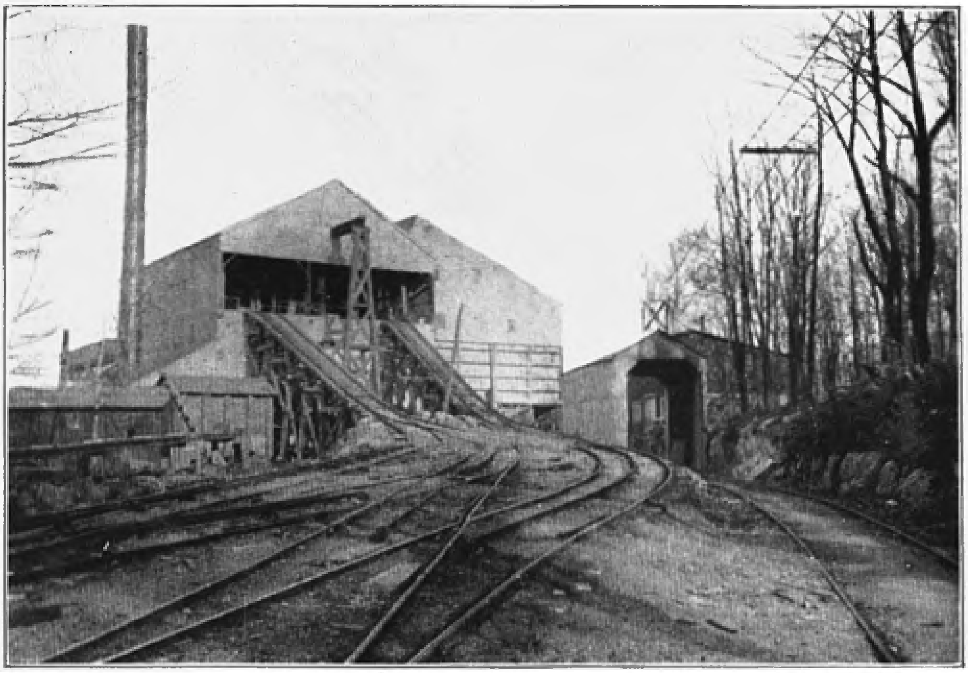
Laurin & Leitch, contractors and operators.

T. A. Morrison, 204 St. James street, Montreal, agent for the sale of products.

This quarry is one of the best equipped in the district. It is situated at Outremont, on the northern slope of Mount Royal. The excavation being made there will serve as a reservoir for the Montreal Water & Power Co. This will be 1,000 feet long by 800 feet wide and with a minimum depth of 40 feet.

The stone quarried is a Trenton limestone, which has been considerably altered in consequence of its vicinity to Mount Royal. As a rule the beds, which are of varying thicknesses, dip slightly towards the north, but sometimes they have been folded through lateral pressure and in some places small anticlinals are visible. Besides the principal mass of igneous rocks, against which the limestone abuts on the mountain, towards the south, these strata are cut in every direction by numerous dykes and sheets varying in thickness from fractions of an inch to 4 or 5 feet. The variety of rocks constituting these dykes is of various colours, sometimes light and sometimes darker. They are probably Comptonites and Bostonites. This stone is not separated from the limestone in the course of quarrying operations; everything is sent to the crusher without distinction, which is an advantage to the consumer, because this stone is tougher than the

PLATE VII.



STONE CRUSHERS (Laurin & Leitch), OUTREMONT.

PLATE VIII.

GENERAL VIEW OF MONTREAL WATER & POWER CO.'S QUARRY, OUTREMONT.

limestone. The strike of these dykes is remarkably irregular; it would seem that the fluid mass has followed the lines of least resistance in making its way through the limestone strata. On the surface they are of a reddish colour owing to the decomposition of ferriferous minerals.

The plant of this quarry is one of the most complete and it is evident that an effort has been made to use every machine which can replace hand-labour, always so costly and at times difficult to control. Traction and drilling are carried on by electric power with the most modern machinery, while the crushers are directly driven by the same engine which runs the generating dynamos. The plant consists of: two boilers from the Erie City Iron Works of 500 horse-power capacity, driving a Belliss & Morgan, Ltd., 750 horse-power engine with an automatic oiler; this engine drives two dynamos: one of 250 volts and 405 amperes from the Allis, halmers, Bullock Co., for the drills, and another of 600 volts and 500 amperes, supplying the current for the electric car system. At the time of our visit, eight machine drills were working, each having a capacity of from 60 to 80 feet per 8-hour day. Each of these drills, from the Temple-Ingersoll Electric Air Drill Company, is driven by a small electric motor receiving the current from the power-house. The stone blasted with dynamite is loaded on electric cars by means of two steam-shovels of great capacity (See Plate VI) and carried to a rotary crusher with a capacity of 2,400 tons per 8-hour day. The electric cars used for conveying stone to the mill are run up to the level of the crusher on an inclined viaduct by means of a steel cable (Plate VII). After undergoing a first crushing, the stone passes through a large screen, whence the oversize is distributed to four other smaller crushers and thence by a series of screens it is classified and sent on to the bins in the city. The city electric cars run under each of these bins, where they are loaded. Plate VIII gives a general view of the quarry, which gives employment to 50 men, each earning an average of $720.00 per annum.

MARTINEAU QUARRY.

Messrs. O. Martineau & Fils, proprietors.

These quarries, known as the Morrison Quarries, are situated on Papineau and Delorimier streets. The first, on Papineau street, is in the horizontal Trenton strata, the beds of which vary in thickness from a few inches to over two feet, as may be seen by the photograph (Plate IX). This quarry supplies a good quality of building stone which is dressed in a shed at the quarry itself, employing some 20 men. The remainder of the rock is sent to the crusher, which is also on the premises. The stone is conveyed to the various works in carts, on which it is loaded by means of steam cranes (Plate IX). The plant, in the quarry, apart from the dressing shed, comprises, according to the report on the Mining and Metallurgical Industries of Canada, of the Department of Mines, Ottawa:

A jaw-crusher.

An electric motor of 50 horse-power.

Two compressed air drills.

An air compressor.

A pump.

The second quarry, on Delorimier Avenue, is also in Trenton limestone, but here the latter is overlain by a sheet of tinguaite (Banc Rouge), some 20 feet thick, thinning out towards the north. These two kinds of rock are quarried and sent to the crusher separately. The Banc Rouge is a medium-grained rock, very tough and possessing the best qualities for road metal An analysis made in the laboratory of Mr. Milton L. Hersey, of Montreal, gave the following results:

Silica	46.30%
Alumina and oxyde of iron	28.20%
Lime	3.20%
Magnesia	0.63%
Loss by fire	5.64%
Alkalis (by difference)	16.03%

In his report, Mr. Hersey states that "this rock is very hard and we know of none beter for making concrete."

PLATE IX.

Martineau & Fils' Quarry, Upper Delorimier Avenue.

PLATE X.

NEPHELINE SYENITE, IN CONTACT WITH LIMESTONE
City of Montreal Quarry, Outremont.

Physical tests have also been made of the Banc Rouge stone from this quarry in the laboratories of McGill University by Mr. E. Brown, assistant professor. The results speak for themselves and are highly satisfactory. We give them for purposes of comparison:

"The tests made of the cubes also showed that this rock is very hard and of a strong nature. Four tests gave the following results:

Dimensions in inches.	Weight per cubic foot.	Split at lbs.	Max. load lbs.	Ultimate strength per square inch.
2.15 x 2.15 x 1.83...	158.1..	86.000..	123,000...	26,700
2.04 x 2.19 x 1.97...	157.5..	89,600..	128,600...	28,820
1.93 x 1.96 x 1.89...	158.1..	46,000..	85,500...	22,650
2.06 x 2.16 x 1.97...	157.5..	66,000..	115,200...	25,920
Average....................				26,050 lbs.

These results are uniformly good and show that this rock possesses a remarkable resistance to compression. The comparison of these figures with those of tables giving the strength of the natural rocks, shows that several granites have a much lower crushing strength, and this "Banc Rouge" stone almost reaches the figures of the best granite. Fire test at 2,250 degrees Fahr." (E. Brown, 1907).

MAISONNEUVE QUARRY.

Mr. Jos. Rhéaume, proprietor.

This quarry is on Desjardins street in Maisonneuve (Côte Visitation) and covers an area of about 6 acres. The stone quarried is limestone and Banc Rouge, a sheet of which, about 20 feet thick, covers the former over the whole area. Broken stone and building stone are extracted, the latter chiefly in winter. This quarry also offers a fine example of the use of machinery in the handling of the products. The stone is brought to the crushers or dressing sheds on self-dumping cars driven by electricity. The capacity of the mill is 1500 tons per day. The plant comprises:

Three crushers (Nos. 7½, 5 and 4).

An electric motor of 125 horse-power for the large crusher (7½).

An electric motor of 50 horse-power for crusher No. 5.

An electric motor of 50 horse-power for the cranes and traction system.

An electric motor of 25 horse-power for crusher No. 4.

An electric motor of 30 horse-power for the pumps.

An electric motor of 8 horse-power for the sorting room.

An electric motor of ¼ horse-power for the forge fires.

Electricity is supplied by the Dominion Light, Heat and Power Company.

The delivery of the stone to the various parts of the city where it is to be used, is effected by the electric cars of the Montreal Street Railway, whose track runs under the hoppers, enabling the loading to be done automatically.

Last summer a bore-hole was drilled in the quarry to a depth of 450 feet by means of a cable drill. At that depth a bed of fissured sand was found yielding large quantities of water. The level rose and maintains itself at 17 feet from the surface. Throughout that depth, Mr. Rhéaume reports, the drill went through limestone which seemed to improve as the depth increased. The first 70 feet passed through layers from which good building stone could be obtained. Some 75 men are employed yearly in that quarry and earn $900 on an average. Most of the stone is used in Montreal. It is practically impossible to fix a price per ton, because it is supplied under special contracts for extensive building operations and the price varies according to the quantity of stone required for a contract.

HOCHELAGA QUARRY.

W. J. *Poupore & Co., Ltd.*, proprietors. Capital, $150,000. G. C. Poupore, manager.

This quarry is situated on the corner of Nicolet and Forsyth streets. The stone quarried is limestone and Banc Rouge stone; the latter covers the former over the whole quarry and is about 6 feet thick towards the south, thinning out towards the north.

The plant comprises a boiler driving a 75 horse-power engine which works the cranes, the pumps and a crusher with a capacity of 150 tons per day.

Four classes of products are turned out, called : Screenings, ¾ inch, gravel and 2 inch, the price varying between $1.25 and 85 cents per ton.

Some 20 men are employed while the quarry is in operation, but it is closed during the greater part of the winter.

The limestone is dark in colour and this quarry is generally known under the name of "Banc Noir".

Mr. Olivier Limoges, 477 Papineau Avenue.

This gentleman is the owner of an important quarry on the corner of Laurier and Dufferin streets. In 1911, 22 men were employed in quarrying, and chiefly building stone with a little broken stone were got out. This quarry covers an area of 27 acres and has steam drills, cranes and pumps. Besides this quarry, Mr. Limoges owns several lime kilns on Papineau Avenue, where 35 men are employed. The building stone is worth 72 cents a ton on an average; the broken stone sells for $1.00 and the lime for 40 cents per 100 lbs.

Delorimier Quarry Company, 1952 Iberville street. Mr. H. Lalonde, Manager.

This quarry is on the corner of Dandurand and Iberville streets in Delorimier ward. Some 10 men are employed, earning average wages of $562.50 per annum. This quarry is also on the Trenton limestone and building stone and broken stone are taken from it. As the beds of rock are more or less black, the stone is usually called Banc Noir. This name is also given to it in several other places.

During the year a mechanical crusher was set up on this property. The building stone is worth about 45 cents a ton and the broken stone generally sells for 90 cents.

Mr. Joseph Gravel, 482 Duluth Avenue East.

Limestone quarry at the corner of Normanville and Fleurimont streets.

Forty men on an average are employed and the products are building stone and broken stone. These men earn about $800 a year each. The building stone sells for from 40 to 50 cents a ton at the quarry and the broken stone for $1.20. The plant includes a boiler, an engine, cranes, mechanical drills and a crusher with a capacity of 125 tons per day.

Rogers & Quirk, Neville street.

In 1911 only broken stone of the banc noir variety was got out and it sold for a little over $1.00 per ton. Twenty men were employed and earned average wages of $375.00 per annum. The plant, according to the report of the Ottawa Department of Mines, comprises: two boilers, a pump, three mechanical drills, two cranes, carts, etc.

Stinson-Reeb Builders' Supply Co.

This quarry is on Laurier and Rockland Avenues in Outremont and the limestone taken from it is put on the market in the shape of broken stone. It sells for about 80 cents a ton. Twenty-five men are employed in this quarry.

Villeraie Quarry Company, 848 Rosaire street, Montreal, P.Q.
John P. Dixon, Manager.

This company does not work quarries, but it buys the stone extracted by small operators from the land of Messrs. Hughes and Jarry. Among these operators are Messrs. Jos. Lapierre, Charbonneau, Plouffe, Crevier, Foncault, Jos. Morin, Cyr, M. Quesnel and T. Peasant. Each of them rents a small area which he works, getting out building stone and curb-stones. They generally have a crane for hoisting the stone out of the quarry and the stone is hammer-dressed on the spot. The debris and the small stone belong to the surface owner, who sells them as such.

About 3,000 tons of building stone were got out in 1911.

Mr. O. Lapierre, 330 de Carrières street, Montreal.

About 17 men are employed in quarrying and in the dressing shed. Building stone is the chief product. The quarry, an acre in area, is in Côte St. Michel, St. Denis ward. The stone extracted is limestone. The plant comprises a steam crane, three horse-derricks and three hand derricks, an air compressor and two mechanical drills. The price of the stone varies between 45 cents and $1.50 per cubic foot according to the size of the blocks required.

Mr. M. Courtemanche, 2373 Labelle street.

This gentleman works alone and quarries limestone. He gets out about 100 cubic yards, worth $300, yearly.

Sovereign Lime Works, Delorimier street.

This quarry is on Delorimier street, where it is intersected by the line of the Canadian Pacific Railway. Limestone is got out for making lime. Twenty-five men are employed, earning $830 in wages on an average per annum. The lime sells for $7.50 a ton on an average.

C. A. Gervais, 1460 Cadieux street.

This quarry is situated at the above address. Limestone is got out for making lime. About 25 men are employed. The lime sells for $8.00 a ton on an average.

Dominion Quarry Co., Ltd.

Twelve men are employed in this quarry, which is situated on upper Delorimier Avenue. Banc Rouge stone is quarried and sold as broken stone, the price obtained being about $1.25 a ton.

There are several other small quarries whose owners did not report to the Bureau of Mines and which could not be visited through lack of sufficient time. Several of the other quarries also were not visited. The information given has been taken from the official reports sent to us and supplemented from the report of the Ottawa Mines Branch, for 1908.

As may be observed by the above account, though incomplete, the greater portion of the stone quarried on the island of Montreal is used in the shape of broken stone. This tends to show the great development which is being assumed by the use of concrete and the macadamizing of roads, for most of the broken stone in Montreal is used for those two purposes.

The future of quarrying in the province generally and in the district of Montreal especially, seems a bright one from every point of view. The development of concrete construction and the macadamizing of roads, owing to the many "good roads" projects which are being carried out, will offer an almost inexhaustible market to the producer. On the other hand, we think that limestone is likely to play an important rôle some day in our industries as the latter develop. Its qualities as building stone and for making lime are well known, but in time it may be put to many other uses.

Take acetate of lime for instance. This is a by-product obtained in making charcoal, but the use of pure lime is needed for the purpose. As the charcoal industry, owing to the lack of coal in our province, seems destined to develop, certain deposits of fairly pure limestone might then be simultaneously developed. Limestone is also an important factor in the making of sulphate of ammonium, beet-root sugar, calcium carbide, carbonic acid, etc. We would also mention the use of powdered limestone for the improvement of certain soils. This product might, we think, be obtained at a very low price, as the dust and too small pieces arising from the crushing in certain mills are piled up in great heaps, which are not now put to any use.

Before concluding, we would observe that the figures given in our statistics for the stone produced, do not represent all the stone used for various purposes. Thus, at Westmount, the West Crescent Heights Company, which is making considerable improvements on certain grounds, has cut and extracted 52,508 cubic yards during the past 15 months in the course of levelling roads and excavating drains, and the whole of this stone has been used in macadamizing the roads. These figures were given us by Mr. Hector Cadieux, the engineer in charge of the work. There is no doubt that several other works of the same kind will be carried on and the stone used on the spot. Thus the Government, in macadamizing the road called the Edward VII Boulevard, has used boulders from the fields, which were hauled by the surface owners and broken on the spot where they were to be used.

PRELIMINARY REPORT ON SOME IRON DEPOSITS ON THE NORTH SHORE OF THE RIVER AND GULF OF ST. LAWRENCE.*

(By Prof. E. Dulieux).

I.—*Introduction.*

The explorations which form the subject matter of this report are a part of a more extensive programme of work which will cover all the iron deposits of the Province of Quebec at present known. The general results of these studies, which will be an inventory of the Province's resources as regards iron ores, will be given in a detailed report which will appear later.

I will not endeavour in this preliminary report to give the deposits now occupying our attention, in logical sequence; I will merely describe them in the order in which I visited them. I will, further, leave aside the bibliography of titanic and magnetic iron ores, as well as the metallurgy of these various ores, which will be set forth in the final report. Geology and petrography will be restricted to such points as are essential to the description of the deposits.

REGIONS VISITED.

I spent about two and a half months, from the 15th June to the 2nd September, in the field, accompanied by Mr. E. Poitevin, a graduate in Mining Engineering from the Polytechnic School (Laval University) of Montreal. Owing to the wrecking of the steamer "General Wolfe", which we were to take on the 6th July to proceed from Quebec to Seven Islands, our stay on the North Shore of the Gulf of St. Lawrence was shortened and we were not able to begin our work at Seven Islands until about the 16th July .

*Translated from the French by Crawford Lindsay.

The last two weeks of the month of June and the first weeks of July were spent in examining the deposits at St. Urbain, in the county of Charlevoix. We established our headquarters at a place within easy access of the deposits, Mr. Joseph Bouchard's sawmill, on the Renny river. Mr. Bouchard, who knows the country thoroughly, and who is, moreover, the representative of the Quebec Seminary in the seigniory of Beaupré, greatly assisted us in our explorations.

After determining by transit triangulation the relative location of the various deposits that have been worked, we made a list of all the outcrops of titanic iron ore known in the region. At the same time we endeavoured to determine, by readings of the dip needle, the boundaries of the areas of magnetic disturbance corresponding to the mineral masses concealed beneath the clay soil.

On our return to Quebec on the 11th July, we purchased the equipment and provisions needed for our journey on the North Shore. We left Quebec in the morning of the 14th July on the steamer Arranmore, belonging the Holiday Brothers' Company, and reached Seven Islands during the night of the following day.

At Seven Islands we were greatly assisted by Mr. Duclos, in charge of the Revillon Company's post, who obtained the guides and boats necessary for our small expedition and who received us in a most hospitable manner.

On Monday, the 17th July, we started from the village of Seven Islands with two canoes and two guides to go and camp at the mouth of the Rapid river. After examining the rocks and deposits at the Cran de Fer falls, we left on the 21st July for Great Rapid lake. On Sunday, the 24th, we were back at Seven Islands.

We succeeded in chartering a small yacht belonging to Captain Heliodore Vignault on very favorable terms, with the help of Mr. Duclos. The yacht, measuring 35 feet in the keel and drawing 5 feet, had been built for Hon. Louis Philippe Pelletier, and after passing through many hands, had become the property of Monseigneur Blanche of Seven Islands. It was hauled down from the beach for us and made its first trip with us. Besides Captain Vignault, our small crew consisted of a sailor and a cook.

We left Seven Islands on the 28th July for the Moisie river, where we remained until the 3rd August. During the interval we examined the magnetic sands to the east and west of that river and made some borings.

On August 3rd we left the Moisie river for the Chaloupe river, but a head wind compelled us to run into a small harbour near Point St. Charles. From the 4th to the 12th, we remained at the Rivière des Graines and Chaloupe river and skirted the shore from the Manitou river to about four miles west of Sheldrake point. We made lists of the outcrops of titaniferous magnetic iron at Chaloupe river and Round Cape.

On the 13th of August we set sail for the St. John river, but a heavy sea prevented our entering, so we put in at Magpie. A second attempt to enter on the following day was equally unsuccessful and, driven by the wind, we had to seek shelter in Mingan harbour.

As the bad weather continued, I decided to leave our yacht and to walk the 15 miles between Mingan and the St. John river. While Mr. Poitevin camped at Long Point and made some borings in the sandy cliffs between Long Point and St. John, I proceeded in a canoe about 13 miles up the St. John river, where I was told there was a deposit of iron ore; this, on examination, turned out to be nothing but a few pockets of titanic iron ore in the anorthosite.

After continuing to study the magnetic sands of the St. John river with Mr. Poitevin, we returned to our yacht and at 1 a.m. on Friday, the 18th, we left Mingan harbour to return to Seven Islands.

With a fair wind it should have taken only 36 hours to sail the distance of 120 miles between Mingan and Seven Islands, but owing to a long spell of bad weather and with storms and prevailing southwest winds, we did not reach Seven Islands until the night of the 25th. During that time we put in at Thunder river (where I examined a small outcropping of titanic iron) and also in two other harbours of Point St. Charles.

We left our yacht at Seven Islands and between the 28th and 30th August we examined the deposits of the St. Margaret river near Clarke City.

On our return to Seven Islands, on the 1st September, we put our samples in order and on the 2nd we took the steamer Natashquan of the National Navigation Company, which landed us back in Quebec in the evening of the following day.

About 210 samples were brought back from this expedition. Some were analyzed in the Provincial Laboratory, Montreal (Mining Department of the Polytechnic School); from others thin sections were made at McGill University and studied by myself and Mr. A. Mailhot, associate professor of the Polytechnic School, who was then in Paris, where he was working in the Natural History Museum.

Finally 3,000 lbs. of ore from the Cran de Fer falls (Rivière des Rapides), were shipped to Mr. G. W. McKenzie, of the Mines Department, Ottawa, who made concentrating tests of it.

II.—*St. Urbain Deposits.*

(County of Charlevoix).

AREA COVERED BY THIS REPORT.

The village of St. Urbain, from which the deposits derive their name, is situated in the county of Charlevoix, about nine miles north of the village of Baie St. Paul, being about 60 miles below Quebec on the north shore of the River St. Lawrence.

The work done in the months of June and July of the year 1911 covered a strip of ground about 15 miles long lying parallel to the Rivière du Gouffre, chiefly on the right bank. It starts from the village of Baie St. Paul and ends at the unsurveyed lands of the seigniory of Ste. Anne de Beaupré, about three miles from the outlet of Lac des Cygnes. It comprises the Mare à la Truite, the St. Lazare, St. Jérôme and St. Thomas ranges in the parish of Baie St. Paul; the St. Urbain and St. Jérôme ranges and a portion of the St. Thomas, St. George and Cran Blanc ranges, in the parish of St. Urbain. A rather hurried examination was also made of the sandy plateau extending eastward from range IX of St. Urbain in the unsurveyed lands of the Seminary, and of the high mountains rising to the north of the St. Thomas range and above which rises the Lac des Islets mountain.

PHYSICAL FEATURES OF THE COUNTRY.

The Rivière du Gouffre, which drains all the waters of this region, flows in the bottom of a very wide valley, the width of which is far from proportionate to the river's volume of water. Thus, in the vicinity of St. Urbain village, the two chains of hills immediately bordering the valley are separated from one another by a distance never less than two and a half miles. The bottom of the valley contains deep deposits of white sands, to which quite a characteristic relief has ben given by recent phenomena of erosion. Viewed from one of the rocky heights dominating it, the valley appears to have a rolling rather than a level surface, owing to a series of sandy mounds or rounded dunes. Although streams are not infrequently met with in the depressions between the mounds, it is evident that their origin must be sought for in the depressions occurring between these hillocks, and in the drifting and slight cohesion of these sands which slip and shift with exceeding facility. Through such sands the Rivière du Gouffre forces its way, a very winding and uncertain one since, in the course of a few years, its deviations have caused very appreciable changes in the area of riparian properties. In many places the river has eroded its bed down to bed-rock and forms small rapids. Nowhere are the rocky barriers which it meets of sufficient size to form real falls, but the water often drops very rapidly, especially two or three miles above St. Urbain village. For water-power to establish a factory or works, the waters would have to be kept back by artificial means, which might not perhaps present great difficulties, by utilizing a narrowing of the valley three miles above St. Urbain village.

Below the village the sides of the valley rise in fairly gentle slopes to about mid-way to the summit, where the sands end and the anorthosites appear.

These anorthosites lead, on the right side of the valley, to a wide undulating plateau,, the altitude of which above the sea varies between 1100 and 1200 feet. On this plateau, or more properly speaking, on its southeast border, lie the great deposits of titanic iron which constitute the subject of this study. The central part of this plateau, and the low parts generally, are covered with clay; in some points borings showed a depth of 12 feet. The clay covering interferes with prospecting and no doubt conceals iron deposits. Nevertheless, the nature of the underlying rocks can be ascertained from various outcroppings.

This plateau rises imperceptibly towards the west and ends at the foot of rather large mountains, the altitude of which seems to exceed 3,000 feet. Thus, by means of the barometer, we found the height of one of these mountains which we ascended, to be 2,300 feet above Baie St. Paul, and, in front of us, the mountain known in this part of the country as the Lac de l'Islet mountain, rose more than 1,000 feet higher.

GEOLOGY.

The geology of the region under consideration may be divided into three parts:

The anorthosites and their granular and gneissic varieties;

The Ordovician sediments (Trenton limestone);

The glacial and post-glacial deposits.

To explain the nature of these deposits, it will be sufficient to briefly describe the anorthosites and to say a few words about the glacial and post-glacial deposits.

In fact, the Trenton limestones are of but secondary interest to us: they are found in outcrops in the shape of isolated outliers in various places along the valley of the Rivière du Gouffre from its mouth to St. Urbain village.

The anorthosites in the St. Urbain plateau may be classified into two chief varieties:

The compact anorthosites;

The granular and gneissic anorthosites.

COMPACT ANORTHOSITES.

These are rocks generally of a light color, with medium grain and of fairly high crushing strength. In hand specimen they seem to consist almost entirely of feldspar, sometimes light grey, sometimes white, at times pinkish and at others red or blue. Dark coloured constituents are rare; some specimens contain none. Thus, behind the boiler-house of the former Canadian

Titanic Iron Company, is a grey, almost white, anorthosite, which might very easily be taken for marble by a casual observer.

Most of these light-coloured anorthosites change to white on the surface. Some or them would supply very fine material for building or decorative purposes. I would especially mention the anorthosite on the east side of the St. Urbain plateau, on lot 482 of St. Lazare range, of the parish of Baie St. Paul. There is at that place a high, perpendicular rocky cliff, and the pieces that have fallen from it form a talus at the base. The colours of the anorthosite are very pretty; sometimes pink feldspar predominates in a light yellow ground: sometimes the same feldspars are mixed with blueish grey ones. It would certainly take a very fine polish and its working would be facilitated by the precipitous side of the mountain. An aerial tramway three-quarters of a mile long could take the material down to the level of the Rivière du Gouffre, where a branch railway of about 6 miles would convey it to Baie St. Paul. The most frequent among the rare dark constituents visible to the naked eye are ilmenite and black mica.

As a rule the grains of feldspar are of fairly even size, but large individual grains of grey feldspar are rather frequently met with amidst grains of yellow or reddish feldspars. Such is the case especially as regards the anorthosites north of the mill of the Discharge, on the road leading to the Seminary mine.

The feldspars are not generally oriented in any special direction; nevertheless, on lot 485 and lot 480 of St. Lazare, a general elongation of individuals is very clearly seen. This direction is emphasized by some threads of black constituents, titanic iron or black mica. These anorthosites are but a short distance from the gneissic anorthosite we speak of further on; probably the strain which gave rise to the formation of the gneissic structure in the neighboring rocks made itself felt also, but to a lesser degree, in these compact anorthosites.

As seen through the microscope, these true anorthosites consist of lime-soda feldspars, sometimes perfectly sound, but frequently cracked. The fissures are then filled with greenish or yellowish elements of alteration in the nature of bastite.

Near certain deposits of titanic iron the cracks in the feldspars are filled with a mosaic of very small fragments of broken feldspar indicating a beginning of granulation of the constituents.

As accessory constituents one finds titanic iron, white mica, black mica (especially in the vicinity of deposits of titanic iron), but all in very small quantities.

The feldspars very seldom show the small black thread-like inclusions so frequent in the anorthosites.

GRANULAR OR GNEISSIC ANORTHOSITES.

I have included under this head a series of rocks with rather variable characteristics, but the mass whereof is made up mostly of lime-soda feldspars. They seem to be derived from the true anorthosites by dynamic metamorphism. These rocks are generally yellowish, sometimes grey in colour; they are friable and break along irregular and granulous surfaces. To the naked eye and even to the magnifying glass, the feldspars show but imperfect cleavages; the surfaces of the breaks are often curved.

Some varieties contain dark elements which are most frequently in line. The rock then assumes a gneissic aspect, which is especially apparent on the large bare outcrops which have been weathered.

The most abundant black constituent seems to be a titaniferous magnetite. To the presence of this magnetite must be attributed, beyond a doubt, the local variations shown by the dip needle. It rather frequently happens in fact that the needle dips to fairly wide angles, attaining as much as 25 or 30 degrees without any ore outcrop being visible.

If we take into account the fact that the masses of titaniferous iron now known, exert but a comparatively weak influence on the needle in proportion to their dimensions, it would be unreasonable to conclude that the magnetic variations in the neighbourhood of the gneissic anorthosites are due to the existence of deep masses of slightly magnetic titanic iron, rather than to the direct influence of the small quantities of magnetite disseminated through the rock.

In fact such grains of titaniferous magnetite disseminated through the gneissic anorthosites exercise an influence on the compass wholly comparable to that of masses of titanic iron. Each of these grains is in effect much more magnetic than a grain of titanic iron. This can easily be ascertained in the field. By crushing a gneissic anorthosite, the dark constitutents are attracted in abundance by the magnet. On the contrary, by crushing a compact anorthosite adjoining a mass of titanic iron, which itself contains small grains of iron ore, only a very slight portion of the ferruginous elements are picked up by the magnet. These results are confirmed by chemical analysis. After crushing three samples: one from the solid mass of the Lac des Islets mountain, another from the mountain dominating the Renny river in the direction of the Bouchard mill (gneissic anorthosite), and the third from lot 621 of the St. Jérôme range (anorthosite in contact with a mass of titanic iron), I had an analysis made of the iron grains contained in the rock and hand-picked. I obtained the following results:

	Iron	Titanium	Prop. Fe Ti
Iron ore from the gneissic anorthosite of Lac des Islets mountain................	64.06%	4.61%	13.93
Iron ore from the gneissic anorthosite at Bouchard's mill	57.16%	4.03%	14.27
Iron ore from the anorthosite on lot 622...............	32.71%	20.74%	1.05

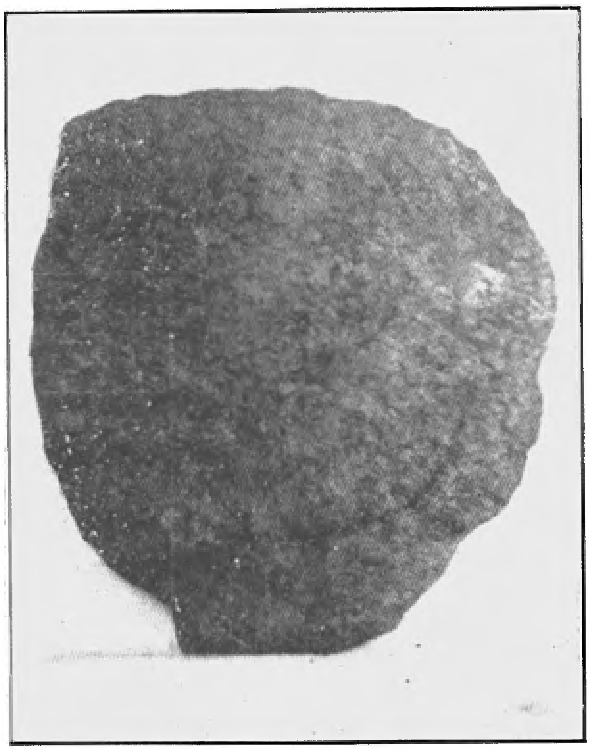
It would seem, therefore, that the iron ore accompanying the granular and gneissic anorthosites is titaniferous magnetite, while the compact anorthosites contain practically ilmenite only.

It should be further observed that hitherto all the deposits of titanic iron of any importance are in compact anorthosite. In the immediate vicinity of the mass, the anorthosite often contains grains of titanic iron, but, a few feet from the contact, the grains of titanic iron visible to the naked eye disappear almost completely and ilmenite is only an accessory element in the rock.

On the contrary, the granular and gneissic anorthosites which are rather uniformly charged with ferruginous elements, over a small area, contain no mass of ore of any importance in the region under consideration.

A particularly interesting region, as regards the study of gneissic anorthosites with ferruginous elements, is that of the Lac à l'Islet mountain, about two miles to the northwest of the

PLATE XI.



FERRUGINOUS GNEISSIC ANORTHOSITE.

St. Thomas range of St. Urbain parish in the unsurveyed lands of the seigniory of Beaupré. There the ferruginous elements show very clearly on the altered surfaces and form a more or less continuous network of black threads surrounding the grains of feldspar (See photograph No. XI). Throughout the whole, these threads extend in a direction from north to south, which is remarkably constant over the whole length (about 1½ mile), where I was able to observe it.

Without doubt it is to the disaggregation of these gneissic anorthosites that the iron sands are due, which are met with on the eastern slope of the St. Urbain plateau. The process of the mechanical concentration of these sands into magnetite can, moreover, be actually observed. In all the ruts in the roads of the St. Urbain plateau, especially after heavy rains, black streaks of fine magnetic sand may be seen. The same occurs in the hollows and furrows of the rocks of the intrusion at Lac de l'Islet. And even when no black train is seen, the mere running of the magnet through the sands filling the cavities, suffices to bring out magnetite.

The accessory constituents visible to the naked eye in these granular and gneissic anorthosites are hornblende, hypersthene and mica.

Under the microscope all these rocks reveal a common character, showing the effects of the pressure to which they have been subjected. The feldspars as a rule have no crystallographic outline; individuals penetrate one another by curved and irregular lines. Frequently the polysynthetic twinning is effaced as it were; at other times the bands are curved parallelly. The feldspar individuals are fissured and the cracks are filled with a green or yellow substance of the nature of serpentine (bastite).

Some of these rocks are particularly friable; they are those of the most pronounced yellow colour. This friability, and the colour also, are due to a more or less continuous pellicular network of bastite surrounding each grain of feldspar.

The ferro-magnesian constituents are particularly more abundant than in the compact anorthosites. The most abundant are hyperthene, frequently interlocked with titano-magnetite; hornblende; a little olivine generally altered to hydrated ferruginous products. Apatite is sometimes very abundant in broad oval grains; generally a little quartz and zircon are present.

Some rocks contain enough hyperstene to allow of their grading into real anorthosite-gabbros.

Gneissic anorthosites containing large feldspar crystals are not infrequently met with, especially in the mass of Lac de l'Islet mountain. These crystals have resisted compression and flattening, while, on the contrary, the small crystals around them have been crushed. This structure recalls that of ellipsoidal gneisses, the "augen-gneisses" of the German geologists. These two varieties of anorthosite—compact and granular or gneissic—owe their origin beyond a doubt to the consolidation of one and the same magma. They pass imperceptibly from one to another, and the granular and gneissic varieties must be considered as being merely anorthosites which, towards the end of their consolidation, have been flattened and crushed. The gneissic structure, the friability, the granular aspect of these rocks, are but the evidence of dynamo-metamorphic action.

POST-GLACIAL DEPOSITS.

These appear under various aspects :

1. The silicious sands at the bottom of the valley of the Gouffre ;
2. The feldspathic and ferruginous sands on the sides of the valley ;
3. The clays of the St. Urbain plateau.

The silicious sands covering the bottom of the valley of the Gouffre form a sort of undulating and hummocky mantle of characteristic aspect. The action of the raging waters has ploughed furrows at times very deep, but without any definite trend in these sands. Several furrows, intersecting one another, bound a sort of sandy plateau which, owing to its permeability and lack of consistency, falls away at its corners and gives rise to a kind of dunes.

These fine sands are due to local changes in the estuary deposits of the Champlain epoch.

The sides of the valley, to a height half way between the bottom and the top, are sometimes covered with coarser, yellowish or reddish sands, consisting almost solely of feldspars and sometimes greatly charged with grains of magnetic iron. These deposits are especially important at the foot of the cliffs of granular anorthosite and their origin must be sought for in the erosion of these friable rocks at a comparatively recent date, perhaps through wave action at a period when the waters of the sea covered the whole valley of the Gouffre.

The St. Urbain plateau is almost entirely covered by a layer of clay, changing in depth into a kind of shale. The thickness varies between a fraction of a foot and twelve feet.

DEPOSITS OF TITANIC IRON.

The deposits of titanic iron formerly or at present worked, are all on the eastern side of the St. Urbain plateau in the compact anorthosites. As a rule they are in masses of irregular shape and without any definite direction. In some small deposits the titanic iron stretches out in flattened lenses which look like veins for a short distance, but which thin out and disappear. In the large deposits the length and width of the masses are more even.

In the following description, the deposits are given in the order in which they are met with, going from south to north on the road of the St. Jérôme range in the parish of St. Urbain.

Glen Prospects—

At the time of my visit, a small party of men were trenching under the direction of Mr. Glen, of Montreal, on lot 31 of the St. Urbain range of St. Urbain parish, about 2,000 feet to the east of the sketch map. The work followed the bed of a stream and consisted chiefly of trenches in the clay. Two trenches intersecting at right angles had uncovered a fine mass of brilliant and compact titanic iron. This mass showed a width of 35 feet from north to south and 30 feet from east to west. In the north and east it abutted on anorthosite; to the south and west it disappeared under sand and clay.

A hole sunk 70 feet to the west of these trenches struck anorthosite. The prospects were abandoned probably on account of the great depth of sand and clay covering the rock and ore. At some points the trenches went down eight feet before reaching the rock. Working an ore which would sell at a rather low price would have been but little remunerative under such conditions, especially if these conditions of the deposit be compared with

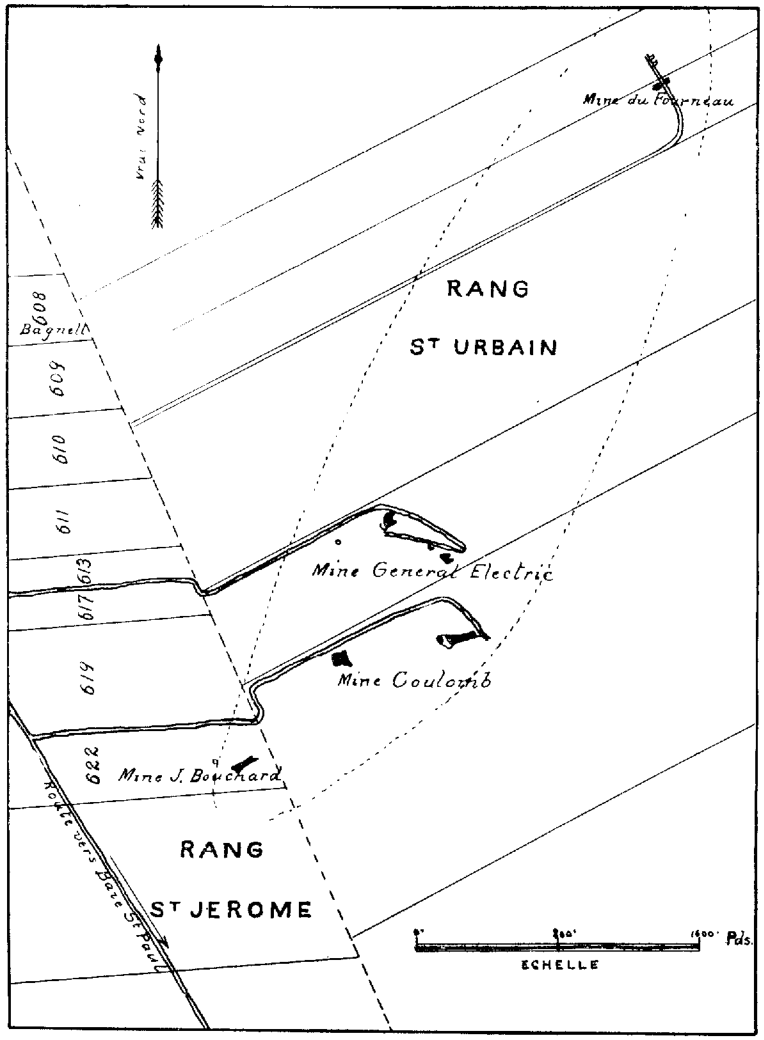


Fig. 1.—Map of St. Urbain deposits, showing their general direction northeast-southwest.

those of the Coulomb or General Electric mines, where the depth of the overlying soil does not exceed four feet and is frequently only half a foot or one foot.

An analysis of this ore was made at the Provincial Laboratory (Polytechnic School) Montreal, with the following results:

Si O_2	1.68
Fe O	55.36
Ti O_2	38.29
S.	0.041
Ph.	traces
Corresponding to metallic iron	43.06
" titanium	23.00

Joseph Bouchard's Mine—

This mine is on lot 622 of the St. Jérôme range of St. Urbain parish, east of the road of the St. Jérôme range. The first work was done in the spring of 1910 and was begun on a small vein a few inches thick. The vein widened in depth and during the year about 800 long tons of ore were shipped to the Titanium Alloy Co. of Niagara Falls.

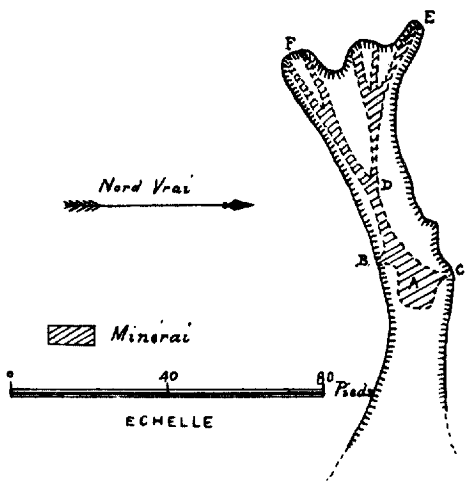


Fig. 2.—Joseph Bouchard's workings, St. Urbain.

The work was abandoned at the time of my visit; the mineralized veins had become very irregular; they dipped in depth and could no longer be conveniently worked open cast; it would have been necessary to install a hoisting plant. The opening of other mines in the vicinity which were more extensive and more easily worked caused the abandonment of this work. It consisted in a cut 15 feet wide on an average and 100 feet long, excavated to a depth of 15 feet in its deepest part.

The annexed sketch clearly shows the mode of formation of the deposit of titanic iron. There are neither veins nor layers, but segregations essentially irregular, in the midst of compact and sound rock. A central core A. of titanic iron about 8 feet in diameter shoots out tongues in two directions: one in B. and C., the other in D. At this point the deposit forks: one branch towards E. and the other towards F. Thus the ore appears in the bottom of the open workings in a series of radiating veins, but in reality very irregular in occurrence.

The rock is an anorthosite of medium grain, generally light gray in color, containing comparatively little titanic iron in isolated grains. At some points on the weathered surface these grains seem to extend in the same direction and to form a sort of broad stippling in parallel lines.

Near the core A. of the ore, the anorthosite is charged with black mica and assumes a slightly gneissic structure. A similar micaceous anorthosite rock is found in abundance in the Coulomb mine.

The ore is compact and very sound. An analysis with a view to the sale of this ore for titanium, gave 36.64% of titanic acid, or 20% of metallic titanium.

The quantity of ore in sight is not considerable and the dip-needle is but slightly affected in its vicinity.

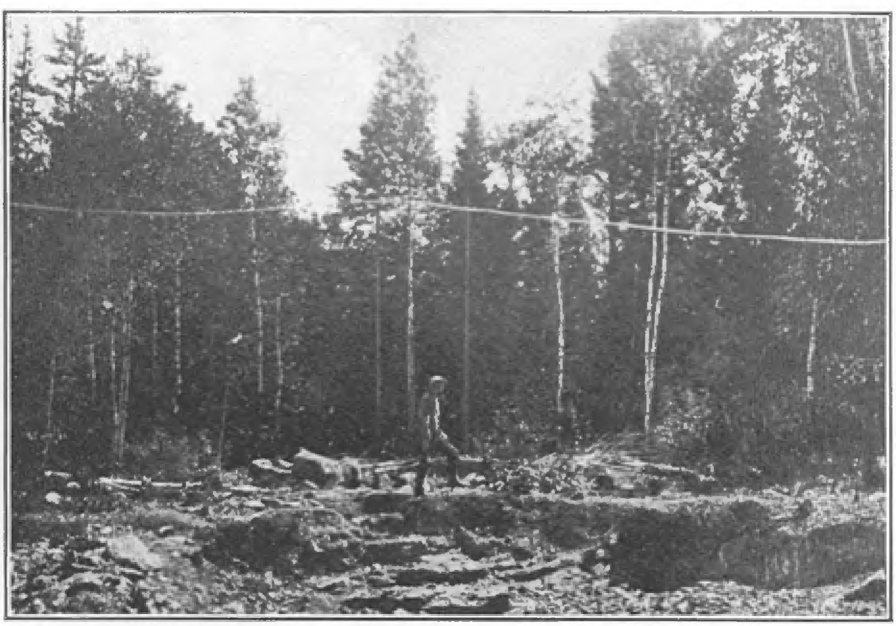
Coulomb Mine—

This mine is at the eastern extremity of the lot marked 319 on the cadastral plan of the St. Urbain range of St. Urbain parish. As a matter of fact, lots 315, 318, 319 and 320 are now in the hands of the same owner, and these lots together constitute what is known as the "Coulomb property". At the time of my visit, it was leased from the Duval estate, which holds the mining rights on a large number of lots in the seigniory, by a local contractor, Mr. Coulomb, who began work in August, 1910.

PLATE XII.

OPEN CUT OF COULOMB'S WORKINGS (Western cut).

PLATE XIII.



WORKINGS OF THE GENERAL ELECTRIC CO., ST. URBAIN.

The work consisted in two open cuts distant about 500 feet from one another and which we will designate as "the western workings" and "eastern workings".

Western Workings—

These are situated about 500 feet to the east of the line between the St. Urbain and St. Jérôme ranges of St. Urbain parish. The clay, which covers the lot uniformly to a depth

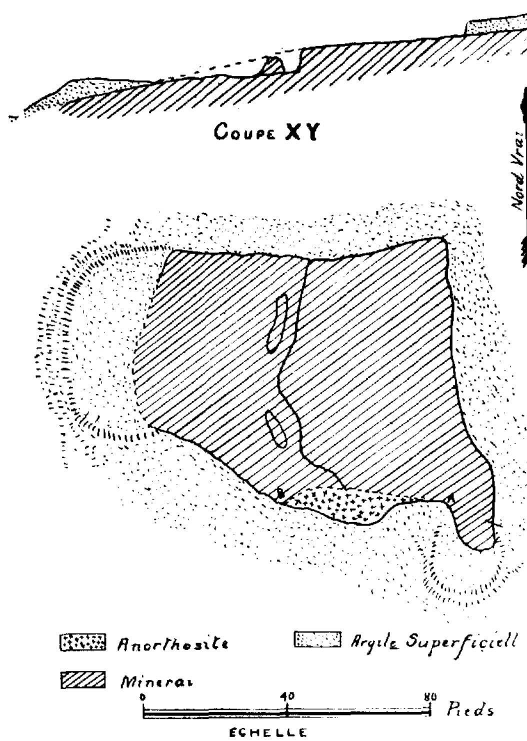


Fig. 3.—Coulomb's workings.—Western open cut

varying between one foot and five feet on an average, has been removed over an area of about 90 by 75 feet. By this means an enormous mass of compact titanic iron has been uncovered, the surface of which shows no barren rock. Towards the south, at A. B., this mineralized mass abuts against an anorthosite, in every respect similar to the anorthosite in the open cut workings of Joseph Bouchard. The rock is compact and sound without any traces of dislocation or enrichment of dark constituents.

The ore is black with a rather greasy lustre. It is rather friable and breaks into a multitude of fragments with small facets pointing in every direction. This friability is chiefly noticeable in the surface samples. It does not seem to be due to the existence of cleavage planes in the ilmenite, but rather to that of surfaces of easy fracture which show themselves especially when the ore has been subjected to the action of secondary alteration. It would seem that the same thing happens in the case of these compact masses of titanic iron as happens for instance in the case of basalts, in which the jointage planes are developed subsequently to cooling. It would then seem that there are in such titanic iron, internal tensions, due either to phenomena of cooling or to phenomena of secondary alterations, which manifested themselves by abrupt and irregular fractures. These phenomena are chiefly apparent in the ore of the mine called the "Seminary Mine," which we will deal with later on. The ore is sometimes very pure, containing but a few yellow grains of sulphides; at other times the pyrite is fairly abundant and shows in thin sheets parallel to one another. Other samples show white and friable spots; these are imbedded feldspars which weathering has altered.

The portion which has not been determined by analysis, comprises magnesia, lime and alkalis derived from feldspars and ferro-magnesian elements imbedded in the mass of titanic iron.

Eastern Workings—

These are situated about 500 feet to the east of the foregoing and consist in an open cut about 160 feet long and averaging 30 feet wide at the bottom. The face of the working widens and attains a breadth of 50 feet with a height of 20 feet. As the ground slopes and the bottom of the trench is level, the height or the working face increases as the work proceeds. Around this open cut, especially to the west, the clay has been removed and the rock uncovered. The annexed sketch shows how the ore and the anorthosite outcropped at the time of my visit. The sections XX, YY, ZZ, convey an idea of the shape of the mineralized mass.

The entrance of the cut probably corresponds to the edge of a mass which widens as it proceeds towards the west. The northern wall or side of this mass is fairly easy to follow; it dips about 80 degrees to the south and its strike is perceptibly to the west.

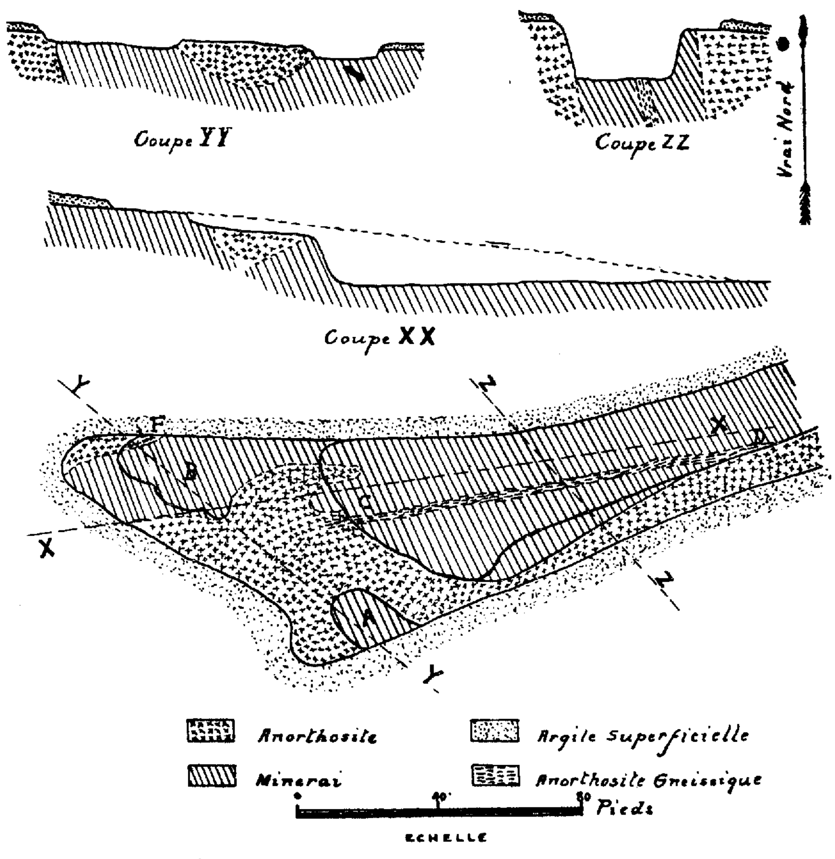


Fig. 4.—Coulomb Mine.—Eastern workings.

The southern wall is more uncertain; it shows at the entrance of the open working, but disappears under the clay towards the west.

Two cuts some 20 feet wide have been made at A. and B., whence fine ore has been extracted. The section YY shows how this ore is covered by a layer of anorthosite.

The anorthosite appears in the shape of a medium-grained rock, grey or whitish grey in color. Under the microscope it seems to be entirely composed of plagioclase feldspars in which bastite crystals or filaments have developed. These crystals are often accompanied by patches of hematite. Grains of titanic iron are very rare. The feldspars are split and contain the usual inclusions.

In the very mass of titanic iron, lenses or veins of a rock appear which has black and white grains, is of gneissic structure and is generally very friable. The white grains are a feldspar with an appearance of porcelain; the black grains are titanic iron or black mica. A vein about two feet wide is visible in the trench and runs throughout its length. (Vein C. D.)

In the anorthosite, black mica is found at some points in contact with the titanic iron. Thus, at E. and F., the anorthosite, otherwise very compact and very hard, shows flakes of black mica, lying parallel to the plane of contact with the titanic iron. This mica disappears very rapidly away from the contact with the titanic iron and, at a distance of a foot, the anorthosite resumes its normal composition.

Borings have been made at various points between the western and eastern workings. Titanic iron has been found under the clay at many spots and it is probable that the two masses of titanic iron of the two workings form part of a single mass which would thus extend over a length of 600 feet.

In both workings the mining is carried on by open cuts. The ore, which is rather friable, is blasted out with small dynamite charges of 40%; it is broken with a sledge and piled behind the working. It is then hauled to the wharf in the village of Baie St. Paul. All the work is done by hand without any hoisting apparatus, so that the cost of mining could be considerably reduced by using derricks, tramways, booms, etc. No sorting is done in the western open workings; in the eastern all that is done is to put to one side the blocks from the feldspathic veins.

The sampling of the ore piled in heaps was done hastily.

From every heap a sample of about 40 pounds was taken for testing; then it was crushed on the spot and reduced by quartering to about two pounds. The analysis made in the Laboratory of the Department (Polytechnic School, Montreal) gave the following results:

	I.	II.	III.
$S.\ O_2$	2.64	3.12	2.68
Fe O	51.54	55.14	52.98
$Ti\ O_2$	41.00	25.46	38.40
Ph.	0.040	0.044	0.041
S.	0.041	0.040	0.040
Not ascertained........	4.729	6.196	5.859
Total............	100.00	100.00	100.00
Metallic Iron..........	40.09	42.89	41.21
Titanium	24.62	21.30	23.06

Column I. represents the ore from the Western workings; Column II. the ore extracted from the small open workings A. and B. (Eastern workings); Column III. the ore taken from the open cut (Eastern workings).

At the time of my visit, 1500 tons had already been taken out and shipped to the Titanium Alloy Co. of Niagara Falls.

General Electric Company's Mine—

This mine is at the eastern extremity of the lot, three arpents wide, corresponding to the lots marked 321 and 325 of the St. Urbain range of St. Urbain parish, on the cadastral plan. At the time of my visit, the mining rights had been leased by the owners, the Duval estate, to the General Electric Company of Schenectady, who had begun somewhat active mining operations in the sumer of 1910. In 1911 these consisted in two open cuts about 150 feet from one another.

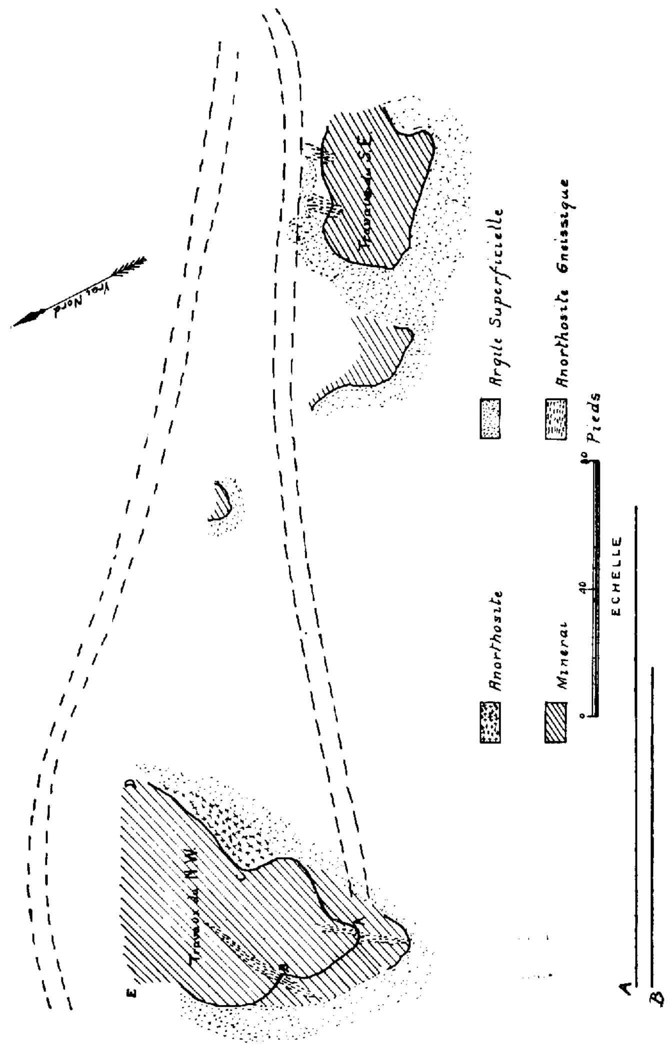


Fig. 5.—General Electric Mine, St. Urbain.

In the northwestern open working the clay had been removed The rock consisted of massive titanic iron, except at the points over a triangular area of three equal sides of about 90 feet each.

A., B. and C. The ore, less friable than that of the Coulomb mine, was also much less charged with sulphides and feldspars. From D. to E., a distance of 85 feet, the titanic iron showed in a single mass without any barren inclusions.

In A. and B. appear two lenses, with a thickness of 1½ and 2½ inches respectively, of a rock of gneissic structure, white and black. The white constituents are a brittle feldspar; the black elements are either titanic iron or black mica.

In C. the mass of titanic iron stops against an anorthosite. In fact, judging from the appearance of the contact surface, it looks as if the mass of titanic iron broadens in depth under the anorthosite. Thus the anorthosite must cover a mass of much greater dimensions than the outcrop indicates.

The transition from the titanic iron to the rock is very abrupt. Museum specimens may be broken off, a portion whereof is massive titanic iron and the other portion is rock without any appreciable quantity of titanic iron. On the other hand, the rock contains many scales of black mica very regularly aligned in planes parallel to the plane of contact. As the distance from the contact increases, the rock, which was rather friable, becomes harder and less charged with mica. Finally, about a dozen inches away, an anorthosite appears with some rare crystals of mica and then the normal anorthosite.

The southern open cut is barely more than 50 feet in its greatest dimension. It is also in a mass of titanic iron with few barren inclusions of a rock composed of feldspar, ilmenite and mica, like that already found in the western open workings.

Between these two open cuts, which are about 160 feet apart, other excavations have been made showing the presence of titanic iron.

Owing to the irregular shape of the masses of titanic iron, it is impossible at present to give the direction in which the mass extends, which has been discovered by the present operators. It is possible that such direction may be southwesterly, if one may judge by that of the lenses of barren rock intercalated in the mass.

A collection of samples similar to those obtained from the Coulomb mine was taken from the ore dump from the northwestern open workings. The analysis of the samples gave the following result:

SiO	1.10
FeO	57.24
TiO_2	41.61
S	traces
Ph	trace
Not determined	0.06
Total	100.00
Metallic iron	44.52
Titanium	24.98

Of all the ores collected, this is the richest in iron or titanium and, at the same time, the purest.

Mining is carried on entirely by hand, as at the Coulomb mine, and the hauling is done by horse carts. The General Electric Company has had a rather large wooden shed erected, which is used as a storehouse and as lodgings for some of the men.

The work was stopped at the time of my visit. It is reported that borings made in August, 1911, by the General Electric Company showed titanic iron at a depth of 100 feet.

Furnace Mine—

This mine is so called because near it are the ruins of the blast furnaces put up by the Canadian Titanic Iron Co. in 1872. Of the extensive buildings erected by that company in 1871 and 1872, but little now remains: six roasting stalls of 12 x 25 x 9 feet; four walls of fine rubble stone which were a part of the boiler-house and also of that which held the blowing machinery; some heaps of bricks and slag showing where the blast furnaces stood.

When the company failed in 1874, the buildings were sold for the materials and all were torn down to get the stone and brick from them: In fact not a trace can now be seen of the furnaces or machinery.

Of the old workings, about 1500 tons of ore remained on the dump of the mine and from this the Titanium Alloy Co. made a test of the St. Urbain ore for the first time. A first shipment of 250 tons was made in 1908 and,, in the autumn of 1909, a second shipment of 1,000 tons was effected.

The mine is not worked at present and, in fact, no work has been done since 1873.

All that can be seen of the workings consist of two open cuts on lots 351 and 362 of the St. Urbain range, St. Urbain parish, about 19 arpents west of the road of the St. Jérôme range. The first one, about 75 feet wide, was cut in a mass of titanic iron. Lenses of anorthosite appear in two places, but they seem only an accident in the mineralized mass, the walls of which cannot be ascertained by mere inspection.

The second open cut, about 120 feet southeast of the foregoing, really consists of two holes half filled by slides of surface deposit. Between these two holes an old haulage road runs across the lot westward to join the road of the St. Jérôme range. In one of these holes the face of the cutting, which has an elliptical outline of about 120 feet, is entirely cut in compact titanic iron. The other hole, which is nearly filled up, also shows titanic iron.

About half way between the two workings are two stalls for roasting, in an excellent state of preservation. The ore taken out was apparently piled six feet thick on these gratings; underneath from 2 to 2½ feet thick of cordwood were placed and set fire to. It is odd that the metallurgists of the old company should have thought that such a roasting, at a necessarily low temperature, could have been of any use for the final treatment of the ore.

There are still other roasting stalls further west, descending towards the Gouffre river.

The blast furnaces were erected on lot 364 of the St. Urbain range, ten arpents below the workings whence the ore was obtained. The ore roasted in the stalls was charged in the blast furnaces with charcoal which was made on the left bank of the Gouffre river along the road running through the first "Cran Blanc" range.

The rock of which the slopes of the mountain consist at that place is a fine-grained anorthosite, sometimes slightly reddish; at others grey and occasionally very white and similar to marble.

Various geologists who visited the deposit have had the ore analyzed and I give the result of two of such analyses:

	Analysis of the Geological Survey of Canada in 1863.	Another analysis of the Geological Survey.
SiO_2	....	1.91
Fe_2O_3	10.42	20.35
FeO	37.06	29.57
TiO_2	48.60	40.00
Al_2O_3	....	4.00
CaO	....	1.00
MgO	3.60	3.17
Total	99.68	100.00
Iron	36.25	37.21
Titanium	29.16	24.00

OTHER OUTCROPS OF TITANIC IRON.

Bagnell Electric Company's Workings—

On lot 608 of the St. Jérôme range of the parish of St. Urbain, between the road and the line between the St. Jérôme and St. Urbain ranges, are a dozen small prospecting pits 3 x 3 feet. These holes, which are now covered with branches and half filled by the caving in of the sides, were dug in the clay. Some reached titanic iron and near these holes are some blocks of fine ore which were taken out of them.

In order to ascertain whether there was any continuity in the mass of titanic iron, I had three excavations made on the adjacent lot No. 609, about a hundred feet to the west of the line, at a point where the variations of the dip-needle were particularly strong. Two of the holes reached the anorthosite at a depth of five and seven feet respectively. The third was abandoned at a depth of eight feet, as nothing was found but sand and clay.

The existence of a thick layer of sand and clay on top of the mineralized mass on the Bagnell lot would make it more expensive to mine than those on the Coulomb and General Electric Company's lots.

Lot 641, St. Thomas range, parish of St. Urbain—

About 1,000 feet to the west of the road of the St. Thomas range, on lot 641, quite near lot 640, in a rather friable anorthosite, a small lenticular mass of rather impure titanic iron is found. The mineralized outcrop is about 6 x 4 feet; the iron contains numerous inclusions of feldspar.

The dip-needle is not perceptibly affected in its vicinity; the lens is of small dimensions.

Gilbert's Workings—

Slight prospecting work has been done on the left bank of the Gouffre river in the Décharge range, on a lot belonging to Mr. Gilbert, about 3 miles above St. Urbain village. A vein (or rather a lens) of titanic iron ore has been discovered there which is six or seven feet wide and is imbedded in a compact grey anorthosite. The extremities of the lens disappear under the clay.

The ore contains some feldspars and ferro-magnesian elements in its mass.

Seminary's outcroppings—

These outcrops are on the land of the seignory of Beaupré, not yet conceded to settlers and still belonging to the Quebec Seminary. They are reached by crossing the Gouffre river over the bridge at Pitre Tremblay's mill, about 14 miles above the parish of St. Urbain; then taking a winding road which intersects the old post-road to Chicoutimi. About 3 miles north northwest of Tremblay's mill, the road, which is swampy or sandy, shows here and there rocky outcrops consisting of very compact anorthosite, sometimes white and like marble, sometimes pink, sometimes grey with coarse elements. Four and a half miles from the mill, on the same road, a lenticular mass of titanic iron appears, which is about five feet long, disappearing on one side beneath a grey anorthosite with large feldspar crystals, and on the other under a thick layer of vegetable soil and moss. No work has been done and it was impossible for us to ascertain the extent of the mass.

A very curious modification appears in the exposed part of the mass: the titanic iron is entirely granulated and one can gather the ore in handfuls by scratching with one's fingers to a depth of three inches. The grains are light yellow ochre in color and about the size of a bean. They are not round, but broken in curved faces with polygonal outline. The shape of some grains approaches that of a pentagonal dodecahedron. These faces do not seem due to crystallisation or cleavage, but appear to be jointage faces due to shrinking, which produced internal strains or to phenomena of secondary alteration.

Two analyses were made of this granulated ore and of the compact ore found six inches below the surface.

SiO_2	2.00	2.50
Fe O	63.22	65.16
TiO_2	32.25	31.28
S	0.042	0.040
Ph	trace	trace
Undetermined	2.488	1.02
Total	100.00	100.00
Iron	49.17	50.68
Titanium	19.37	18.78

The increased quantity of iron in the granulated ore is due to the presence of ochres in the jointage planes of the ore.

MAGNETIC SANDS.

By moving the magnet through the sands on the slopes of the St. Urbain plateau and on that plateau itself, a large cluster of grains of magnetic iron is almost invariably brought to the surface. On the other hand the sands in the valley are very poor in grains of iron.

I have already stated that, in fact, two kinds of sands have to be distinguished: the silicious sands in the bottom of the valley of the Gouffre river, and the feldspathic sands on the flanks of the valley. We will not deal with the former, as the analysis of samples 57 and 61 show how little magnetite they contain.

At certain points on the slopes of the St. Urbain plateau, the feldspathic sands are considerably charged with magnetite.

I will point out two remarkable ferriferous deposits.

Eloi Simard's Farm—

A path starts from Joseph Bouchard's mill on the Remy river, follows the river for a quarter of a mile and then leaves it to

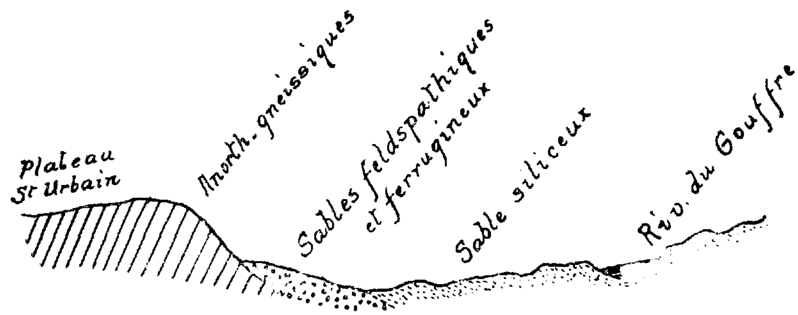


Fig. 6.—Section of valley of Gouffre river, showing sand deposits.

descend straight into the valley of the Gouffre river. On issuing from the woods as soon as the Gouffre river is visible, a sandy piece of land about 700 x 600 feet is reached which contains a large quantity of iron at certain points. This land is known as Eloi Simard's lot and the soil consists of a yellowish sand of a light sienna color. Digging brings to light beds of black sand varying between one inch and six inches in thickness. As I had no appliances for boring, I had to content myself with digging holes 2 feet deep with a scoop. Sample 51 comes from a six inch bed of grey sand; sample 56 from a hole two feet deep which was particularly rich. Samples 75, 76, 77, come from a six foot hole which I caused to be dug at night with pick and shovel at a point chosen at haphazard. The ill-will of the inhabitants did not allow of my making a thorough examination.

These samples were subjected to a rudimentary concentration by means of a hand magnet. They gave percentages of 20.75 and 28.84 for the former and of 3.01, 1.17 and 1.12 for the latter. (See table of assays). The chemical analysis of these concentrates, showed:

	Concentrates No. 51	Concentrates No. 56
Metallic iron	64.60	67.32
Metallic titanium	3.62	3.09

These analyses should be compared with those of the concentrates obtained by crushing the gneissic anorthosite (see page 79). The proportions of iron to titanium, without being precisely the same, approach one another closely enough. The situation of these sands at the foot of the cliff of gneissic anorthosites, the proportion of feldspar they hold and the composition of the iron grains they contain, clearly show that these sands are directly due to the disintegration of the adjacent gneissic anorthosites.

Lot 489 and adjacent lots in the St. Lazare range—

These sandy banks spread over the slopes of the St. Urbain plateau, close up to a kind of promontory of gneissic anorthosite.

Sample 47 was obtained by collecting a small quantity of sand from every five foot square over a particularly rich surface of 50 x 50 feet. By concentration it gave 17.49 per cent. of black sand.

From a hole 2 feet deep, sand was taken (sample 58) containing 16.16% of black sand.

Analyses gave the following results:

	Concentrates No. 47	Concentrates No. 58
Iron	67.66	67.32
Titanium	2.73	3.09

A glance at the table on page 101 will show that the percentage in black sand of the other samples obtained is far from equalling the foregoing. The sands on Eloi Simard's farm and on lot 489 therefore indicate a very special concentration. Through lack of appliances for boring I was unable to ascertain how rich these sandy banks were.

Table of concentration tests made with the magnet on some sands from the valley of the Gouffre river and from the St. Urbain plateau (St. Urbain parish).

No. of sample	Weight of sample	Weight of test sample	Weight of portion separated by the magnet	Proportion of magnetic sand
	grams.	grams.	grams.	
47	730	51.61	9.53	17.49%
51	40	40	8.30	20.75%
54	273	72.12	1.80	2.19%
56	975	84.30	17.57	20.84%
57	205	56.19	0.42	0.74%
58	560	91.58	14.80	16.16%
61	210	33.10	1.03	3.11%
64	137	70.22	0.65	0.85%
74	273	33.02	0.56	1.69%
75	388	56.73	1.73	3.04%
76	315	50.18	0.59	1.17%
77	605	46.15	0.52	1.12%

Place whence samples were obtained—

Sample 47—Slopes of St. Urbain plateau, lot 480, St. Lazare range.
" 51—Slopes of St. Urbain plateau, Eloi Simard's farm.
" 54—Coarse sand at foot of anorthosite cliffs, Eloi Simard's farm.
" 56—Average sample from a hole 2 feet deep on Eloi Simard's farm.
" 57—Silicious sand from a mound in the bottom of the valley.
" 58—Average sample from a hole 2 feet deep on lot 480, St. Lazare range.
" 61—Running sand, rather silicious, slopes of St. Urbain plateau.
" 64—Lot 1456, St. Jérôme.
" 74—Terrebonne, St. Gabriel range.
" 75, 76, 77—From a hole 6 feet deep on Eloi Simard's farm at depths of 2, 4 and 6 feet.

Conclusion—

It may now be considered that, on the St. Urbain plateau and on the slopes overlooking St. Urbain village, there are three well defined deposits of titanic iron from which large quantities of iron ore can be obtained: these are the Coulomb mine, the General Electric mine and the Furnace mine.

At the Coulomb mine the western and eastern open cuts might, in the condition in which I saw them, yield 1100 or 1200 tons each, per foot of depth. Admitting that the two mineralized masses uncovered join one another—which is very probable since intermediate borings have revealed the presence of ore under the clay—we should have a mass 600 feet long and from 40 to 80 feet wide. This would then mean a tonnage of at least 4,000 tons per foot of depth.

A similar calculation for the General Electric mine would give, for the northwestern workings as represented on sketch No. 2, about 600 tons per foot of depth. But, considering that the northwestern and southeastern workings are in a same mass 250 feet long by from 40 to 100 feet wide, we should be able to count upon a minimum tonnage of 1700 tons per foot of depth.

The results of the Furnace mine might compare with these.

These calculations are based on an estimate of 6 cubic feet of ore to the ton.

The other properties outside these three well-known mines can be looked upon merely as prospects. The Glen prospect seems to be the most interesting as regards both the dimensions of the outcrops found under the clay and the quality of the ore. No work has been done on the Bagnell property which would enable an estimate to be made.

Plan Fig. 1, which indicates the location of these various mines, shows that the three large masses of titanic iron lie in the same straight line running slightly to the east of the Bouchard mine. It would seem that all these masses belong to the same mineralized belt, about a mile long and running from north northeast to south southwest. If any searches are to be made in future, it would be advisable that they be directed towards ascertaining the distance covered by that belt.

On the whole, there is a very considerable quantity of titanic iron ore at St. Urbain. A boring made by the General Electric Company found ore at a depth of 120 feet. There is no doubt that, with outcrops such as those already ascertained, the mineralized masses must descend still lower and that the probable quantity of ore should be estimated at more than a million tons.

DEPOSITS AT THE BAY OF SEVEN ISLANDS, RAPID RIVER AND ST. MARGARET RIVER, P.Q.

The bay of Seven Islands, 340 miles below Quebec, is the greatest centre of activity on the whole of the North Shore. The village of Seven Islands has over 100 families and is the seat of a bishopric. The Hudson's Bay Company and the Révillon Company have each a trading post there. The neatness of the houses and streets, and the residents' comfortable appearance are all the more remarkable because most of the villages on the North Shore are rather poor. This wealth—a relative one, it is true—must be attributed on the one hand to the fact that both white and Indian trappers, after selling their furs, buy more from the local traders than from the fur companies, as is frequently the case at the other posts, and, on the other hand, to the vicinity of the pulp mills of Clarke City.

Fishing is also carried on, but on a rather limited scale; salmon are taken in May and June and cod in the summer months. The islands that shut in the bay abound in lobsters, crabs and shell-fish of all kinds. The fishermen find it difficult to dispose of their catch owing to lack of means of transport.

There are two industrial establishments on the other side of the bay, on the western shore. The most southern one is a whale fishery belonging to a Norwegian company. Whale fishing is carried on in the gulf with two whale-boats fitted with harpoon-guns. The whales, when harpooned, are towed to the works, hauled up on an inclined slip and cut up. Oil is the chief product; the flesh is steam-dried, pulverized and sold, as are also the bones, as fertilizers.

A mile further north, on the same west side, is the wharf of the Clarke City pulp-mill. A railway 9 miles long connects the wharf with the mill which is built on the left bank of the St. Margaret river to the south of the first falls.

This pulp-mill established by the Messrs. Clarke and which belongs to the North Shore Pulp Company, was turning out 160 short tons of dry pulp in 24 hours at the time of my visit. In reality the pulp goes out of the mill with 42% of water, which makes the daily output about 300 tons.

The logs, cut in 2 foot lengths, are rossed by 14 rossing machines requiring 150 horse-power in all.

The pulp-mill proper has four pulping machines, each of which is driven by a 2400 horse-power turbine. One machine has six grindstones and can crush 42 tons of dry pulp in 24 hours.

The water required for the water-power is brought by four pipes; the two largest supplying 4,800 horse-power each, and the two others 750 and 500 horse-power respectively. The two latter feed the machinery for washing and drying the pulp, the hydraulic presses, the conveyor, transmission shafts, etc. The mill obtains 600 additional horse-power by burning the refuse wood under six boilers.

The head of water supplied to the turbines is 58 feet.

The timber comes from limits situate above the pulp-mill on the St. Margaret river. There are other lumbering establishments on the river and at Lac des Rapides: the timber is towed by tow boats in the bay to the wharf at Clarke City.

The Bay of Seven Islands—

This is a very fine natural harbor. Until now, large vessels could moor only at the pulp-mill wharf and freight and passengers for the village of Seven Islands had to be conveyed there in canoes. During the summer of 1911, the Government was having a wharf built at the village of Seven Islands. When this wharf is finished, vessels drawing 15 feet of water will be able to moor at it at low tide.

The head of the bay, the western shore and the greater portion of the eastern shore have sand banks which are covered at high tide and bare at low tide. These sands have been brought down by torrent-like rivers, such as the Rivière aux Foins, the Rivière des Rapides, the Hall river. These rivers can be reached in boats only by following the channel which each one has eroded through the silt. At low tide the minimum depth of water in the channel of the Rapid river is a foot and a half; at high tide this river is accessible to vessels with a draught of eight feet.

The two places in the neighborhood of the bay where iron ore has been found are on the Rivière des Rapides and on the St. Margaret river at the first falls. I will describe them in succession.

DEPOSITS OF THE RIVIÈRE DES RAPIDES.

Rivière des Rapides—

This river, which falls into the bay of Seven Islands, owes its name to its broken waters. Along the four miles between its mouth and the outlet of Grand Lac des Rapides, there are no less than four important falls and portaging has to be resorted to for about one-third of the way, to reach the lake from the sea. As it issues from the Lac des Rapides, the river runs in a narrow gorge ending with the Outarde falls; about 40 chains from Lac à l'Outarde the slope of the great falls begins, the water dropping 90 feet with the rapids, the height of the falls alone being 75 feet. Thirty chains further down are the Cran de Fer falls, so called because they are shut in by two cliffs mostly consisting of titanic iron. Finally, some ten chains from its mouth, the river narrows and runs in deep gorges which mark the last rapids and the last falls

Portage Roads—

Access to the lake and to the various parts of the river and of the Grand Lac des Rapides is facilitated by many portage roads starting from the sea shore. One of these roads goes to the head of the lower rapids; another goes straight to the Cran de Fer falls and thence to the foot of the largest falls. Finally the rapids on the outlet of Grand Lac des Rapides can be directly reached by a road starting from lot 1 of range I. north of the Bay of Seven Islands. This road was opened by the Messrs. Clarke of the Clarke City pulp-mills, to reach their hunting lodge at the outlet of the lake.

Aspect of the country—

Except in range I north of Seven Islands, where the country is level, the region is hilly and broken. I have mentioned the narrow gorges of the lower rapids and of the outlet of Lac des Rapides. The shores of the lakes are also very high. At some points, especially in the Baie des Crans and in the Baie Cachée, the waters of the lake wash enormous perpendicular cliffs 150 feet high.

The country is well timbered: the forests are of fine growth and consist of the trees usually found in the region. The North Shore Power Company (Clarke City Pulp Company), has lumbering establishments there.

As is the case nearly everywhere in this region, the rocky outcrops are visible only along the streams and thick layers of moss cover the rocks. Moreover, at some points, especially in range I north of Seven Islands, the country is low and swampy.

GEOLOGY.

Following the river to near the middle of the Grand Lac des Rapides, the primary rocks all belong to very basic series of anorthosites or gabbros. From the middle of the Lac des Rapides, there is a very gradual transition from the gabbro-anorthosite of the south shore to a pink syenite of slightly gneissic structure on the north shore.

The variations in the compositon of the gabbro-anorthosite are very great from one point to another. In some places there is a white anorthosite, which looks like marble when seen from afar and, under the microscope, seems to be formed almost entirely of plagioclase feldspars somewhat saussuritized; in others the heavy and black rock is a real gabbro with a diallage heavily charged with grains of titaniferous magnetite. Such variation in aspect and composition cannot be in anywise attributed to local variations of one and the same magma; it must be admitted that tectonic movements took place during the cooling period of these rocks, at a time when the mass was still rather fluid, but when a n enormous differentiation had already occurred which had separated—probably in order of density—a feldspathic magma and a ferro-magnesian magma. Such movements displaced these two already differentiated magmas and caused them to penetrate one another.

Such penetration was probably effected without reciprocal metamorphic action; at least, I never found any traces of it wherever I could observe the two rocks in contact. Thus, we can see on a rocky cliff of the hill marked A. on the sketch page 109, a spur of white anorthosite consisting almost solely of feldspars in the midst of a heavy black rock, a real gabbro.

At other times the gabbro and anorthosite form alternate beds; the gabbro is then very fine-grained and the anorthosite is no longer so white nor so granular. Such phenomena may doubtless be explained by the action of strains.

The true anorthosite contains but few grains of titano-magnetite, while the gabbros, on the contrary, are highly charged with it. Frequently the latter become true ores of iron and titanium by successive enrichments. This remark leads one to think that the deposits of magnetic titaniferous iron of the Cran de Fer falls, which will be dealt with further on, are closely associated with the encasing magnetic gabbros and constitute the heaviest and lowest residue of the ferro-magnesian differentiation already referred to in the foregoing hypothesis. The movements produced in mixing a heterogeneous, but still pasty, mass would have fractured and displaced such imbedded iron-bearing masses which, after long erosions, now reveal themselves to us in the shape of irregular deposits.

Deposits—

Although the gabbros bordering on the river are nearly everywhere charged with grains of titano-magnetite, to the extent sometimes of being taken, when seen with the naked eye, for true iron ores, there are but three points where the percentage of iron and titanium is such that a deposit may be spoken of. These three deposits are, in order of probable importance: that of the Cran de Fer falls, that of the Outarde falls and the Gagnon deposit.

Deposit at the Cran de Fer falls—

The various geological reports under the name of "the Bay of Seven Islands deposits", refer to this one. Dr. Sterry Hunt was the first to mention it in the report of the Geological Survey for 1866-69. It is mentioned in the report for 1888-89 (Dr. R. W. Ells); in "the Mines and Minerals of Quebec," published in 1889 by Mr. J. Obalski; in the "Report on Mining Operations in the Province of Quebec" in 1901, by Mr. J. Obalski. Attempts at magnetic concentration by means of a Wetherill separator have also been made and the results were published in the Report on Mining Operations in the Province of Quebec in 1903 by Mr. J. Obalski.

This deposit lies at the foot of the second falls of the Rapid river, starting from its mouth. As a considerable portion of the rocks over which the water of the falls runs, are themselves gabbros rich in iron, I have called them the "Cran de Fer Falls". The deposit is known as the "Molson Mine", because Mr. W. M. Molson was the first to carry on mining operations there. The mining rights on both sides of the river still belong to the Molson estate.

At the very foot of the falls, the banks seem to consist of the three varieties of rocks which I have already mentioned: white anorthosite, gabbro and titano-magnetite. The transition from anorthosite to gabbro is always sharply defined and the same applies to the transition from anorthosite to titano-magnetite.

On the contrary, the transition from gabbro to titano-magnetite is much less marked; it frequently seems as if there had been a gradual transition from gabbro to titano-magnetite through en-

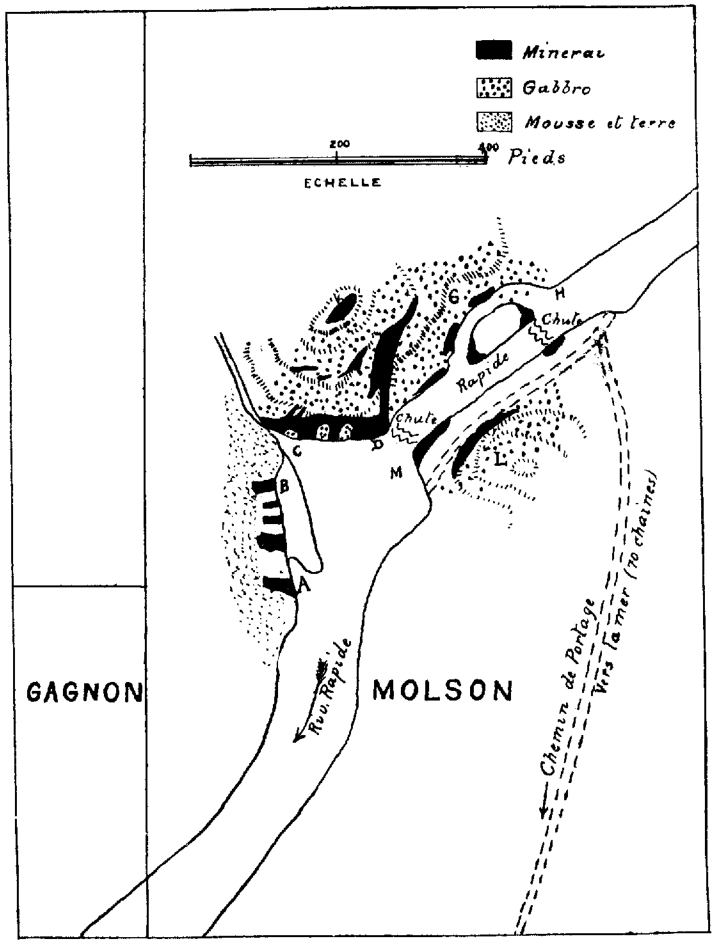


Fig. 7.—Sketch of Titaniferous Iron Ore Deposits at Crau de Fer Falls, Rapid River, Seven Islands.

richment by grains of iron; at other times, on the contrary, one observes a juxtaposition of parallel and very distinct strips of a granular and greyish gabbro and of a black and compact iron ore.

When the iron ore is in contact with the anorthosite, it is easy to ascertain the boundaries of the mass; the difficulty is much greater, on the contrary, when the transition of the gabbro to iron ore is gradual. The sketch Fig. 7 shows the mineralized outcroppings of this deposit better than any description.

On the right bank—

From A. to B. there is nearly as much ore as anorthosite; the ore is very pure; it shows itself in masses from 25 to 35 feet in frontage along the bank and which seem to broaden in depth. From C. to D. the titano-magnetite is compact and heavy. From D. to E. it is still fine; but some parts are not so heavy as the gabbros are approached.

The banks C. D. E. are precipitous and form cliffs from 20 to 30 feeet high above the river. Behind these cliffs the ground rises in steep slopes to about 80 feet above the falls. The whole of this hill, the summit of which is indicated by the letter K., consists of gabbros rich in iron and of titano-magnetites, the limits of the contact surfaces of which are difficult to determine. In fact, the two rocks are of the same colour and much of the same density when the gabbro is charged with iron. At certain points, moreover, the transition is imperceptible.

With a view to ascertaining the value of this large mineralized mass, I broke off with the hammer several samples which seemed to me to represent the various qualities of the rock. Some were analyzed at the provincial laboratory in Montreal, with the following results:

Samples	88A	88B	88C	88D
$Si\ O_2$	26.85	....	6.72	14.26
$Fe\ O$	36.77	28.37	58.76	28.06
$Ti\ O_2$	0.375	1.18	24.52	6.92
Al_2O_3	17.30	20.00	3.16	11.67
$Ca\ O$	9.48	8.81	0.29	....
$Mg\ O$	2.16	1.28	3.28	....
S	0.25	0.21	....	....
P_2O_5	2.75	3.86	....	....

Corresponding to:				
Iron	28.60	22.06	45.70	21.82
Titanium	0.225	0.71	14.73	4.15
Phosphorus	1.20	1.68	....	....

The rocks 88A, 88B and 88D are evidently gabbros and cannot in any way be looked upon as ores. Their percentage in titanium is remarkably low. As they are slightly magnetic, it must be admitted that the ferruginous grains they contain are charged almost solely with magnetite. On the contrary, as soon as high percentages in iron are reached (sample 88C), the percentage in titanium increases immediately. The same phenomenon seems to exist here as that at Baie St. Paul, which I have already mentioned. The isolated grains of iron in the rocks are more nearly related to magnetite than to ilmenite; on the contrary, as soon as there is differentiation, or concentration of ferruginous masses in important bodies, titanium appears in large quantities. The ilmenite thus appears an ore of segregation much more than does the magnetite.

A sample of the rich and compact ore forming the outcrops marked D on the sketch, gave the following result on being analyzed:

	Sample 89
Fe_2O_3	67.90
TiO_2	22.42
P_2O_5	0.05
S	0.13
Iron	52.84
Titanium	13.46

This analysis may be considered as probably representing the rich ore which outcrops in masses very different from the anorthosite at A, B, C, D.

On the whole, from point A to point H, for a distance of 650 feet, a real deposit of titanic iron outcrops. The percentages of the ore vary; some portions are very rich in oxydes of iron and in free titanium and do not contain 10% of gangue. In others, a portion of the iron which figures in the result of the analysis is combined with silica, especially in the samples from the hill overlooking the falls.

It is almost impossible to estimate the quantity of iron ore which this deposit may contain, as no prospecting was done. It may, however, be stated that the hill, the summit of which I have indicated by the letter K, contains 25 and perhaps 40 per cent. of an iron ore, the average richness whereof would be shown by the analysis of samples 88C and 89. If the average height of the hill be put at 60 feet (the summit is 80 feet above the falls), and if we consider that the conditions apparent on 400 feet of the bank continue for 200 feet inland, we come to a cubic contents of iron ore equivalent to: 400 x 60 x 200 x 0.3—1,440,000 cubic feet, or about 250,000 tons, taking the weight of the ore at 330 pounds to the square foot.

This estimate probably corresponds to a portion only of the whole deposit on the right bank and these figures should be higher if prospects revealed the existence of ore at more than 200 feet from the water's edge and in greater depth.

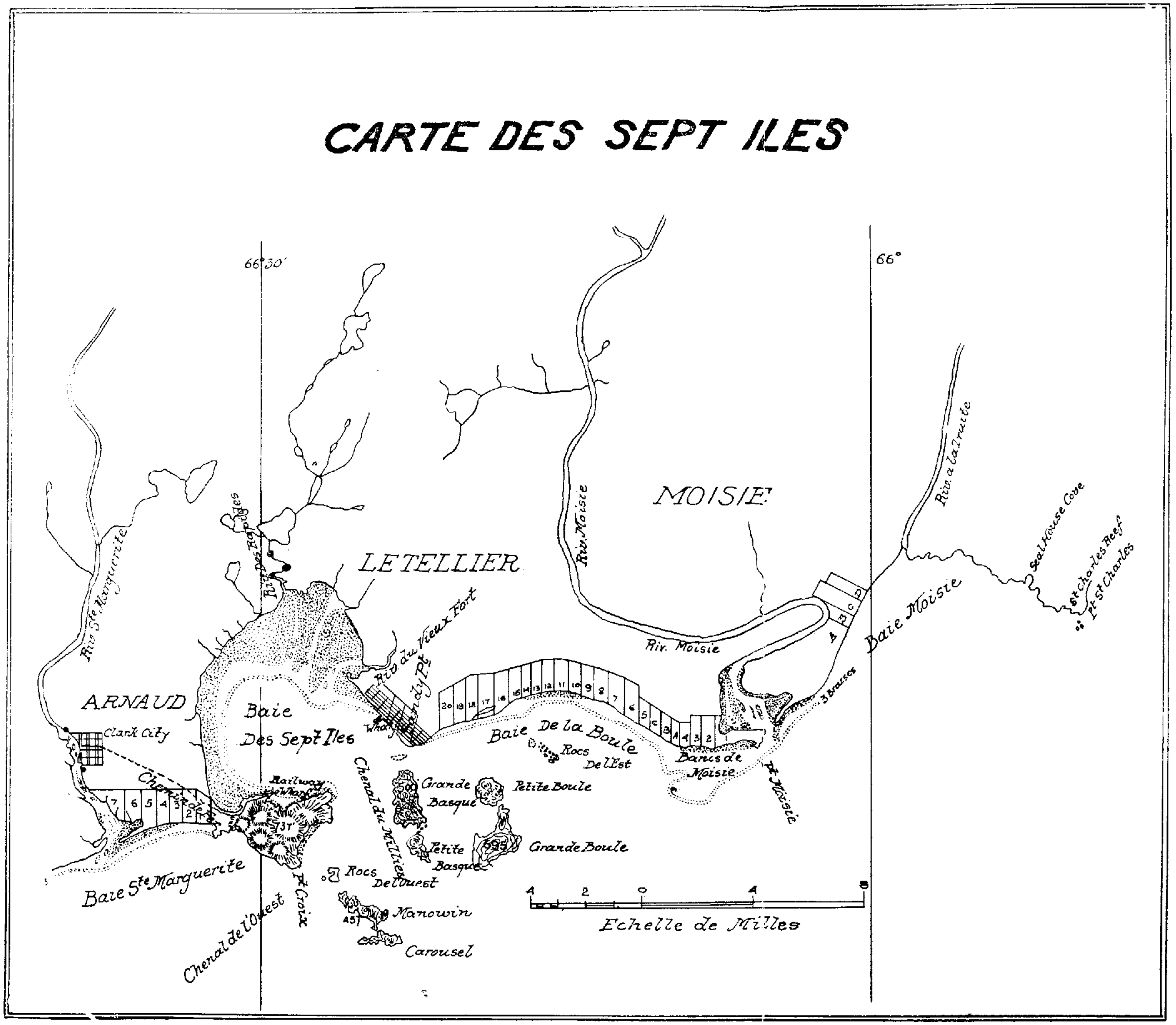
On the left bank of the river there is a similar deposit. A hill L., consisting of the same black, magnetic gabbros and containing masses of titano-magnetite, dominates the falls. A portage road runs along a precipitous cliff of this hill.

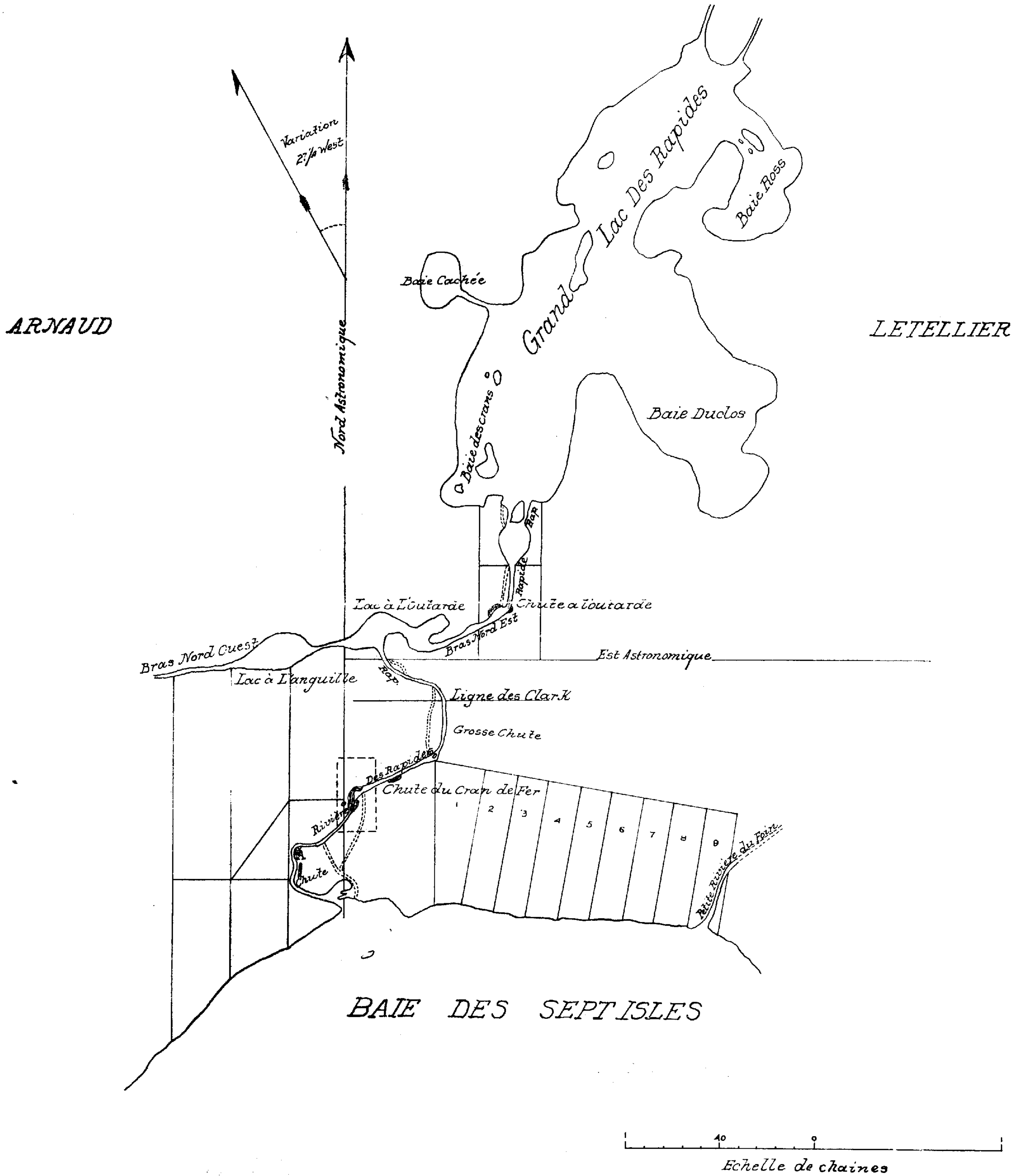
An analysis of a strongly magnetic piece of gabbro gave the following result:

	Sample 92
$Si\ O_2$	14.60
$Fe\ O$	20.76
$Ti\ O_2$	9.40
Al_2O_3	12.13
Corresponding to:	
Iron	16.15
Titanium	5.60

A compact titano-magnetite gave:

	Sample 91
$Fe\ O$	63.97
$Ti\ O_2$	21.40
Corresponding to:	
Iron	49.75
Titanium	12.85


CARTE DES SEPT ILES
66°30'
66°
MOISIE
LETELLIER
ARNAUD
Baie Des Sept Iles
Clark City
Baie De la Boule
Rocs De l'Est
Bancs de Moisie
Baie Moisie
Riv. Moisie
Riv. à la Truite
Seal House Cove
St Charles Reef
Pt St Charles
Riv. du Vieux Fort
Grande Basque
Petite Boule
Petite Basque
Grande Boule
Rocs De l'Ouest
Manowin
Carousel
Chenal du Milieu
Chenal de l'Ouest
Pt Croix
Baie Ste Marguerite
Riv. Ste Marguerite
Railway Wharf
Pt Moisie
3 Brasses
Echelle de Milles



Variation
2°1/4 West
Nord Astronomique
ARNAUD
LETELLIER
Grand Lac Des Rapides
Baie Ross
Baie Cachée
Baie des crans
Baie Duclos
Rap
Rapide
Chute a Loutarde
Lac à Loutarde
Bras Nord Est
Bras Nord Ouest
Est Astronomique
Lac à L'anguille
Rap
Ligne des Clark
Grosse Chute
Rivière Des Rapides
Chute du Cran de Fer
1
2
3
4
5
6
7
8
9
Petite Rivière du Foin
Chute
BAIE DES SEPT ISLES
40
0
Echelle de chaines

The best showings of magnetite are on the water's edge. Some parts of the hill consist almost entirely of that ore. Although the outcroppings of pure ore are less extensive on the south bank than on the right, there are large quantities of ore on the left bank. The Molson Company formerly attempted to work the deposit on the latter bank at the water's edge. At M., a dump of the ore that was taken out, amounting to some ten tons, can still be seen. I had about 3,000 pounds of ore taken from this heap and shipped to the Department of Mines at Ottawa.

To the south, east and west, the deposit at the Cran de Fer falls disappears under a layer of vegetable mould and moss which renders any approximate valuation of the probable tonnage impossible. Nevertheless, about 200 feet to the east of the falls, at the intersection of the two lines N. S. and E. W., which bound the Molson and Gagnon properties, there are two small outcroppings revealed by surface workings. One is found to be about 3 x 3 feet and consists of a fine iron ore associated with a gabbro charged with magnetite. The mass of ore is not limited and it disappears under the moss. An analysis gave:

	Sample 82
$Si\ O_2$	1.16
$Fe\ O$	66.67
$Ti\ O_2$	25.82
Al_2O_3	1.50
$Mg\ O$	3.42
$Ca\ O$	0.32
Corresponding to:	
Iron	51.85
Titanium	15.51

Forty feet further to the north, the same titano-magnetite is found in the bed of a small stream.

Ascending the Rapid river from the Cran de Fer falls, the banks continue to consist of the same magnetiferous, black, heavy gabbro, containing masses of titanic iron in places. At a point 600 feet above the Cran de Fer falls, on the left bank, there is a fine, but isolated, outcropping of titanic iron.

The large falls run over a gabbro rather poor in grains of titano-magnetite and without any mass of segregation. It is necessary to go up to the Outarde falls to find a mass of any importance.

On the whole, the deposit at the Cran de Fer falls 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. It would be interesting to make tests of magnetic concentration on this rock.

Any estimate of the tonnage can be but a guess. From what may be seen in the outcroppings in the vicinity of the falls, it may be put at a minimum tonnage of from 300,000 to 400,000 tons of rich ore. It is reasonable to suppose that the real tonnage is much higher.

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.

Thus, at the point A., about 125 feet from the river, one can follow, for a length of 80 feet, a cliff from 15 to 18 feet high consisting of gabbro very rich in magnetite.

An analysis of a sample gave the following result:

	Sample 98
SiO_2	11.78
FeO	33.18
TiO_2	18.62
Al_2O_3	8.29
Or:	
Iron	25.81
Titanium	11.18

Likewise, at the level of the lower falls, 125 feet from the river on the same left bank, is another outcropping of exactly similar rocks.

An analysis of a sample gave the following result:

	Sample 97
$Si\,O_2$	12.08
$Fe\,O$	36.48
$Ti\,O_2$	14.62
Al_2O_3	1.61
Or:	
Iron	28.37
Titanium	8.79

The rocks on the bank are similar and would probably yield similar results.

Such rock cannot be shipped as iron ore and it cannot be used unless works are installed for magnetic concentration after crushing. One of the falls of the river might perhaps be made use of for obtaining at slight expense a crushed product containing from 50 to 55 per cent of iron and from 10 to 15 per cent of titanium.

The utilization of such a product as well as of the compact ore at the Cran de Fer falls will be specially dealt with in a future report.

Deposits at the Outarde falls—

The river at the Outarde falls runs between banks consisting of an anorthosite gabbro with a gneissic structure. At the head of the portage the rock is light grey: the constituents, feldspar especially, are of large dimensions. As one approaches the foot of the falls, the gabbro alters more and more on the surface and becomes granular; it progressively becomes richer in grains of magnetite as the foliation becomes accentuated. The rock immediately at the foot of the falls is in every way identical with that forming the St. Urbain plateau and the mountains of Lac à l'Islet.

On the right bank, about 100 feet below the falls, the gabbro is charged with magnetite to such an extent that it becomes an iron ore. Moreover, we find all phases of the transition between gabbro properly so-called and the pure ore. Rightly speaking there is no mass of ore in the midst of a barren rock; there is a lateral and progressive gradation from slightly magnetic rock to the compact ore.

On the bank itself, the pure ore appears in only comparatively small quantities; on the other hand, the ferriferous gabbro is so rich and the grains of iron are so clearly differentiated from the grains of feldspar and augite that it would certainly be very easy to effect a magnetic concentration after crushing. These conditions continue for a length of 60 feet along the bank, after which the rocky outcrops disappear for about 300 feet under the moss. At that spot the rock is still a gabbro, but much less rich in iron ore; and augite and hornblende constitute the greater portion of the dark constituents.

The only rocky outcrop I could see, as I left the bank a slight distance to the west, is about 100 feet from the river. It consists of an iron ore, the analysis of which is given below (sample 115). Sample 116 is of a ferriferous gabbro taken on the bank.

	Sample 115	Sample 116
$Fe\ O$	70.70	33.11
$Ti\ O_2$	18.12	17.54
P_2O_5	0.075	....
S	0.08	....
Or:		
Metallic iron	50.99	25.75
Titanium	10.88	10.53
Phosphorus	0.033	....

Some surface work has been done on the bank of the river, but not in sufficient quantity to allow one to judge the size of the deposit. It would be interesting to strip the ground at this spot, for, on the one hand, some samples give very good percentages in iron, while comparatively not very rich in titanium, and, on the other hand, the deposit seems to be of some importance.

MINING AND UTILIZATION OF THE ORES ON THE RIVIÈRE DES RAPIDES

Of the three deposits described above, one alone, that at the Cran de Fer falls on the Molson properties, is sufficiently developed to be called a mine.

It would be easy to work it by quarrying on both sides of the river. The ore mined on the right bank could be transferred to the left bank by means of a cable tramway with a span of from 200 to 300 feet. Later on, as the quarries deepened, it would be possible to penetrate under the river bed to follow the continuations of the mineralized masses and the ore could be conveyed from one bank to the other by a tunnel under the river.

The loading of the ore at the mouth of the Rivière des Rapides could easily be arranged: the ore would be conveyed from the mine to the seashore by a short railway 2½ miles long, be loaded on lighters and towed to the Seven Islands wharf. The Rivière des Rapides has an open channel at the head of the Bay of Seven Islands of sufficient depth for small tow-boats and, at high tide, vessels drawing 9 feet could moor at a small wharf at the mouth of the Rivière des Rapides.

Such means of transportation would do only for operations on a small scale. When a hundred thousand tons would have to be dealt with, it would be necessary to avoid handling ore several times and to convey the ore directly by a railway from the mine to the Seven Islands wharf. Such a line of railway would be about 8 miles long and could easily be built around the bay.

If prospecting revealed the existence of a sufficient quantity of ore at the Outarde falls, it could be conveyed, after mining, by a branch line a mile and three-quarters long to the main line. A good portage road now runs from the Outarde falls straight to the seashore.

Working the magnetiferous gabbros of the Outarde falls and of the problematical ones on the Gagnon property could be carried on only with a crushing and magnetic concentration plant.

Power developed at the Great Falls—

With a view to ascertaining the available power at the Great Falls, I took two sections across the bed of the river about 500 feet below the falls. The following table gives the measured depths from the right to the left bank:

Section.	Distance to the bank.	Depth of upper. section	Depth of lower section	Time the float took to descend.
A.	0	0	0	
	10′	2′	1′8″	1m 40s.
	10′	3′	1′4″	
	30′	3′10″	1′10″	
B.	40′	4′2″	2′0″	
	50′	4′4″	2′7″	1m 8s.
	60′	5′4″	3′6″	
C.	70′	7′6″	4′10″	
	80′	8′	5′	
	90′	8′5″	4′2″	1m 2s.
D.	100′	7′5″	5′	
	110′	4′6″	4′3″	1m 20′
	120′	3′3″	3′4″	
	130′	0	3″	
	140′	0	0	

The speed was determined by means of 4 floats, let loose in each of the quarters A., B., C., D. The distance between the two cross sections was 100 feet. With these data, the following results can be established :

Sector	Average section	Speed per second	Flow
A	54 square feet	1 foot	54 cubic feet
B	101 "	1′. 47	148 "
C	180 "	1′. 61	290 "
D	172 "	1′. 25	215 "
		Total flow......	707 "

PLATE XIV.

CRAN DE FER FALLS, RAPID RIVER.

PLATE XV.

BIG FALLS (Grosse Chute) RAPID RIVER.

Taking the height of the falls at 75 feet (the difference in level of the falls and rapids below is 90 feet), it will be seen that the total capacity of the falls at the time of my visit on the 1st July, 1911, was:

$$\frac{707 \times 75 \times 62.5}{550} \text{ say about 6,000 horse-power.}$$

According to my guides, the water was then at its mean level.

The utilization of these falls would thus provide amply sufficient power for the working and also for the magnetic concentration of the magnetiferous gabbros.

ST. MARGARET RIVER.

The St. Margaret river has an important volume of water. A mile from its mouth it is from 55 to 60 chains wide. It is navigable by fishing boats to the foot of its first falls, about 4 miles from the sea. At low tide a craft drawing 7 feet of water can go to the very foot of the falls.

These falls are utilized and a pulp mill belonging to the North Shore Power Company gets its power from them. At present the power developed at the mean depth of water is 10,400 horse-power. The falls were originally 43 feet high, but a head of 58 feet is now obtained by means of a dam.

About 1½ mile above these first falls, is a second one which is 75 feet high according to Mr. Rinfret's map. It is not utilized.

Near the pulp-mill lies a neat little town, Clarke City, with an excellent hotel and shops, and connected with the seashore by a railway 9 miles long ending at a wharf, where the vessels moor that come to load pulp.

Above the banks of the St. Margaret river, where we examined them, lie terraces of clay and sand and the country rock outcrops only in small areas in the immediate vicinity of the water.

Geology—

The country rock which outcrops along the river or at the wharf, on the bay, is an anorthosite, dark, sometimes nearly black in color, with pretty coarse grains. The accessory constituents are titano-magnetite, a little pyroxene, a little hornblende. The feldspars are saussuritized and some thin sections

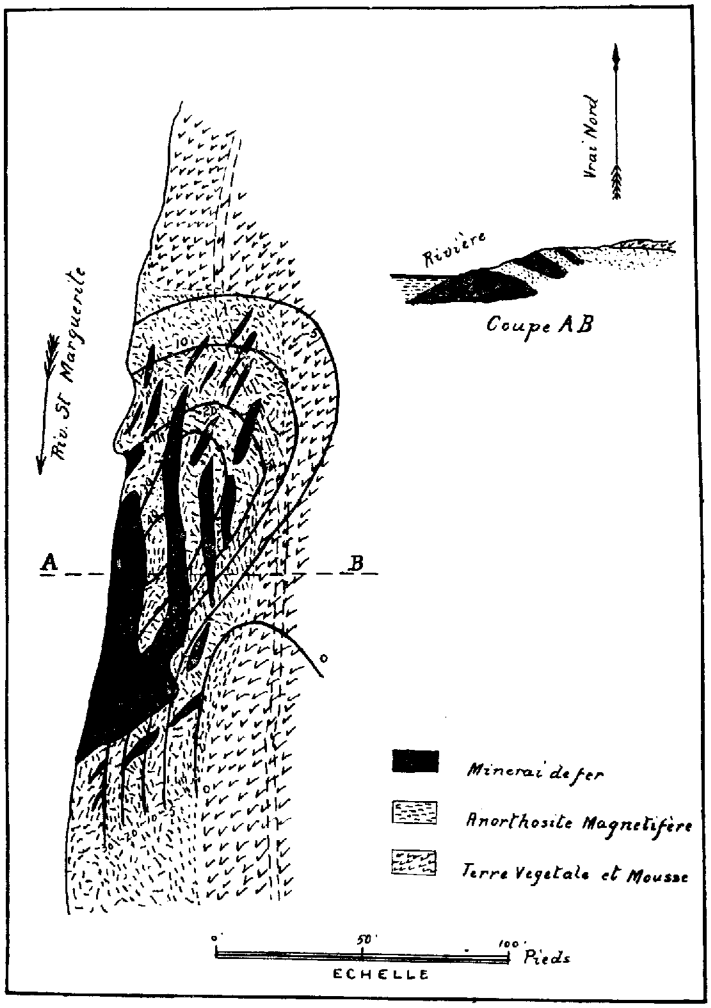


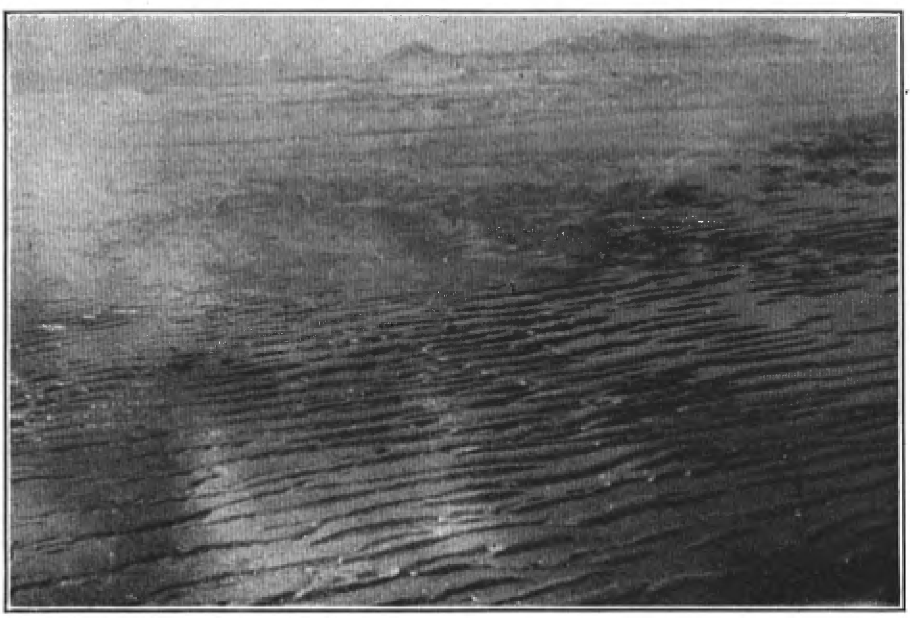
Fig. 8.—Deposits of Ste. Marguerite river—Below Clarke City.

also show the products of decomposition of calcite and white mica.

PLATE XVI.

STE. MARGUERITE RIVER.
In foreground are situated the "Lower workings."

PLATE XVII.



RIPPLE MARKS OF PRESENT ORIGIN, ON BEACH NEAR CHALOUPE RIVER

Deposits—

As the banks of the St. Margaret river are covered by high terraces of clay and sand, the rocky outcrops are but of slight extent. The only two mineralized outcroppings I could see are in the vicinity of the falls of Clarke City and I describe them under the names of "the deposit below Clarke City" and the deposit above Clarke City".

Deposit below Clarke City—

About half a mile below the pulp mill dam, between the river and the terraces of sand and clay, an outcrop is observed, from 50 to 60 feet wide, of dark anorthosite containing some black constituents, grains of hypersthene and of iron ore. For a length of about 400 feet from north to south, the rock is heavily charged with grains of iron ore and by crushing it with a hammer and holding a magnet to it, a bunch of grains of ore can be gathered. On the surfaces, altered and polished by water, the white feldspars and black magnetite form a kind of mosaic.

Lenticular masses of rather pure iron ore are imbedded in this rock as shown on Fig 8. The largest, about 15 feet wide and 80 feet long, disappears under the waters of the river. The whole mineralized mass is not more than 40 feet wide and 140 feet long. Great depth cannot be expected, because these outcroppings correspond to limited masses and not to veins.

To ascertain the extent of the deposit, I obtained the magnetic dips with the dip-needle and drew the curves which are shown on sketch Fig. 8. Going up towards Clarke City, through the woods, the needle is also affected, with dip from 10 to 15. The isolated boulders showing through the soil and moss also consist of the same anorthosite charged with magnetite, so that the dips may as well be attributed to the presence of magnetite disseminated in the rock, as to the presence of masses of pure iron ore. On the whole the outcrops uncovered are very limited and the quantity in sight cannot be counted upon as being more than about ten thousand tons.

Two samples of compact ore were taken from two lenses and their analysis gave the following results:

	Sample 211	Sample 213
$Si\ O_2$	1.52	7.88
$Fe\ O$	71.38	68.18
$Ti\ O_2$	20.68	16.40
P_2O_5	0.11	0.029
S	0.23	0.59
Corresponding to:		
Iron	55.10	53.03
Titanium	12.42	9.84
Phosphorus	0.049	0.013

The magnetiferous anorthosite of which the bank consists for a length of 400 feet and which must extend at least 300 feet to the north under the vegetable mould, would be difficult to work notwithstanding its percentage. By roughly pulverizing several pieces of this rock in a porcelain mortar so that it would pass through a 30 mesh screen, I succeeded, with a magnet, in separating a rich portion from a poor one.

The portion which was rich in iron and corresponded to 34.6% of the total weight treated, gave, when analyzed:

$Fe\ O$	57.24
$Ti\ O_2$	17.56
Al_2O_3	8.88
Corresponding to:	
Iron	44.53
Titanium	10.63

With a more perfect magnetic separation, a product richer in iron would perhaps be obtained. The utilizable tonnage of the rock would then be considerable.

Deposits above Clarke City—

The stone used in building the pulp-mill and dam was mostly taken from a quarry on the left bank of the river on the water's edge, about half a mile above the falls. In this quarry the iron ore was discovered, the outcrops of which are shown on the plan (Fig. 9).

The stone was taken out from an elliptical opening about 165 feet long by 65 feet wide; the centre is encumbered with debris and the nature of the outcrop can be ascertained only along the sides.

The rock is a rather coarse grained anorthosite. The feldspars of which it consists are dark grey or greenish grey, strongly schillerized. Sometimes the rock contains small grains of cupriferous iron pyrites.

Magnetic titanic iron appears in two places in the quarry. From B. to C., the rock is considerably charged with iron ore and probably more than half its mass consists of this. In C.,

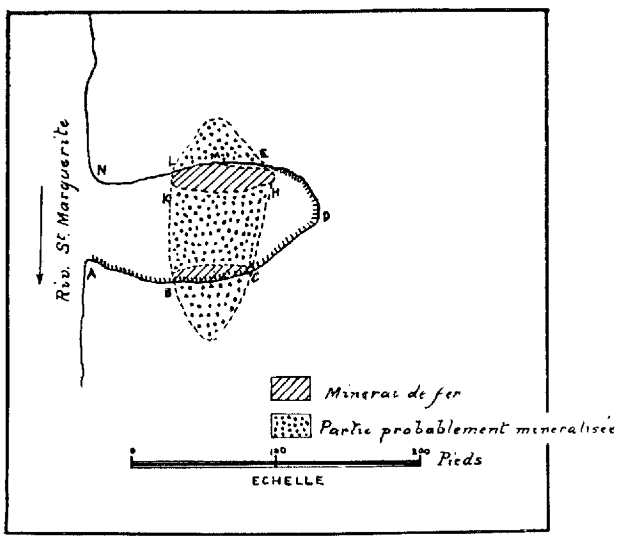


Fig. 9.—River Ste. Marguerite deposits.—Deposit above Clarke City.

D., E., the ore appears only in the shape of disseminated grains. As one approaches E., the percentage gradually increases and, for a length of 70 feet, from E. to L., the rock could pass for a true iron ore. I took a sample from the area E., H., K., L.,

M. (70 by 30 feet). These samples crushed together, mixed and quartered for the average, yielded on being analyzed:

	Sample 220
SiO_2	15.96
FeO	49.96
TiO_2	15.08
CaO	3.27
MgO	3.57
P_2O_5	0.17
S	0.187
Corresponding to:	
Iron	38.86
Titanium	9.06
Phosphorus	0.08

At L. M., a small lens of a particularly compact and pure ore crops out. This lens, the minimum thickness of which is 3 feet, disappears under the rubbish to the west.

The ore, which is fine grained and strongly magnetic, gave the following results when analyzed:

	Sample 219
SiO_2	0.84
FeO	74.36
TiO_2	18.88
S	0.51
Ph	0.013
Corresponding to:	
Iron	57.84
Titanium	11.34

This is the richest ore I found in the region.

The two outcrops, B., C. and E., probably belong to one and the same mineralized mass. The strike of the extension of this mass would then be north and south, like that of the lenses in the lower mine. Its length may probably be assumed to be 150 feet and its width from 30 to 70 feet. Although the supposed mass so defined corresponds to a quantity equal to 15,000 or 20,000 tons per 10 feet of depth, this deposit in its actual state must be looked upon only as an excellent encouragement to prospecting, both in depth and laterally under the clays and sands forming the high banks of the river. It should further be observed that many portions of this mass constitute an ore rather charged with barren elements in the shape of grains of feldspars and of ferro-magnesian constituents.

THE NORTH SHORE FROM SEVEN ISLANDS TO MINGAN.

Chaloupe River and Cap Rond—

On leaving Seven Islands and proceeding eastward we run along a low and sandy shore called Juliette Point and the Moisie banks. The Moisie river, which falls into the sea by this sandy delta, is about 18 miles to the east of the village of Seven Islands. The sand banks disappear about 9 miles to the east of that river's mouth and are replaced by a rocky shore with rounded outlines, but rather deeply indented. Wild, difficult of approach and dangerous for large vessels owing to submersed reefs extending a long way out, this shore is, on the other hand, easy of access for small crafts, barges and yachts, which can find many small harbours in which to take refuge in heavy weather.

Geology—

From the geological standpoint, this shore consists of eruptive rocks which are very clearly anorthosites from the Chaloupe river eastward, but, between the sand banks of the Moisie river and the Chaloupe river, it consists of an igneous complex evidently made up of several distinct varieties. Thus, at Point St. Charles, the shore and islands are formed of banded black and pink rock, more than half the mass of the black stripes consisting of mica and hornblende, while the pink ones correspond to a kind of gneiss with orthoclase and quartz and very little mica. These stripes are sometimes very narrow and parallelly wrinkled; at other times their dimensions are great and over considerable areas there is but one variety of rock, pink gneiss.

At the Manitou river, this igneous complex gives place to a granite with hornblende and black mica, the hornblende predominating. The crystals are large and quartz but slightly abundant.

At the Rivière aux Graines, the banded rocks re-appear with a slightly different aspect from that of the Point St. Charles rocks. The whole is grayer and the pink stripes less numerous.

Three varieties of stripes appear: gray, black and pink. A plagioclase feldspar predominates in the yellowish gray bands; the blackish gray ones consist of feldspars, which are probably plagioclase and of black mica; the pink stripes probably contain a mixture of feldspars, orthoclase predominating, and the plagioclase with black elements, in slight abundance. Some stripes contain individuals of plagioclase feldspar from half an inch to two inches long; this phenomenon occurs not only in the anorthositic, but in the micaceous bands.

Great dykes of pegmatite cut these formations, generally at right angles to the banding. All these dykes have, moreover, the same north and south strike. In them the predominating element is a pink orthoclase; the quartz is in much less important quantities; black mica forms segregations which particularly attract the attention of the north shore fishermen. As a matter of fact, none of these mica crystals have any economic interest.

Whilst west of the Chaloupe river, at the place marked R Q, on the map of the Chaloupe river and Cap Rond, the shore still consists of these alternate strips of pink gneiss, of anorthosites and micaceous rocks, at O. P.; on the other sandy beach P. Q., the primary rock is a massive anorthosite, but which still shows, by the constant alignment of its few black elements, the marks of the efforts of lamination that have affected the whole of this portion of the shore. With secondary variations in the structure and in the abundance of the ferruginous elements, it may be stated that at this spot begins the great mass of anorthosite which I examined from point to point as far as the St. John river.

Grains of iron ore show in the rock. So abundant do these grains become at times as one proceeds eastward, that it is necessary to distinguish three different varieties of rocks for the region extending from the Chaloupe river to Sheldrake point. These are: anorthosites, gneissic anorthosites and titano-magnetites with feldspathic gangues.

I include under the name of "anorthosites" the greater portion of the rocks forming the shore; the other varieties appear only as local accidents. These are rocks with a grey or dirty white fracture, medium grained, taking a fine brownish pink polish under the action of the waves, hard and compact. They consist of the feldspars generally found in the vicinity of Labrador and contain but few ferro-magnesian elements.

It is not unusual to find a local enrichment in black mica in contact with lenses of titano-magnetite.

In some places, especially at Thunder river, I saw large crystals of irridescent labradorite.

The *gneissic anorthosites* originate from the true anorthosites by the addition of a considerable quantity of black constituents: hornblende, black mica, and above all titano-magnetite. These elements are always aligned and the direction of such alignment is maintained in a remarkably constant manner along the whole shore. It is pretty much east and west. The parallelism of these elements is sometimes very clearly visible on the polished surfaces; the rock then has a characteristic gneissic aspect. At other times the black elements (which are almost exclusively titano-magnetite), form small patches joining one another at their extremities, interlocking among themselves and constituting a sort of network of lozenge-shaped meshes, the main axes of which are parallel to the general foliation.

By *titano-magnetites with feldspathic gangues* are meant rocks imbedded in the foliation of the gneissic anorthosites, in the shape of lenses or veins and consisting largely of ilmenite and magnetite. The principal mass, the iron ore, contains either isolated feldspar crystals or globules, or small pockets of anorthosite, visible particularly on the polished surfaces. Pink or brownish feldspars show out on the fine black iron ore. The thickness of these iron lenses seldom exceeds 10 feet; as a rule it is between one and three feet. A single lens, that at Round Cape, is 16 yards wide. These thicknesses are not maintained and often drop to little or nothing.

The iron ores at Cap Rond consist of such ilmenites and of titanic iron with feldspathic gangues.

Deposits at the Chaloupe river and at Cap Rond—

Fig. 10 represents a rapid survey of the shore to the east of the Chaloupe river. On it I have indicated by black dashes the lenses of ilmenite and titanic iron I observed there.

On leaving the Chaloupe river to proceed eastward the rock is a gray anorthosite, changing to pink on the polished surfaces. At A. (Fig. 10), as one draws near the seashore, a series of black bands is noticed which are roughly parallel to one another and are charged with titano-magnetite. One of them can be followed for a length of 200 feet with a thickness varying between 1 and 10 feet. This strip does not consist of compact magnetite from one wall to the other; it contains lenses and even perfectly round inclusions of an anorthosite having all the outward characteristics of the enclosing rock: alteration to brownish pink on the surface, grey fracture, medium grain. Thus, on the surfaces polished by the waves, the appearance is pretty much represented by the figure 11.

When the portions of the vein which seem to consist of compact iron ore, are closely examined, feldspar crystals are seen imbedded in the black mass; this is particularly visible on the polished surfaces.

Towards the east this vein dips into the sea; towards the west it spreads in the shape of a half open fan. The magnetic dip taken on a line N. S., that is to say, perpendicular to the vein, gave readings varying between 74° and 70°.

This vein A. is found again at B. on the other side of the bay with the same characteristics, the same strike, and the same almost vertical dipping (10 degrees north). It extends eastward into the woods, where it is found again under the moss at a distance of 500 feet. This strip or series of parallel bands may be considered as 1500 feet in length.

At C .and D. other veins appear, but of more irregular thickness; properly speaking they are only lenses which suddenly spread out. The filling of these lenses is markedly purer than at A. and B.; the enclosing rock is less rich in black elements and less gneissic in appearance. It would seem that the richest veins or lenses of ore are in the most compact anorthosites and in those less charged with filaments of magnetite or ilmenite.

PLATE XVIII.

LENS OF TITANO-MAGNETITE IN ANORTHOSITES.
Two miles east of Chaloupe river.

PLATE XIX.

JOINT PLANES IN CAP ROND ANORTHOSITES.
Titano-magnetite lenses are intercalated in the joints.

CAP ROND, EAST SIDE.

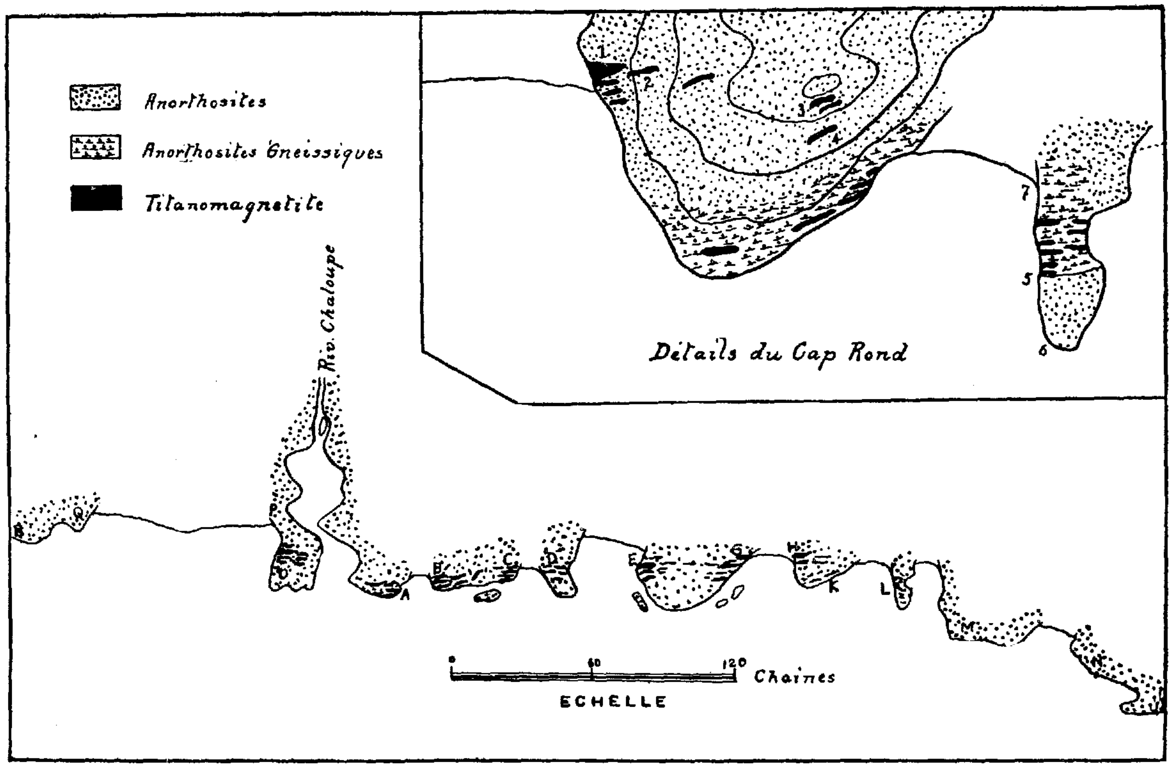


Fig. 10.—North shore in the vicinity of Chaloupe river.

At E. is a series of large veins, rusty on the surface. One of them spreads to a width of 55 feet, but it contains an inclusion of anorthosite of 10 feet. The ore is impure and charged with feldspars. The network of magnetiferous strips can be followed from place to place under the moss from E. to G. There they appear very visibly on the polished surfaces of the rocks. One of them spreads 30 inches without any anorthosite inclusions, but the crystals of titano-magnetite constituting the vein are always accompanied by feldspar crystals. The proportion of feldspar is about 25 per cent. A few feet to the north of this

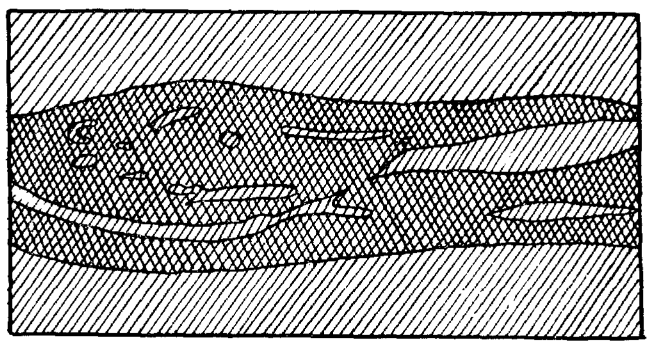


Fig. 11.—Band of Titano-magnetite with anorthosite inclusions.

vein appears a sort of fan of magnetiferous strips which, over a width of 6 feet, may contain 60% of iron ore. This fan is intersected by a dyke of pegmatite running north and south.

Cap Rond—

Cap Rond, where the iron deposits lie which are mentioned by Mr. Jobidon, P. L. S., form a rather high rocky hill which appears round when looked at from the sea. Its southern side, which is washed by the waves, consists of gneissic anorthosite very heavily charged with iron ore. Its foliation is so pronounced that the rock is not polished by the action of the waves or of time, like the other rocks of the country, in rounded hummocks; but jointage planes parallel to the foliation develop in it and the rock breaks, following planes with an E.-W. direction and dipping 10 or 15 degrees north. (See photograph, plate XIX). Sometimes the percentage of the rock in the magnetite is such that some strips constitute a true iron ore. Unfortunately these strips are narrow, the thickest are from 6 to 12 inches thick. They have no continuity; at the end of a few yards they thin out or scatter into a number of narrow bands, which disappear in the rock.

The higher parts of the hill and those in the vicinity of the point H., Fig. 10, consist of an anorthosite which is much less gneissic and much less charged with black constituents. The passing of the true anorthosite to the gneissic anorthosite is at times very abrupt without any transition. In some places the compact, light gray anorthosite, contrasts strongly amidst the gneiss.

The largest deposit of iron ore is at H. At high water mark, right on the beach, is a series of magnetiferous veins, the most important of which is 16 yards in width along the small stream that falls into the sea at this spot. This vein sinks like a wedge into the rocky cliff and seems to have no continuity in width. At a height of 18 feet above the beach, on the side of the hill, the thickness is reduced to nothing. Thus, in reality, the deposit is a true segregation lens of rather limited dimensions.

I searched for the extension of this lens eastward by ascending Cap Rond, but I discovered nothing definite. The anorthosite constituting the mass of the mountain rather frequently contains lenses of iron ore, elongated from east to west, but none of sufficient size to be of interest.

Without seeking to draw up a map with curves of equal magnetic dipping, I took the dips at various points on the hill. The figures I give were taken every 25 feet on lines N.-S., that is to say at right angles to the direction of the elongation of the lenses. The sketch on a large scale of Cap Rond (Fig. 10), shows the location of such lines.

STATIONS ON THE VARIOUS LINES.

	I	II	III	IV	V	VI	VII	VIII	IX
Line No. 1	—10	+44	—57	Inversion of N. end	+34	+20	+5	+10	+5
Line No. 2	—35	—40	Inversion of N. end	+30	+7				
Line No. 3	0	—15	—30	—44	—22	0			

Station IV, 1 corresponds to about the centre of the lens H. Beyond 2, on the extension of this lens, the needle was hardly affected at all. These figures show the limitation of these lenses in width; the rapid variations over such short distances clearly prove the vertical dip of these lenses.

Two samples were taken in two places of the mass H. and their analysis gave:

	No. 177	No. 177 *bis*
Metallic iron	38.84	35.45
Metallic titanium	7.88	6.98

The percentage in iron is rather low: I did not try to select the heaviest and the purest pieces, but rather to ascertain the average value of the mass. The constituents accompanying the ore are, moreover, visible in hand specimens; they are feldspars, pyroxenes and some sulphides. The percentage in titanium is rather low compared to that of the iron (proportion of 1 to 5); it accounts for the fact of the ore being highly magnetic.

Such ore would with difficulty find a market; on the other hand no mass is of sufficient dimensions to be worth working.

As the discoveries now stand and as far as I could judge, there is not, between the Chaloupe river and two or three miles east of Round Cape, any iron deposit of any economic importance. Of course, this applies only to the immediate vicinity of the sea-shore and in nowise condemns the interior regions not yet explored.

Thunder River—

The village of Thunder river is built on the banks of sand and clay on either side of the river. To the north the land rises slightly and rocky hills appear. The country rock is a fine grey anorthosite, changing to white on the surface, compact and without any trace of foliation. This anorthosite often contains large crystals of plagioclase, probably labradorite, and finely twinned albite, enclosed in an aggregate of small glassy feldspar crystals, which fracture irregularly.

On one of these hills, about a mile and three-quarters to the N.-E. of the village, in a sort of depression covered with bushes, is an outcrop of titanic iron, somewhat in the shape of a pear, the direction of the main axis of which would be from S. S.-E. to N. N.-W., its length about 50 feet and its width 35 feet. The ore is black, heavy, hard, slightly magnetic. The line of contact between the ore and the anorthosite is clear, without any trace of mutual action, but irregular, the rock sending out tongues into the mass and reciprocally.

The dip-needle is but slightly affected in the vicinity on a line E.-W. and, at every 15 feet, the readings of the instrument gave +6, +10,—5,—5,—8,—9, +5.

The compass had an initial error of 5. The figure of —8 corresponds to the swell of the pear.

This outcropping of titanic iron is isolated and the compass is not affected in its vicinity.

The analysis of a sample gave:

	Sample 200
Metallic iron	49.75
Metallic titanium	21.20

A fisherman of the village, Mr. Philippe Beaudin, claims to know a similar deposit situate at a place 2½ miles inland, starting from the mouth of the Sheldrake river. The outcrop is said to be 100 feet long by 80 wide and to affect the magnetic needle. A sample he showed me, weighing about 3½ pounds, was in fact rather magnetic. Mr. Beaudin would not take me to his mine in spite of my pressing request.

St. John River—

A mere mention of this river is sufficient, because my visit to the "iron mines" was entirely barren of results. Some guides of Mr. Hill, the American railway magnate, had discovered an iron mine while accompanying engineers who were Mr. Hill's guests, and I went myself to the spot. After going up the St. John river about 13 miles, poling most of the way, we ascended a rather steep mountain, at the top of which we succeeded after a good deal of trouble in finding some small pockets of titanic iron, accompanied by large crystals of hornblende. The rock was a gray anorthosite, changing to white.

The St. John river is probably one of the best on the North Shore for floating timber. Its banks are covered by fine forests, its current is rapid and there are no falls in it for a distance of 60 miles from the sea.

THE MAGNETIC SANDS OF THE NORTH SHORE OF THE GULF OF ST. LAWRENCE.*

(By E. Dulieux)

The existence of magnetic sands at many points on the North Shore of the gulf, has been known for a long time. The Geological Survey report for 1866-1869 by Dr. Sterry Hunt, gives, for the first time, analyses of these sands probably chosen from the naturally richest deposits.

Generally speaking, all the sands on the beach of the North Shore contain grains of magnetite. In some places, particularly in the vicinity of the estuaries of the larger rivers, the sandy banks assume considerable importance, while, at the same time, the dunes or cliffs show remarkable enrichments in black sand. The largest deposits of magnetic sand on the whole of the North Shore are probably those at Betsiamites, Moisie, St. John and Natashquan.

The few following remarks deal only with the two deposits of the Moisie and of the St. John rivers. These notes are very incomplete, as they are the result of a few days' observation: a week for the Moisie and barely three days for the St. John river.

An auger, kindly lent us by Mr. Duclos, of the Revillon firm, at Seven Islands, was a great help to us. It enabled us to bore, with fair rapidity, holes 5 inches in diameter to a depth of from 8 to 10 feet. Unfortunately, as it had no guides, it very easily deviated from the vertical and the extraction of the cores caused caving in of the sides, which compelled us to abandon the holes. This drill could be used only for fine sands.

THE MOISIE SANDS.

The Moisie river falls into the sea by a long, winding estuary, after making its way through a great sandy plateau. In

*Translated from the French by Crawford Lindsay.

the concave parts of the windings, the river flows at the foot of high cliffs rising 100 and even 125 feet above the level of the water. The force of the current undermines these cliffs and accentuates in time the elbows of the stream; the sands forming the border of the convex parts are very high and are the result of recent rehandling.

On each side of the mouth of the Moisie river are long sandy beaches stretching 20 miles to the west, to beyond the village of Seven Islands and 9 miles eastward to Front river. These sands extend far out into the sea, especially on the west of the river's mouth. There they form a submersed bank known as the Pointe à Juliette, which compels even the smallest craft to pass three miles from the shore.

It is impossible to land on any of these banks except in a row boat and in particularly calm weather. On the other hand, the Moisie river offers a harbour, sheltered from all winds, for all craft with a draught not exceeding 8 or 9 feet. The channel is fairly easy at high water, but is dangerous when there is a heavy swell from the southwest.

The steamers plying along the North Shore stop outside about a mile and a half from the mouth, and passengers and freight are conveyed to and fro by a gasoline motor boat.

Magnetic sands are found both on the beaches and in the cliffs of the estuary and in the cliffs bordering the seashore, but the larger quantities are found in the latter.

In previous investigations made on the magnetic sands of the North Shore, a division of these sands into two distinct categories, namely: tidal sands and terrace sands, has generally been omitted. This lack of preliminary definition has given rise to numerous misunderstandings. Some claimed that the quantity of black sand was comparatively small (a few hundred thousand tons), for the larger deposits; others claimed millions of tons.

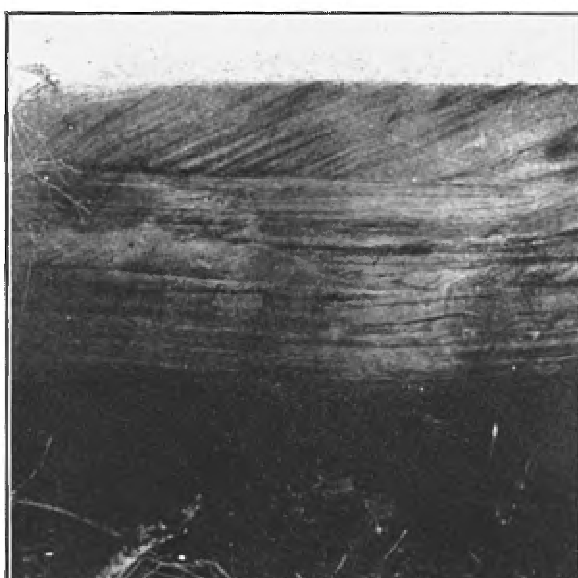
As a matter of fact, one must distinguish between the two kinds.

(*a*) *The tidal sands.*—As a rule these are black sands, heavy, very rich in magnetite, forming a strip bordering on the sea at the foot of the sandy cliffs of the terraces. The average high tides barely reach them; the high tides at the full of the moon,

PLATE XXI.

THE BEACH AT MOISIE, WEST OF MOISIE RIVER.
Iron Sands.

PLATE XXII.



FALSE BEDDING IN SAND CLIFFS AT MOISIE.

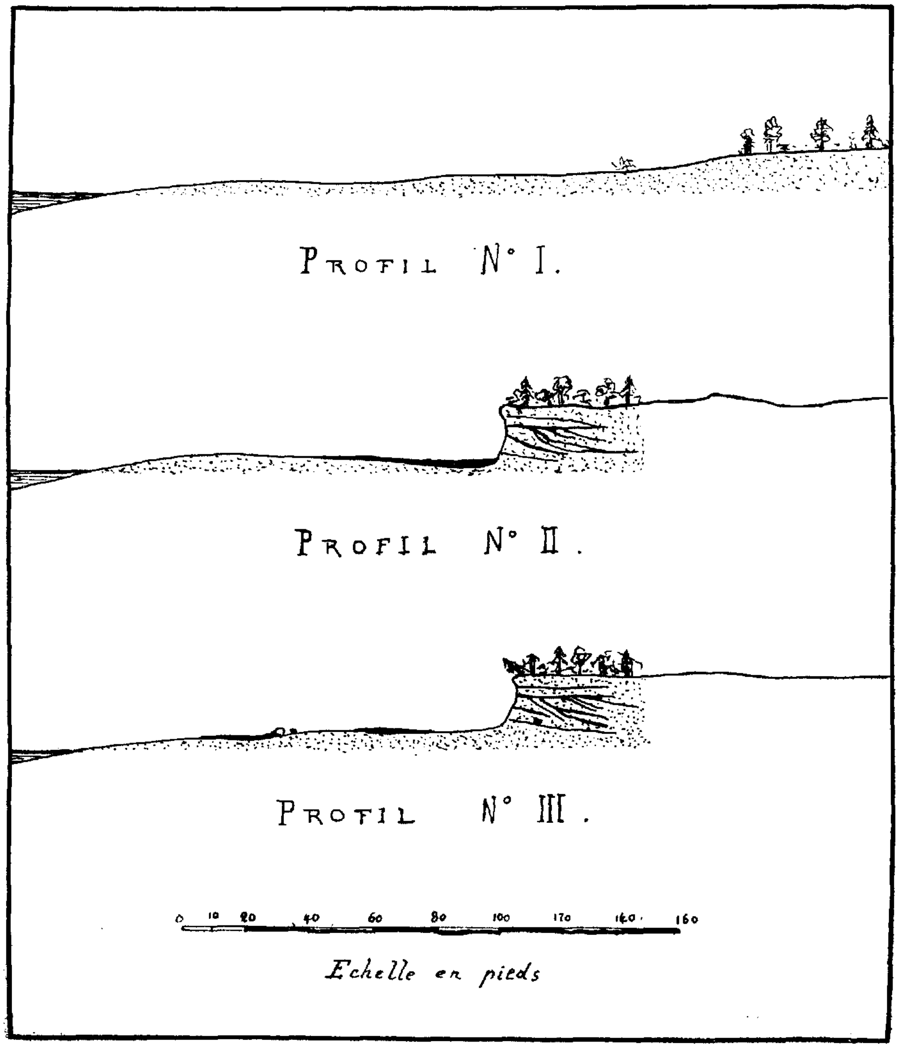


Fig. 12.—Profiles of Beach at Moisie.

partly cover them. They are covered and stirred up by the high tides at the equinoxes. As a rule, they are not found on the low-lying beaches and their presence is connected with that of a cliff beaten by the waves at high tide.

The width of this strip varies between a few inches and 40 or 50 feet; the thickness varies between a few inches and 3 feet. The concentration of these sands is of the present day.

(*b*) *The terrace sands.*—The terraces between which the Moisie river flows and those bordering on the sea, consist of sands of various degrees of coarseness, lying on clay as a rule. Nearly all the borings in these terraces revealed the presence of magnetic sand in irregular beds, without continuity. The percentage in magnetite varies greatly from one point to another; the average percentages are low on the whole. On the other hand the tonnage is considerable.

These sands were no doubt brought down by the streams of the Champlain period and have been rehandled and redeposited by the marine currents and tides of that period. The concentration of the magnetic sands in particularly rich beds, the irregularity of the stratification, the complete lack of continuity in the beds, the false bedding of the layers, all indicate a rehandling of sands under the action of currents changing with the strength of the tide and the predominance of certain winds.

A thorough study of these sands would require several months' work; during the few days we spent at Moisie our work was confined to making an estimate of the quantity and richness of the tidal sands. At the same time we made some shallow borings in the terrace sands; the results figuring in this report must be looked upon merely as isolated indications.

Tidal Sands—

Tidal sands are not found on all parts of the beach on both sides of the Moisie river. Their deposition in important quantities can be effected only under certain conditions and, especially, the presence of a sandy cliff or at least some obstacle against which the waves break, seems indispensable. Thus, such tidal sands are found only in very small quantities on the low-lying beaches which stretch towards the land in unbroken undulations. On the other hand, as soon as the terraces appear, a strip of black sand is found at their foot.

The three sections represented by the sketch Fig. 12 correspond to three different aspects of the Moisie beaches. In profile No. 1, the beach rises gradually as it leads inland and forms undulations; for several hundred feet nothing but sand of present day deposition is found and there is little or no vegetation. The high tides at the equinoxes run very far up and the land is easily swept by storms. Magnetic sand appears only in ripples, rows or entirely superficial patches.

In profile No. 2, the sand beach ends at the foot of a cliff of terrace sands and at the foot of these terraces a concentration and accumulation of ferruginous grains has taken place. The ordinary tides do not reach these cliffs; on the other hand, the high tides of the equinoxes and high winds push the waves to the very foot of the terraces. It may be imagined that such tides and storms bring sand and effect a concentration by a washing analogous to that performed on the concentrating tables of mills, where the mechanical concentration of ores is carried on. The rounded profile No. 2 seems especially favorable to the accumulation of the concentrates.

Profile No. 3 corresponds to a more level beach, more exposed to storms and tides. The magnetic sands are distributed in several zones, in many strips, generally not so thick as the strips running immediately beside the cliffs.

These black sands do not consist solely of magnetite. Even when they appear perfectly black they contain a marked proportion of hornblende, augite, garnets and ilmenite. Thus, a very black sand gathered at the foot of a cliff, gave the following results when analyzed:

	Iron	Titanium
Sand	56.84	8.07
Concentrated with magnet	69.10	1.34
Non-magnetic part	45.26	13.26

The proportion of concentrates to the sand being 48%, it would therefore be impossible to extract by magnetic concentration a greater quantity of iron than 33% of the total weight.

These surface concentrates are found over large areas. East of the Moisie river they form a strip more or less broad and more or less continuous, which runs for a distance of 4 or 5 miles from a point marked A. on the Fig. 13. West of the river, starting from point B., the beach is low at first and its profile resembles profile No. 1; but, at about 3 miles, small tearraces appear at the same time as strips of black sand. These terraces and sands continue for about two miles. Finally, in the estuary of the river itself, on the concave bank, there is also a strip some hundreds of feet long.

With the view of estimating the probable quantity of these black tidal sands, Mr. Poitevin carefully measured the depth and the width of the magnetiferous strip over a length of 10,600 feet starting from point A. and going westward. The table on page 141 shows the work; at 29 points the width and depth of the black sands were measured and about a pound was taken as a sample. Thus were the samples A., B., C., D., E., G., H., K. made up. A final sampling was made by taking from each of the samples A., B., C., K., a weight proportionate to the number of cubic feet represented by each partial sample. Such final sample, when analyzed at the Provincial Laboratory, gave:

	Iron	Titanium	Fe_3O_4	TiO_2
Sample 153, crude	36.42	7.48	50.29	12.84
Sample 153, sorted with magnet..	67.17	1.46	92.66	2.44

The concentrates sorted with the magnet represented 26.23% of the gross weight.

The table thus shows that over a distance of 10,600 feet or about two miles of the shore line, there are about 40,000 tons of a pulverulent ore yielding 26% of magnetic concentrates, that is to say: containing from 17 to 18 per cent of metallic iron.

If we extend these results to the 5 miles of tidal black sand on the east bank and to the 2 miles of the west bank, taking 20,000 tons to the mile, we get a total of 140,000 tons.

These figures are in nowise final; the predominance of certain winds, frequent storms, may cause a re-handling and displacements of these sands; the very superficial nature of the deposits renders them, to a certain extent, very uncertain.

TONNAGE OF THE TIDAL IRON SANDS AT MOISIE.

No. of Station.	Width of Steep. — feet.	Depth of layer. — feet	Section of the layer. — Sq. feet.	Distances along shore	Distances between station	Quantity of sand between stations.	
1	35	0.6	21	0′	200′	4,200	
2	20	2.1	42	200′	200′	8,400	Sample A
3	30	2.1	63	400′	200′	12,600	
4	30	1.6	48	800′	200′	9,600	
5	30	1.1	33	800′	200′	6,600	Sample B
6	40	1	40	1,000′	200′	8,000	
7	30	1.4	42	1,260′	200′	8,400	
8	30	1.2	36	1,400′	200′	7,200	
9	35	0.8	28	1,800′	400′	11,200	Sample C
10	30	2.5	75	2,000′	200′	15,000	
11	30	1.5	45	2,200′	200′	9,000	
12	35	0.7	24	2,600′	400′	9,600	
13	20	0.8	16	3,000′	400′	6,400	Sample D
14	40	1.2	48	3,400′	400′	19,200	
15	45	2.5	112	3,800′	400′	44,800	
16	25	2.1	52	4,200′	400′	20,800	
17	15	2.5	37	4,600′	400′	14,800	Sample E
18	30	1.3	39	5,000′	400′	15,600	
19	35	1	35	5,400′	400′	14,000	
20	30	1.3	39	5,800′	400′	15,600	
21	35	1.4	49	6,200′	400′	19,600	Sample G
22	35	2.5	85	6,600′	400′	34,000	
23	35	3.3	115	7,000′	400′	46,000	
24	40	1.3	42	7,400′	400′	16,800	
25	50	2	100	7,800′	400′	40,000	Sample H
26	50	1.5	75	8,600′	800′	60,000	
27	55	1.3	71	9,400′	800′	56,000	
28	45	2.5	112	10,200′	800′	89,600	Sample K
29	55	1.2	66	10,600′	400′	26,400	

Total..........650,200

Terrace Sands—

The terraces contain magnetic sands in beds which are generally horizontal, but without any continuity. The profiles 2 and 3 show, by exaggerating the vertical scale as compared to the horizontal dimensions, the manner in which these beds present

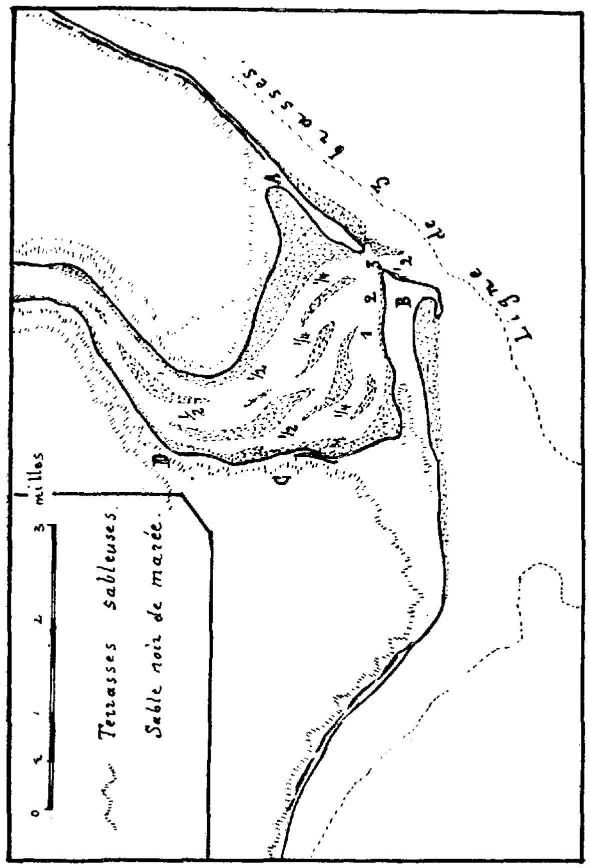


Fig. 13.—Mouth of Moisie river.

themselves. Everything indicates that their deposition was effected in agitated waters. From a practical standpoint, it is impossible to count upon any regularity whatever in the richness in magnetic sand of these terrace sands.

It is probable, moreover, that these beds of black sand are to be found only at certain points, or to be more accurate, along certain lines corresponding to the various lines of the old beaches. Thus, the cliffs dominating the river at the points C. and D. contain no trace of magnetic sand at a height of 100 feet. Right on the surface, however, is a stratum of brown sand, rather strongly cohesive, which contains a little magnetite.

Some borings were made on the two beaches east and west of the Moisie river. The results are given below.

Eastern beach—

Boring No. 1 (c) at about 9,000 feet to the east of the point A., from the top to the bottom of the cliff:

24	inches of	white, slightly gray sand.
3	"	gray sand.
2	"	white sand.
4	"	gray sand.
12	"	white sand.
3	"	dark gray and red sand (garnets).
13	"	white sand.
12	"	dark gray sand strongly charged with magnetite at the top (sample 136).
2	"	white sand.
3	"	gray sand.
4	"	magnetic black sand.
3	"	white sand.
5	"	magnetic black sand (sample 135).

Total... 7 feet, 7 inches.

One sample (No. 137) representing the average of these 7 feet 7 inches, was taken and treated with the magnet at the same time as samples 135 and 136 and the result was as follows:

	Proportion of concentrates.	Proportion of iron in concentrates.	Proportion of titanium in concentrates.
Sample 135	25.35	Not ascertained	Not ascertained
Sample 136	16.54	Not ascertained	Not ascertained
Sample 137	14.41	68.05	2.59

Boring No. 2—At 250 feet to the north of No. 1, from the surface of the soil:

27	inches of	yellow sand.
4	"	gray sand.
32	"	white and yellow sand. with small layers of gray sand.
3	"	black sand.
7	"	light gray sand.
4	"	black sand.
12	"	gray sand with a layer of 2 inches of black sand.
3	"	inches of white sand.
21	"	grey sand with numerous layers of very rich black sand.

Total... 9 feet, 3 inches.

Boring No. 3.—At 500 feet to the north of No. 1, from the surface of the soil:

68	inches of	yellow sand with a layer of 4 inches of gray sand.
8	"	gray sand with a layer of black sand.
5	"	yellow sand.
10	"	gray sand.
4	"	black sand.
10	"	white sand.
12	"	gray sand with many layers of black sand.

Total... 9 feet, 9 inches.

Boring No. 4.—At 1,000 feet to the east of No. 1, a vertical cutting in the cliff, from top to bottom:

12	inches of	gray and garnetiferous sand.
3	"	light gray sand.
5	"	black sand.
12	"	gray sand with threads of black sand.
36	"	light gray sand.

Total... 5 feet, 8 inches.

Sample 138, representing the average of these sands, contained 11.48% of magnetic concentrates.

This cutting was extended by a boring with the drill, which gave :

36	inches of	gray sand.
10	"	white sand.
3	"	black garnetiferous sand.
17	"	white, slightly grayish sand.
3	"	black garnetiferous sand.
10	"	light gray sand.
12	"	coarse sand and gravel.

Total... 7 feet, 7 inches.

Sample 141, representing the average of the sands from the boring, contained 8.17% of magnetic sands.

Boring No. 5.—At 125 feet to the north of No. 4, from top to bottom :

39	inches of	yellow sand.
3	"	gray sand with black layer.
15	"	yellow sand, slightly gray.
5	"	grey, garnetiferous sand.
22	"	yellow, slightly gray sand.

Total... 7 feet.

Sample 139, representing the average of these sands, contains 3.11% of magnetic concentrates.

Boring No. *5a*.—At 500 feet to the north of No. 4, from top to bottom :

28	inches of	yellow sand.
8	"	slightly gray sand.
4	"	gray sand.
20	"	grayish yellow sand with some black layers.
7	"	gray sand with black layers.
22	"	slightly grayish yellow sand.

Total... 7 feet, 5 inches.

Sample No. 140, representing the average, contained 2.46% of magnetic concentrates.

Boring No. 6.—At 2,000 feet to the east of No. 1; a vertical cutting along the cliff, from top to bottom:

80	inches of	white and gray sands with 6 layers of black sands from ½ an inch to 3 inches.
15	"	gray sand.
7	"	black garnetiferous sand (sample 144).
13	"	white, slightly grayish sand.
2	"	greyish black sand.
7	"	white sand.
3	"	greyish black sand.
13	"	white sand.
4	"	grey sand.

Total... 12 feet.

The average sample is No. 145. Samples 144 and 145 gave the following result when analyzed:

	Proportion of magnetic concentrates.	Proportion of iron in concentrates.	Proportion of titanium in concentrates.
Sample 144	6.71%	Not ascertained	Not ascertained
Sample 145	7.44%	65.62%	3.81%

These results may appear surprising since the average sample is richer than the layer of 7 inches of black sand. With a magnifying glass, however, these black sands are observed to consist almost solely of hornblende, augite and garnets. This should put us on our guard respecting estimates of the richness of the sands which are based solely on the abundance of black constituents.

Boring No. 7.—At 500 feet north of No. 5. The average sample No. 143 yielded 9.85% of magnetic concentrates.

Western Beach—

The terraces come down to the seashore only about 3 miles west of the point B. From that point the few borings described further on were made. According to our guides and to the reports I had in my possession, that is the spot where the richest deposits of the western part lie.

Boring No. 8.—Three miles west of point B. and 100 feet from the high water mark of the high tides of July:

6	inches of	gravel.
3	"	grey sand with a layer of magnetic sand an inch thick.
32	"	coarse sand mixed with a little magnetite.

These are evidently beach sands of recent age.

Boring No. 9—1300 feet west of No. 8, a vertical cutting along the sandy cliff bordering the beach:

12	inches of	light gray sand.
2	"	white sand.
12	"	white sand with a gray layer.
24	"	coarse sand.

The whole is very poor in iron.

Boring No. 10—2300 feet west of No. 5; a vertical cutting in the sandy cliff from top to bottom:

6	inches of	vegetable mould.
8	"	white sand.
12	"	gray sand with 2 layers, 2 inches thick, of black garnetiferous sand.
27	"	coarse sand.
9	"	a mixture, in equal parts, of coarse sand and black sand.
32	"	coarse sand with some black layers.

Total... 7 feet.

Sample 146, representing the average of these sands, gave the following results, when analyzed:

	Proportion of concentrates.	Proportion of iron in concentrates.	Proportion of titanium in concentrates.
Sample 146	4.10%	66.64	1.46

Boring No. 11—500 feet north of No. 10. Boring made with an auger from top to bottom:

20	inches of	vegetable mould and humus.
46	"	grayish yellow sand.
14	"	coarse gray sand.
2	"	black sand.
27	"	white sand, and then the water-bearing stratum.

Total... 6 feet, 6 inches.

The average sample gave the following results on being analyzed:

	Proportion of concentrates.	Proportion of iron in concentrates.	Proportion of titanium in concentrates.
Sample 147	7.30%	65.48%	1.48%

Boring No. 12—4,300 feet west of No. 8, a vertical cutting in the sand cliff from top to bottom:

12	inches of	white sand.
15	"	gray sand with small layers of black sand.
33	"	white sand.
46	"	rusty yellow sand with many layers of magnetic sand unevenly stratified.

At that level a bed of clay and the water-bearing stratum are reached.

Total, 8 feet 10 inches.

The average sample (148) contained 3.49% of magnetic concentrates.

Boring No. 13—7,500 feet west of No. 8; a vertical cutting of 5 feet in the sand cliff. The average sample (No. 150) contained 9.65 of magnetic concentrates.

Boring No. 14—9,000 feet west of No. 8. The terraces become lower and a few hundred feet further on the shore has no more sand banks. The boring made with a drill, at the edge of the forest vegetation, gave:

4	inches of	white sand.
8	"	gray sand, particularly rich at the top.
10	"	grayish yellow sand.
2	"	black sand.
6	"	gray sand.
4	"	coarse yellow sand with a layer of black sand.
16	"	light gray sand.
2	"	coarse yellow sand; then water-bearing stratum.

Total... 4 feet, 4 inches.

The average sample (No. 149) gave the following results when analyzed:

	Proportion of concentrates.	Proportion of iron in concentrates.	Proportion of titanium in concentrates.
Sample 149	8.25%	65.76%	2.28%

Conclusions—

By tabulating the results of these various borings, we get the following figures:

BEACH EAST OF MOISIE RIVER.

Proportion of concentrates.

		Average samples	Rich layers
Sample No.	130	....	32.78%
"	135	....	23.55%
"	136	....	16.54%
"	137	14.41%	....
"	138	11.48	....
"	139	3.11	....
"	140	2.46	....
"	141	8.17	....
"	143	2.85	....
"	144	....	6.71%
"	145	7.44	....
BEACH WEST OF MOISIE RIVER.			
"	146	4.10%	....
"	147	7.30	....
"	148	3.49	....
"	149	8.25	....
"	150	9.63	....

These proportions of magnetic concentrates are interesting. They may, perhaps, be somewhat high as regards what would be obtained from borings 1,000 or 2,000 feet from the sea. On these data we might calculate what would be contained in a square mile of ground taking the workable depth at 6 feet, for instance. As our borings were never made far from the sea, we can give an estimate only for a strip 500 feet wide and 6 feet deep, running parallel to the seashore. Taking the average yield in concentrates at 6.80% (which is about the average of the foregoing table) and 100 pounds as the weight of a cubic foot of sand, we come to the conclusion that, for a mile in length, this strip would contain 57,000 tons of concentrates with 65,67% of metallic iron.

There are magnetic separators which could yield concentrates freer from titanium. In any case these percentages in titanium offer no serious impediment to the working of the ore.

THE SANDS OF THE ST. JOHN RIVER.

Between the St. John river and the Mingan river, the beach consists entirely of sand. About half way between the two rivers (exactly 12 miles from Mingan and 9 miles from the St. John river), the shore makes a sharp bend, on which is a rather important fishing station called Long Point. Although badly protected from southerly winds, the fishing boats of this station remain a long while anchored off this point. Long Point is also the residence of the superintendent of the telegraph line of the North Shore and one of the terminals of the cable connecting Anticosti with the mainland.

The sands of this part of the shore are nearly everywhere charged with dark minerals. These are not only magnetite, and frequently the sands, which are richest in black elements, are not the most magnetic.

The best deposits of magnetic sands are between Long Point and the St. John river. The remarks on the Moisie sands apply equally to these and a distinction must be made between the terrace sands and the tidal sands. On the other hand the shore sometimes has an appearance which Moisie has not; between the timber-covered terraces and the sea, dunes extend which are of recent formation and are doubtless due to the action of the winds.

The richest accumulations of tidal magnetic sand are always at the foot of the cliff; there are some also on the sea slope of certain dunes. These dunes themselves contain magnetic sand either on the surface or beneath it in the shape of irregular layers. A boring might reveal a layer of six inches; the next one, 100 feet away, would give only white or gray sands.

On leaving the St. John river and going in the direction of Long Point, from the beach, which is from 50 to 200 feet wide, rise sand hills 10 to 15 feet high. A strip of tidal magnetic sands lies at the foot of the hills with a width varying between 10 and 30 feet. By digging with a shovel, a succession of magnetic layers, from 1 to 6 inches thick, will be found. Some holes may give 25% of concentrates; others from 2 to 5%. This strip runs for about three-quarters of a mile.

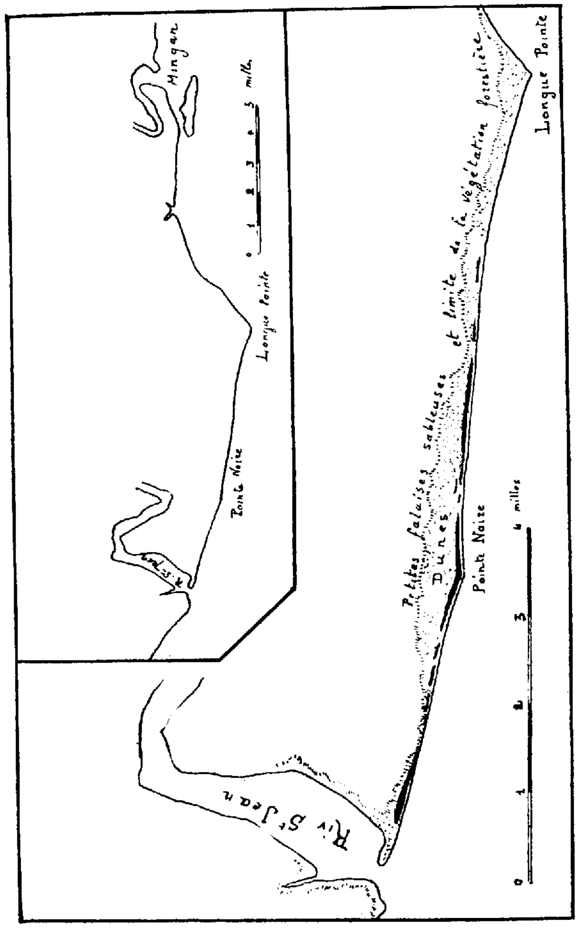


Fig. 14.—Beach between River St-Jean and Long Point.

At that distance the beach narrows and even disappears at high tide for a length of half a mile. At a mile and a quarter it widens again, but contains no large quantities of black sand.

Two miles and a half from the St. John river, the terraces begin to recede from the sea and the beach runs inland in a sort of undulating plateau and small dunes of present day formation. Fig. 15 gives the profile of the hill at that place. At the level C. D. is a superficial strip of black sands which runs from 3,000 to 4,000 feet and varies between a few feet and 40 feet in width, while the thickness is as a rule rather

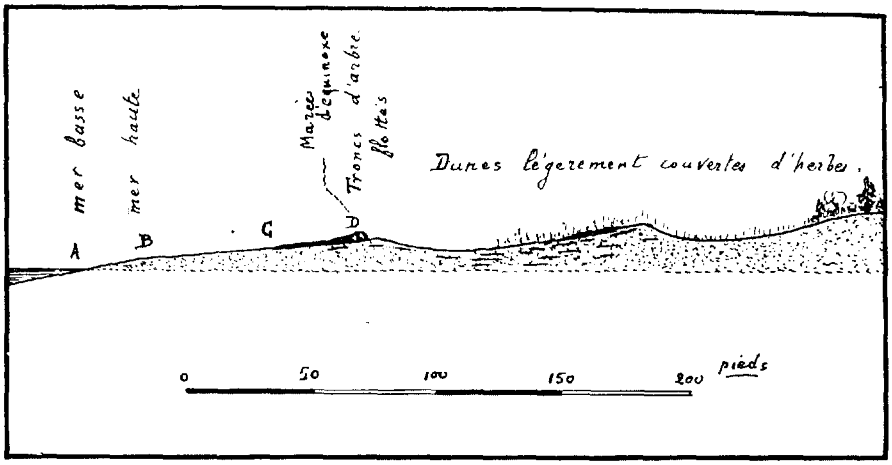


Fig. 15.—Section of beach at Pointe Noire.

slight, say 4 inches. The presence of this strip of black sand and the slight change in the trend of the hill has led to this place being called Black Point. About opposite this point, some 500 feet from the seashore, are the remains of an old boiler formerly belonging to a small station for concentrating these sands. The last strips of tidal sands encountered before reaching Long Point, are about 5 miles from the St. John river and run a length of one and a half to two miles.

The Dunes—

The undulating plateau extending between the terraces with forest vegetation and the sea, about opposite Black Point, consists of sand which is generally gray and strongly charged with magnetite, titanic iron, hornblende, augite and garnet. In some places the percentage of magnetite is rather high and there are areas of from 1500 to 2,000 feet long with a width of 500 feet, which, with a depth of 6 inches on an average, might give 8% of magnetic sand. (The sample 196, which may be considered as representing the average of the sands of that area, gave 8.16% of magnetic sands when concentrated). On the other hand, the percentage is much lower than this in other places.

The Terraces—

When the terraces draw near the sea and form cliffs worn away by water, their composition can easily be ascertained. On the whole, they seem poor in magnetic beds. The cliffs especially, which border the sea a mile and a half to the east of the St. John river, contain very little magnetite. It will be observed that the borings Nos. 7, 8 and 13, made on the terraces between Black Point and Long Point, gave 7.28%, 1.10% and 3.10% of concentrate, while, on the other hand, they gave but a low percentage at the latter point.

Result of the Borings—

The borings were made at slight distances from the shore line, starting from Long Point and going towards the St. John river. This work was done by Mr. Poitevin.

Boring No. 1—Opposite the Anticosti cable, 60 feet from the seashore. The boring reached gravel and water at a depth of 3½ feet, 2 layers of magnetic sand 2 inches thick being met. The average sample (No. 199) gave 2.05% of magnetic concentrates.

Boring No. 2—1,000 feet west of No. 1, 70 feet from the sea. The boring reached gravel and water at a depth of 7 feet; the first four feet contained 3 layers of black sand, 4 inches, 2 inches and 1 inch thick respectively; the three last were perfectly white. The average sample (No. 200) gave 4.51% of magnetic concentrates.

Boring No. 3—At the same distance as the first, but 300 feet from the sea. The boring reached coarse sand and gravel at a depth of 4½ feet and met only layers of gray and brown sand of no great value.

Boring No. 4—3,000 feet west of No. 1, 200 feet from the sea:

2 inches of magnetic sand.
4 " white sand.
6 " gray sand.
48 " white sand.

Total.— 5 feet.

The average sample (No. 201) gave 6.02% of concentrates.

Boring No. 5—5,000 feet west of No. 1, 200 feet from the sea; a vertical cutting in a hill 15 feet high:

4 feet of light gray sand.
1 foot of white sand.
6 inches of magnetic sand.
6 " gray sand.
2 feet of light gray sand.
2 feet of white sand.

Total... 10 feet.

The average sample (No. 202) gave 4.95 of concentrates. At the foot of the hill, a small strip of magnetic sand 6 inches thick.

Boring No. 6—7,000 feet west of No. 1, 300 feet from the sea. A vertical cutting in a bank 5 feet high:

2 inches of magnetic sand.
5 feet of gray sand.
1½ foot of white sand.

Total... 6 feet 8 inches.

The average sample (No. 203) gave 1.75% of concentrates.

Boring No. 7—900 feet west of No. 1, on the road of the telegraph line:

8 inches of gray sand.
5 " black sand.
23 " gray sand.
6 " black sand.
10 " gray magnetic sand.
26 " gray sand.
6 " coarse sand.

Total... 7 feet.

The average sample (No. 209) gave only 7.28% of magnetic concentrates.

Boring No. 8—12,000 feet west of No. 1 on the road of the telegraph line:

In a depth of 5 feet 6 inches, white or light gray sand only are found. The whole is not very rich and (No. 210) gave only 1.10% of concentrates.

Boring No. 9—15,000 feet west of No. 1, on a dune 350 feet above high water mark:

6	inches of	blackish gray sand.
24	"	light gray sand.
4	"	black sand.
14	"	gray sand.
2	"	black sand.
3	"	gray sand.

Total... 4 feet 6 inches, below which nothing but coarse sand was found.

Sample No. 197, representing the average of the 4′ 6″, gave 8.42 of concentrates.

Boring No. 10—16,500 feet west of No. 1, 80 feet from the sea. The first six feet of sand are very gray and contain many magnetic layers. The average sample (No. 211) gave 16.42% of concentrates. These figures must not be taken as an average percentage of the sands of the dunes, which, as I have already said, vary greatly from one point to another.

Boring No. 11—About 3½ miles west of Long Point. A vertical cutting in the cliff from top to bottom:

2½ feet of white sand.
2 feet of white sand with black layers.

Sample 190, representing the lower two feet, gave 11.50% of concentrates.

Boring No. 12—4½ miles west of the village of Long Pointe, 60 feet from high water mark, in a mound of black sand:

2 inches of black sand.
2 " white sand.
1 inch of black sand.
19 inches of gray sand.
60 " coarse white sand.

Total... 7 feet.

The average sample (No. 208) gives only 2.60% of concentrates.

Boring No. 13—3,000 feet west of No. 12, near the telegraph line:

48 feet of gray sand.
2 inches of magnetic black sand.
6 " gray sand.
3 " magnetic black sand.
12 " gray sand.
20 " coarse white sand.

Total... 7 feet 7 inches. The average sample (No. 207) gave 3.72% of concentrates.

Boring No. 14—5,000 feet west of No. 12. A boring of 7 feet gave 5.39% of concentrates (Sample No. 206).

Boring No. 15—6,000 feet west of No. 12. Two vertical cuttings in the sandy cliff showed nothing but thin layers of magnetic sand. The whole is not very rich.

Boring No. 16—7,000 feet west of No. 12, on the beach covered with black sand:

4 inches of black sand.
9 " gray sand.
2 " coarse white sand.
27 " fine gray sand.
18 " coarse white sand.

Total... 5 feet.

The average sample gave 4.50% of concentrates.

Boring No. 17—7500 feet west of No. 12, 400 feet from the sea, between two ponds. This is nearly opposite the old boiler (Black Point). The boring was done on a dune covered with black sand:

5 inches of black sand.
7 " gray sand.
3 " magnetic black sand.
9 " white sand.
4 " magnetic black sand.
10 " gray sand.

Total... 3 feet, 2 inches.

The average sample (No. 204) gave 7.58% of concentrates.

Composition of the sands—

As stated above, the black sands do not consist solely of magnetite, but contain other ferruginous elements, such as: augite, hornblende and ilmenite.

The sands of the St. John river contain more titanium as compared with the sands of the Moisie. Concentration with a hand magnet gives products richer in titanium and poorer in iron. The results of this concentration were as follows:

	Sam. No. 196 Sand of the dunes	Sam. No. 204 Boring No. 17	Sam. No. 209 Boring No. 7
Proportion of concen.	8.60%	7.58	7.28%
Iron in sand	18.38%	Not ascert.	Not ascert.
Titanium in sand	5.58%	Not ascert.	Not ascert.
Iron in concentrate...	56.84%	61.60	61.26
Tit. in concentrate....	2.40%	3.98	3.65

CONCLUSIONS.

To sum up, the material taken from the 17 foregoing borings gave the following proportions of magnetic sands on being concentrated: 2.05%, 4.51%, almost nothing, 6.02%, 4.95%, 1.75%, 7.28%, 1.10%, 8.42%, 16.42%, 11.50%, 2.60%, 3.72%, 5.39%, almost nothing, 4.50%, 7.58%. The average would be about 6.25%.

Any estimate as to quantity is impossible, because our borings were done only in the sands of the beach or of the dunes, or on the slopes of the cliffs on the seashore. In the vicinity of Black Point there are evidently fairly large quantities of present day sands which could easily be worked by means of steam dredges or shovels, thereby obtaining a high proportion of concentrates. But before thinking of carrying on work on a large scale, the richness of the sandy terraces must be ascertained. Under present conditions, the area of the tidal sands or dune sands is not large enough to justify installation of an extensive plant. Before all, it is indispensable that the magnetic sands of the terraces be taken into account.

The question of the working, handling and concentration of these sands, briquetting or nodulizing them, will be dealt with in a future report.

REPORT ON THE GEOLOGY AND MINERAL RESOURCES OF KEEKEEK AND KEWAGAMA LAKES REGION.

DEPARTMENT OF GEOLOGY, McGILL UNIVERSITY,

Montreal, March 30, 1912.

THÉOPHILE C. DENIS, Esq.,

Superintendent of Mines,

Department of Colonization, Mines and Fisheries,

Quebec, Que.

SIR,—

I beg to submit the following preliminary report on the geology of a portion of northwestern Quebec, including the townships of Preissac, La Pause, Joanne, Bousquet, Cadillac and portions of others, all of which lie to the south and east of the Kinojevis River.

I have the honour to be,

Sir,

Your obedient servant,

J. AUSTEN BANCROFT.

KEEKEEK LAKE (Looking west from hill on southern shore, near the eastern end of the lake.)

INTRODUCTION.

General Statement—

In the following preliminary report will be found the more important economic results of a geological investigation of an area to which, recently, considerable attention has been attracted because of the numerous rumours and reports concerning the discovery of valuable minerals within its borders. Since field work will be resumed in adjacent areas during the coming summer, it is deemed advisable to postpone the production of a more detailed report, with an accompanying map, for another year.

Since 1901, when the presence of molybdenite and bismuthinite was reported from the eastern shore of the large peninsula in Kewagama Lake, and especially since 1906, when the discovery of a promising deposit of these minerals was announced from the western bank of the river bearing the same name, many other deposits of a similar character have been located within this area. In certain instances, these discoveries have been followed by very favourable reports portraying the peculiar excellence of these deposits.

Late in the autumn of 1910, prospectors returning from Keekeek Lake, situated about sixty miles, N. 40° E., from the northern end of Lake Timiskaming, reported the discovery of native gold in quartz veins in the vicinity of its shores. Their glowing accounts of the size and extent of the quartz veins, and of the remarkable assay values received from their samples, coming at a psychological moment so soon after the discovery of Porcupine, caused a "rush" during the following winter. With the arrival of spring about 400 claims, embracing an area of 25,000 acres, in the vicinity of Keekeek and Wabuskus Lakes, had been staked and recorded at the bureau of the Provincial Department of Mines in Ville Marie. Among other mineral claims, located in adjacent areas during the same year, were those to the south of Newagama Lake upon a recently discovered iron range, and those to the north of Indian Bay in Poirier Lake, where a vein, four feet wide, bearing galena and zinc blende, had been found.

Particular significance and emphasis was given to these discoveries because none of them are more than thirty-five miles distant from the rails of the National Transcontinental Railway. To make a geological survey of an area including these and other mineral claims was the task assigned to the writer by Mr. T. C. Denis, Superintendent of Mines of the Province of Quebec

Acknowledgements—

In the prosecution of this work, very efficient assistance in geological mapping was rendered by Mr. J. H. Valiquette, the Assistant Superintendent of Mines in Quebec. Mr. A. O. Dufresne, a graduate of Laval Polytechnic School, Montreal, assisted by Mr. Adrian Valiquette, a second year student from the same school. made a new and much more complete topographical map of the district than has previously existed. To this group of enthusiasts in exploration, the writer feels very much indebted, as well as to his canoemen—Cléophas Lavoie, Jerry Guay and Ladislaus Girard, of Lake St. John; A. Sioui, of Lorette, and A. Dallaire, of Ville Marie—who at all times displayed an excellent spirit in their work.

For advice upon many problems, geological and otherwise, which pertained to the ultimate success of the expedition, the writer is most grateful to Dr. A. E. Barlow, who with a party of student assistants was prospecting within the district.

Position of the Area—

The area discussed in the following report comprises about 550 square miles, approximately in the form of a rectangle, the southern side of which when projected westward intersects the Ontario boundary line at a point about 42 miles north of Lake Timiskaming. The western margin of the area is about 30 miles east of this interprovincial boundary. O'Sullivan's base line, which nearly divides the area in the middle, represents lat. 48°17′14″, while the eastern boundary of the area corresponds to long. 78°13′31″.

It includes the projected townships of Preissac and La Pause and major portions of Joanne, Bousquet, Cadillac and Clericy. together with small areas in adjacent townships. The reason for the irregularity in the form of the area, suggested by the last sentence, is due to the somewhat serpentine course of the Kinojevis

River, which was selected as the western and northern boundaries of the area to be investigated.

Means of Access—

At present the National Transcontinental Railway has been completed eastward from Cochrane to the Harricanaw River. The most direct route to the area described is reached by descending from the train at a point 124 miles east of Cochrane, where the railway crosses a stream which joins the Nawapatechin River about half a mile south of this point. A good portage extends from the railroad to the Nawapatechin River, down which, after a canoe trip of 24 miles, (continuous during high water, and interrupted by four or five very short portages when the water is low), 'The Forks'' is reached, where the waters of this river unite with those of the Kewagama to form the East Branch of the Kinojevis River. From this point one may easily depart by canoe to any portion of this area by means of its excellent waterways. Another means of approach is by passing up the Harricanaw River and its lakes for a distance of 30 miles, and thence by a portage two miles long over the extremely low "height of land" between Seals' Home and Newagama lakes. A third and more devious route is afforded by descending from the train where it crosses the Whitefish River, and then taking the canoe route via Abitibi lake and river, Agotawekami Lake and a chain of small lakes leading to the headwaters of the West Branch of the Kinojevis River.

Itinerary of the Expedition—

During the time occupied by this expedition, the rails of the N. T. R. had not reached either of the points which are mentioned first. On June 8th the party, supplied with the necessary outfit and provision for the whole summer, left Ville Marie for Gillies' Depot on Lac des Quinze, a distance of 23 miles by waggon road. A small steamboat, an accident to which caused the delay of a day, was engaged to transport the party to the Sturgeon Rapids on the Ottawa River ,a distance of 33 miles. Thence after a canoe trip, via the Ottawa and Kinojevis Rivers, Long Lake, Crooked Creek, Keekeek Lake and River, a distance of about 58 miles, involving three portages with a total length of about two miles, Kewagama Lake was reached on June 16th. In making this trip, a day was spent at Keekeek Lake in a preliminary examination of the geological relationships of some of the reported occurrences of gold. Upon arriving in Kewagama Lake, a central camp was established upon a point on the eastern side of Indian peninsula in this lake.

Upon the return trip, the party descended the Kewagama and Kinojevis Rivers, carrying the survey to the point, where the latter river enters the lake of the same name. Kinojevis Lake was reached on the evening of September 8th, and two days later the party arrived in Ville Marie from Gillies' Depot.

Previous Geological Work—

Several members of the Geological Survey of Canada have investigated portions of this area. In 1901 Mr. J. F. E. Johnston made a hurried reconnaissance trip along the Kinojevis River and into Kewagama and Keekeek lakes. (1) In 1906 Mr. W. J. Wilson examined the molybdenite deposits on the eastern side of Indian peninsula in Kewagama Lake, as well as "the hills back from the lake" along that portion of the shore. (2) A portion of the data collected by them was incorporated in the compilation of a map, on a scale of four miles to one inch, of the "Vicinity of the National Transcontinental Railway, Abitibi District," which, in 1910, accompanied by a report written by W. J. Wilson, was issued by the Geological Survey. In 1910 Mr. Morley E. Wilson visited a few of the deposits of molybdenite on Indian peninsula, and those on the west bank of the Kewagama River. (3)

In 1905, Mr. J. Obalski, then the Superintendent of Mines in Quebec, passed up the Kinojevis Rivers, through East Kewagama and Newagama Lakes and continued his explorations across the height of land into adjacent portions of the drainage basin of the Harricanaw River. (4)

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(1) Summary Report on the Operations of the Geological Survey for 1900, pp. 134-136.
(2) Ibid,—for 1906, p. 123.
(3) Ibid,—for 1910, p. 207.
(4) Mining Operations in the Province of Quebec for 1906, pp. 10-13.

In 1909, while preparing a report on the "Molybdenum Ores of Canada" for the Mines Branch, Otawa, Dr. T. L. Walker, of the Department of Geology in the University of Toronto, investigated the most important of the numerous occurrences of molybdenite within the area. (5)

GENERAL CHARACTER OF THE DISTRICT.

Topography—

In this portion of the Laurentian plateau, the "height of land" makes a rather sudden bend southward, separating the waters flowing into the Harricanaw River, which enters James Bay, from those passing into the Kinojevis River, a very important tributary of the upper portion of the Ottawa River. The area discussed in this report ocupies a position within this bend, being both to the south and west of the watershed. With the exception of a small portion of Cadillac township, which drains into Seals' Home Lake on the Harricanaw River, its numerous rivers and lakes constitute the most important portion of the headwaters of the East Branch of the Kinojevis River.

In general, it is a district of widespread, slightly undulating clay "flats" and extended swamps, which, as one passes from the western to the eastern portions of the area, range from about 900 to 975 feet above sea-level,, and are surmounted by hills and low ridges which rise from 200 to 300 feet higher.

These hills and ridges usually rise very abruptly, frequently possessing summits of bare rock or are partially covered with a thin coating of soil. In the major portion of this area, the land stands but a few feet above the adjacent waterways, while small hills, 25 to 100 feet above the general level, form very prominent landmarks. Towards the southern portion of the area, the intervening lowlands and swamps become less extensive, while the hills and ridges are more numerous.

A large percentage of the topographic irregularities owe their origin to the presence of intrusive igneous rocks, as granite, syenite, quartz-porphyry, porphyrites, peridotite, hornblendite, diabase and gabbro which, being much more massive and harder

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(5) Report on the Molybdenum Ores of Canada, p.p. 32-38.

than the majority of the other rock types of the district, have formed hills of irregular outline. Prominent exemples are the granite hills of the middle portion of Indian peninsula, which rises 250 to 300 feet above Kewagama Lake (958 feet above sea-level), the granite hills dispersed at intervals eastward from Kewagama River along the stretch just above the lower rapids, the hills of hornblende-syenite in the southeastern part of the area exemplified by those at the southern end of Wabuskus Lake, and those of porphyrites and quartz-porphyry, which are of frequent occurrence in the western portion of the area. Small isolated stocks or low ridges of diabase, elongated in a general N.E.-S.W. direction corresponding to the strike of the dikes to which the ridges owe their existence, occasionally rise in a very abrupt manner; the long ridge from three to four miles east of Keekeek Lake, and that traversing the southern end of Indian peninsula may be cited as examples.

The direction of the longer axes of the remaining ridges usually corresponds to the strike of the metamorphic rocks, which quite universally display a very definite schistose structure. As a rule they trend nearly east and west, or slightly north of east, their situation being dependent upon the more resistant character of their component rocks or to their fortuitous position with reference to the development of the drainage. Such is the long and continuous ridge of squeezed conglomerate, arkose and greywacke, which, rising 150 to 200 feet above the general level, extends from the Kinojevis River, at a point about three miles below Rush Lake, to Keekeek Lake, beyond which it becomes broken and finally seems to disappear. Other excellent exemples are the hills distributed along O'Sullivan's line from the Kinojevis River to Kewagama Lake, or the prominent hill of Keewatin iron formation, situated two miles south of Kewagama Lake, above which it rises to a maximum of about 300 feet.

The strike of these rocks also roughly controls the disposition of some of the drainage features. The longer axis of Keekeek Lake roughly corresponds to such a direction, as well as the southern shore of Kewagama Lake. It seems probable that transverse lines of weakness, associated with probable fractures and possible faults, are responsible for the north-northeasterly trend of some of the lakes and certain stretches along the rivers. Some of the streams assume a very serpentine course as they wind their way across the low clay lands. Comparatively few streams in the world simulate the remarkable meanders of Crooked Creek, which joins Long and Keekeek Lakes. In so far as is known, the lakes are very shallow. Soundings were made along a line across the middle portion of East Kewagama Lake, where an exceptional depth of 42 feet proved to be a maximum. A very large portion of Poirier Lake is less than seven feet in depth. From June 18th to Sept. 1st, the level of Kewagama Lake was lowered one foot and five inches, as was determined from observing a pole which, soon after our arrival, was firmly driven into the bottom of the lake to serve as a gauge.

As examples of the many extensive swamps in the area, may be mentioned those bordering the three streams of dark water which enter Newagama Lake from the east, south and west, in the vicinity of Kapitagama Lake, and along the streams connecting the chain of lakes which lie to the west of West Kewagama Lake. An excellent example of a swamp or muskeg of a "high-level" type extends from the western end of Keekeek Lake across to the Kinojevis River, lying immediately north of the ridge of squeezed conglomerate, etc., which has ben mentioned previously.

It is difficult to harmonize this district of extensive lowlands and swamps, of shallow lakes and of rivers and streams which, apart from a few rapids or low chutes, are so sluggish in habit that they have developed most intricate meanders, with a popular notion of an area near a "height of land". To the north of this area the position of the "height of land" is marked by a very much broken "swinging chain" of hills, which apparently rise to a maximum altitude of about 500 feet above the surrounding country. For considerable distances these hills so descend as to appear to merge with the average level; so ill-defined is the watershed that it may be crossed easily without being aware of its presence, until one realizes that brooks are flowing in a new general direction. On the portage, two miles in length, across the height of land between Newagama Lake, whose waters eventually enter the Ottawa River and Seals' Home Lake on the Harricanaw River, no point is more than 20 to 25 feet above the level of either of these lakes. It is a portage which, especially during wet weather, is almost one continuous swamp.

Soil and Climate—

Extensive areas within this and adjacent districts are well adapted for agricultural purposes. In general, the soils are fertile, being very similar in character to those in the vicinity of Lake Timiskaming, and to-day small flourishing farming communities have been and are being established upon similar lands between Lake Timiskaming and Lac des Quinze. Especially suitable for cultivation are areas, such as the southern portion of Indian peninsula in Kewagama Lake, or along the northwestern shore of East Kewagama Lake, where the clays become sandy or loamy at the present surface. Where the clays maintain their tenacious habit, and possibly a stratified character, close to the surface, the roots of trees spread in preference to growing downward. In such areas the clays become baked and tough upon exposure to the sun, while at a depth of a few inches they may be nearly saturated with moisture. Such lands will require diligent cultivation to improve them.

Of the projected townships discussed in this report, La Pause, Preissac and the northern portions of Cadillac and Clericy offer the best opportunities for agriculture. The remaining portions of the area, apart from the lands adjacent to the Kinojevis and other waterways, are more hilly, and are not so easily accessible. La Pause exhibits very few outcrops of rock and, although quite swampy, contains much valuable land. Blake River, in the northern portion of Cadillac, gives ready access to much valuable land. Preissac, though largely composed of the waters of East Kewagama, Poirier, Kapitagama and Newagama Lakes, and containing the bare granite hills of the middle portion of Indian peninsula, as well as those near its northern boundary, to the east of Kewagama River, possesses much fertile land.

At the present time the question of climate is of the utmost importance. On the night of July 7th, while camped about a mile south of the chain of small lakes to the west of Lake Kewagama, which drain into Poirier Lake, quite a heavy frost was experienced. On the night of August 29th, while camped at the falls on Blake River, about two miles and a half from its mouth, the temperature became sufficiently low to form a thin continuous film of ice over water in a tin pail. Both of these frosts were felt in the widespread portions of the area where the land is low, while the hills and lands bordering upon the larger lakes did not suffer at all. For instance, upon the date mentioned first, potatoes on the property of the Height of Land Mining Co., Kewagama River, were partially blackened, while those on the northern side of Kewagama Lake, just west of its outlet, remained untouched. I was informed by Mr. C. S. Richmond, who for the last five years has lived upon the property referred to, that previously he had never noticed a frost in the month of July. Moreover, data kindly furnished by Mr. R. F. Stupart, Director of the Meteorological Bureau of Canada, Toronto, show that upon July of last summer the minimum temperatures recorded at Abitibi and Matheson were 54° and 33° respectively.

Upon the establishment of farming settlements, the climate will certainly become much better. With felling of the bush some of the widespread swamps will be drained, which in early and late summer permit the heat of the day to penetrate but to very slight depth, the lowlands will be exposed to whatever air movements are in progress, and the ploughed fields will deter the rapidity of nocturnal radiation. Such changes as these will lengthen the period during which frosts may not be expected. It would seem advisable that, at present, settlement should be encouraged in the vicinity of the larger lakes where the range of diurnal temperatures is not so great and is subject to the least fluctuation.

Certain portions of the area will be excellent land for the growth of hay, oats, barley, rye, potatoes, turnips, etc.: in short, a district for mixed farming and dairying.

Flora—

For the most part, this district is still covered by its primeval forest, since fires have devastated but comparatively small areas. Over considerable portions of the area, a fair proportion of the trees will yield good lumber; over more widespread portions, they are suitable for the manufacture of pulp. Many of the extensive swampy areas, however, are either partially or quite free from trees, or they are covered by extensive thickets of small black spruce, with a dense growth of alders and a few tamarack and jackpine. In the vicinity of Kewagama Lake, especially upon the northern and southern portions of Indian peninsula, and to the south in certain parts of Cadillac and Bousquet townships, there is much excellent timber.

The more important trees of the district are black spruce, white spruce, balsam, white birch, aspen, balsam poplar, jackpine, tamarack and white cedar. Of these, the spruce and aspen are apparently the most abundant. In addition, a few white pine, red pine, yellow birch and black poplar were noticed. Some excellent specimens of white pine occur upon the southern part of Indian peninsula, occasionally a very few are scattered in the townships south of Kewagama Lake, a rather fine grove of these trees being situated near a small pond called Round Lake, which lies about a mile in a south-southwesterly direction from the rapids on Keekeek River. The white birch grows to large size; when in large numbers, this tree indicates the presence of a soil containing numerous boulders, or the occurrence of outcrops of bed-rock in their vicinity. The jackpine flourishes best upon sandy soil; between the 40th and 42nd mile posts on O'Sullivan's line, where the soil is sandy for hundreds of yards at a stretch, the jackpine is practically the only tree to be seen. Small, scrubby and gnarled white cedar grow in the vicinity of lake shores and occasionally upon the margin of some of the streams. Tamarack is fairly abundant in the swampy areas, the majority of the large trees of this species having died from the ravages of the larch-fly some years ago.

The heavy undergrowth of Labrador tea, laurel, alders, ground maple, small ash, etc., together with the heavy blanket of mosses, which almost universally covers this country, makes prospecting an arduous task. Anyone contemplating an expedition to prospect this or adjacent districts should provide themselves with a mattock, which will prove to be even as useful as the customary hammer.

Fauna—

Moose are quite plentiful, being seen on several occasions by members of the expedition. Near the waterways, in some portions of the area, their trails are well beaten and always fresh. Black bear must be fairly abundant, for evidences of their presence were noticed repeatedly in the bush, especially upon the granite hills of Indian peninsula, where blueberries grow in great profusion. The small fur-bearing animals are rapidly disappearing, although specimens of beaver, mink, marten, fisher, otter, fox, ermine and muskrat, or traces of their presence, were observed by those connected with the party. Of these the muskrat is most numerous; happy in his natural habitat of almost continuous low muddy banks, this creature seems to be the last of the animals to realize that this area is about to be more frequently visited, and probably settled. The other animals have sought out the most secluded spots in an attempt to continue their existence. The lynx, a few wolves and an occasional caribou are said to be present. Rabbits are not uncommon. Squirrels and chipmunks are plentiful.

Gulls of two varieties, a large and a small, have selected rocky islets in several of the more important lakes as nesting-places. Ducks are comparatively scarce, but the ruffled grouse and spruce partridge exist in large numbers.

Fish are quite plentiful. Of the edible varieties, pike, maskinonge, pickerel and whitefish are the most abundant, while a very few bass are only known to occur in the waters of Keekeek Lake, whose shores are the most rocky of any lake in the area. Sturgeon, of which several large specimens were seen, are reported to be comparatively numerous in the waters of the Kinojevis River and Kewagama and Newagama Lakes. The chub and suckers are of frequent occurrence, several of the peculiar heaps of pebbles which are constructed by the former in breeding season being noticed along the Kinojevis River. The complete absence of trout is worthy of special comment.

GENERAL GEOLOGY.

The following table of formations displays in a concise manner the geological sequence recorded within the area examined :—

1. QUATERNARY.—Glacial and post-glacial clays, sands and gravels. Post glacial stratified clays, frequently bearing calcareous concretions, occupy very large areas.

Very great unconformity.

2. POST-HURONIAN.—Large dikes and small stocks of quartz-diabase, olivine-diabase and olivine-gabbro. (Probably of Keweenawan age).

Igneous contact.

3. HURONIAN (?).—Conglomerate, arkose and greywacke—all of which have become schistose. (Possibly belongs to the Fabre-Timiskaming series).

Unconformity.

4. LAURENTIAN.—Batholiths and stock-like intrusions of granite and syenite, with allied dike rocks.

Igneous contact.

5. KEEWATIN.—A complex of biotite, actinolite chlorite, quartzose, sericite and talcose schists, amphibolites, slates, "iron-formation," tuffs, volcanic breccias. rhyolites and basalts intersected by much altered but frequently yet massive intrusions of peridotite, hornblendite, gabbro, diabase, porphyrite and quartz-porphyry.

Keewatin—

The major portion of the area is underlain by this complicated group of rocks, comprising a portion of the earliest records in the Pre-Cambrian geology of North America. Repeatedly having been subjected to intense metamorphism, quite generally these rocks have become so schistose that their original character either can only be deciphered by patient research, or possibly has been effectually obscured. It is remarkable that in some localities, either they have been spared from or have so successfully resisted the squeezing and shearing that they have retained their original appearance to a marked degree. Especial reference may here be made to certain flows of rhyolite and basalt in the vicinity of Cascade Rapids on the Kinojevis River, which display amygdaloidal structures that have been but slightly modified; to numerous intrusive bodies of quartz porphyry, gabbro, diabase, etc., which partially altered from a mineralogical point of view still retain their original peripheral outline; and to granular quartzose rocks, slightly foliated, which, inter-banded with the iron formation south of Newagama Lake, have the appearance of modified arkose or quartzite.

The Keewatin rocks are chiefly schists trending in a general direction slightly north of east and intersected by numerous intrusions of so-called "green stones," including peridotite, hornblendite, diorite, gabbro, diabase, porphyrite and quartz porphyry. In very many instances these intrusive bodies of igneous rocks have been converted either partially or completely into schists, but frequently they have proved to be more resistant both to the metamorphic and weathering processes than the rocks into which they have been injected. These intrusions, rising through the schists and protruding from beneath the clays, often with rounded and glaciated surfaces, form a large proportion of the hummocks or low hills which rise above the average level of the district.

South of a line drawn from the bend which the Kinojevis River makes toward the southwest, about three miles below Routhier Lake, across to the rapids on Keekeek River and beyond, distinct intrusive bodies of Keewatin greenstone are not of such frequent occurrence as in other parts, while biotite-schists with occasional bands of hornblende and chlorite-schists are the predominant types of rock. A portion of this area is occupied by the zone of schistose conglomerate, arkose and greywacke, provisionally described in this report under the Huronian. Although the petrographical study of Keewatin schists collected in the field has not yet been completed, it seems certain that a considerable portion of them are of sedimentary origin; but difficulty arises in that some of the light grayish-green quartz-porphyries or porphyrites were found passing into biotite-schists, which simulate very closely some of those to which a possible sedimentary origin might be attributed. It is certain that those rocks associated with the iron formation south of Newagama Lake are altered sediments. Though more or less schistose, they retain the appearance of sedimentary rocks, and their microscopic study bears confirmatory evidence.

Quartzose biotite schists are of frequent occurrence in Preissac township in the vicinity of granitic intrusions. Near the contacts, the schists frequently possess a granitized appearance and are often characterized by leaf-like aggregations of flakes of biotite, arranged parallel to the schistosity and seldom more than an inch or two across when the plane of schistosity, upon which they occur, is exposed.

In the northwestern portion of the area, old lava flows, quite frequently retaining some of their early characteristics; volcanic breccias and tuffs occur, the former typically exposed to the south of the Cascade Rapids and also on the northern portion of the eastern shore of the lake on the Kinojevis River above the Clay Rapids. Light grayish-green intrusions of quartz porphyry, sometimes partially converted to slates, are of frequent occurrence in the northwestern and western portions of the area. Intrusions of peridotite are especially numerous in the vicinity of East Kewagama Lake, west of Poirier Lake and on the northwestern part of Indian peninsula. In places the peridotites are commonly altered to talc, a light greenish mica and a carbonate probably rich in magnesium and particles of black iron ore. Upon one of the larger islands in East Kewagama, the talc, though very impure, is the best observed within the area.

The intrusive igneous rocks of Keewatin age appeared in an order of decreasing basicity. The peridotites are cut across by intrusions of Keewatin diabase. The gabbros, presumably injected at the same time as the diabase, are intruded by the quartz-porphyries. As a culmination of this sequence of intrusions, in which each successive type was somewhat more acidic than the preceding, the Keewatin rocks became invaded by batholiths and smaller bodies of magma of granitic character, which are now included under the name 'Laurentian''.

Laurentian—

The close of the Keewatin was marked by the intrusion of batholiths and small bosses of granite and syenite, together with dikes of allied rocks. In fact, it seems probable that the Keewatin rocks were then resting upon a continuous basement of acidic magma, from which these intrusions emanated.

The more important areas underlain by granite are within the township of Preissac. In the southern portion of the district, near the southern end of Wabuskus Lake and at the rapids on Crooked creek, intrusions of massive, coarse-grained quartz-hornblende syenite probably represent the northern margin of an extensive area of Laurentian which lies to the south of the area examined. Small intrusive bodies and dikes of granite, usually exhibiting a porphyritic structure, are of very widespread and frequent occurrence.

In hand specimens the prevailing granite is light grey or whitish and of medium or normal granitoid texture. It is a biotite-muscovite granite, rich in quartz and oligoclase with some orthoclase and microcline, a few small crystals of apatite and zircon and a very few minute grains of magnetite. Small red garnets and irregular grains of epidote are common constituents. Near the contact it develops into varied marginal facies, which are sometimes repeated in the small, isolated intrusions. It becomes slightly gneissoid or exhibits a tendency toward a porphyritic structure. In some localities, as on the west side of Kewagama River and on parts of Indian peninsula, it develops pegmatitic and aplitic facies. In other places, as on some of the islands in East Kewagama Lake and on the point which forms the southern side of the entrance into the large southeast bay of this lake, it contains much hornblende, sphene and primary epidote. Occasionally hornblende, in the form of small, needle-like crystals, is present to the exclusion of biotite.

Near the contacts, ribbon-like inclusions of schist within the granite are of frequent occurrence. The schists enwrapping the batholiths are often intruded by dikes of granite which assume a direction parallel to the planes of schistosity.

After the now invisible portions of the batholiths of granite had crystallized, the region was injected by a multitude of very quartzose pegmatite dikes. Locally, where they cut the granite or the adjacent schists, these quartzose pegmatite veins contain molybdenite, bismuthinite, fluorite, etc.; they will be described at length in that portion of this report devoted to the occurrence of these economic minerals. Although, within the area as a whole, many of the quartz veins probably were formed by heated solutions which passed outward while the upper portions of the batholiths were cooling, it seems certain that the largest of the veins and bodies of quartz came into existence during this period of pegmatitic injection.

Huronian (?)—

For about three miles below Routhier Lake, the Kinojevis River flows eastward, when it suddenly bends toward the southwest. A short distance below the small lake which is situated at this bend, exposures of very much metamorphosed conglomerates, arkose and greywacke appear at intervals on both sides of the river for about three-fourths of a mile. Either vertical or dipping very steeply toward the north, and striking nearly east and west, these rocks may be traced to Keekeek Lake and the upper portion of the river bearing the same name. Some of the most easily accessible and typical exposures of the conglomerate occur on Demers' and other claims, situated to the northwest of Wabuskus Lake, upon the northern shore of Keekeek Lake near its western end, and to the north of Keekeek River for about three miles below the lake. The most eastern outcrops of these rocks observed appear on C. E. O'Neill's claim No. 1, which includes a portion of the small pond called Round Lake, situated about two miles and a half east of Keekeek Lake. In this locality the conglomerates and associated rocks were dipping 80° or more toward the north and striking 12° south of east. Three traverses southward into Cadillac township failed to detect the presence of these rocks.

The conglomerate is chiefly composed of pebbles of Keewatin greenstone, although pebbles of granite and diorite are of frequent occurrence. Originally the pebbles were well rounded and varied in size up to at least a foot across; they have been so flattened by pressure that to-day they possess lenticular forms, often drawn out to great length, the longer axes of which correspond to the regional strike of the schistose rocks. In certain instances, the pebbles have been smeared out to such an extent that their former presence is represented by a light-coloured streak within the schistose matrix; in a few instances where metamorphism has been most intense, the deformation of the pebbles may be traced in successive stages to such extremes that it seems certain that the former presence of some pebbles has been effectually obliterated.

The matrix of the conglomerate as well as the arkose and greywacke have been quite universally converted into biotite-schists, partially or completely recrystallized, yet repeatedly exhibiting their original clastic character. In thin section under the microscope, the original rounded grains of quartz and feldspar form beautiful "augen" enwrapped by the biotite.

The exact relationship of this group of sediments is obscure within the area examined. That they rest unconformably upon the Keewatin proper is evidenced by the pebbles in the conglomerate, and the position which some of the exposures bear to those of the Keewatin. Certain features suggest that their manner of occurrence is due to a tightly compressed syncline. At no point was their contact with subjacent rocks observed; likewise they were not noticed to be intruded by tongues or dikes of granite. Although tentatively placed in the Huronian, many features connected with their occurrence suggest that they belong to the Fabre-Temiskaming series, which (in the summer of 1909) were first recognized by Messrs. R. Harvie and C. Reinhardt while working independently within areas to the east and west of Lake Temiskaming respectively. The superabundance of pebbles of Keewatin greenstones in the conglomerate, the extremely schistose character of the series and the large number of quartz veins which traverse them, suggest this possibility.

Through information from Dr. A. E. Barlow, it has been learned that in the vicinity of Kekeko Lake, which lies about eight miles westward from the area described in this report and in direct line of strike with this series, comparatively flat-lying and unmetamorphosed conglomerates of the Lower Huronian occur. It thus seems probable that the key to the stratigraphic position of these highly schistose rocks may be found in that locality.

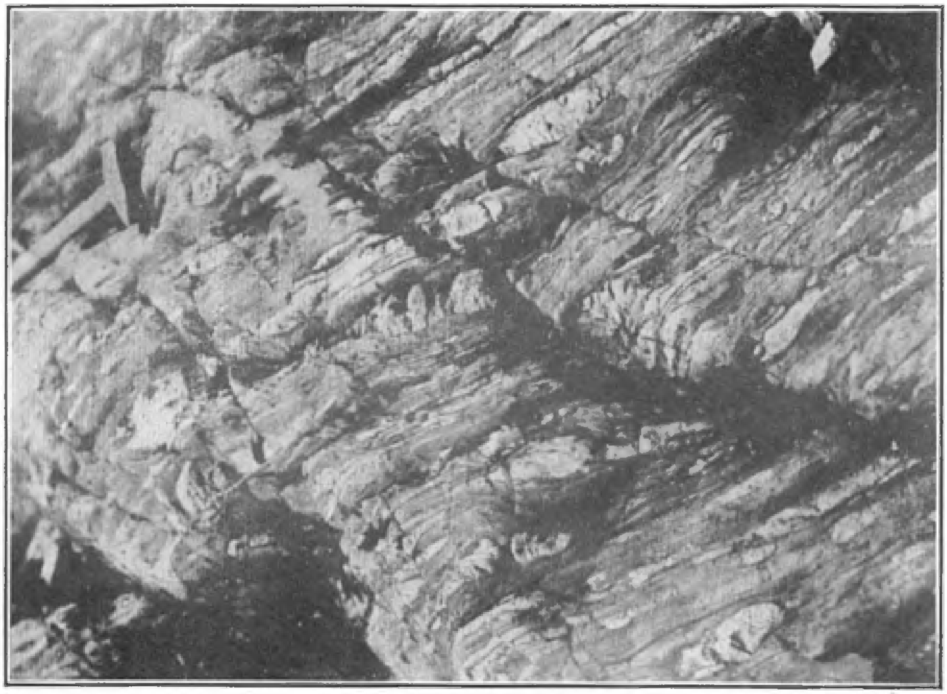
The sharp point, which projects from the eastern shore of Clericy Lake in the township of the same name, is composed of massive beds of arkose two or three feet thick, separated by shales, which are striking S. 64° E. and dipping about 30° toward the southwest. This isolated outcrop is the termination of a low clay-covered ridge which extends toward the southeast for a few hundred yards; because of the comparatively unmetamorphosed condition of these rocks, it is quite probable that they are of Huronian age.

Post-Huronian—

The youngest rocks within this area are diabase and gabbro, which in the form of dikes and small stocks intersect all other rock types. Large dikes, varying from thirty to five hundred feet in width and remarkable for their continuity, traverse the region in a general N.-N.E.—S.-S.W. direction. A few small dikes, up to three feet in width, branch off from the major series, yet were never noticed to extend more than a few yards from their parental source. Being a massive, compact and comparatively fresh rock, the diabase, of which the gabbro is a phase, resists the processes of weathering better than the other rock varieties. Where these dikes traverse granite, as on Indian peninsula in Kewagama Lake, and to the east of Kewagama River, their exposed surfaces are either flush with or rise in relief above those of the granite. In areas underlain by other rocks, often rendered very flat by the presence of a heavy blanket of clay, barren wall-like ridges of diabase rise steeply to a height of from twenty to a hundred feet, or these may extend for several hundred feet or yards as a continuous outcrop, and, terminating suddenly, may frequently be found again if the direction of elongation of the outcrop be followed. The small stocks occupy isolated positions, or are distributed along a line corresponding to the prolongation of some dike.

Frequently near their margins these intrusive bodies contain fragments of the rocks which they have penetrated. Such intrusions are less numerous where they traverse Keewatin rocks than when their course lies across areas where their intersection with the granite is exposed. About three-quarters of a mile to the east of Kewagama River, opposite to the property owned by the Height of Land Mining Co., a dike of diabase with a maximum width of about 400 feet was followed by almost continuous

PLATE XXIV.



METAMORPHOSED CONGLOMERATE, KEEKEEK LAKE, AT DISCOVERY POST OF S. LEROY'S CLAIM No. 2.

PLATE XXV.

INCLUSIONS OF GRANITE (G) WITHIN THE NEWER DIABASE.
(About ¾ of a mile east of Kewagama River).

outcrop for about two miles. Where it intersects the granite, the diabase occasionally includes numerous long slabs of this rock; so narrow and remarkable are some of these inclusions that, at first glance, they may be mistaken for dikes of granite cutting the diabase. (See Plate XXV).

Occasionally the marginal portions of the dikes of quartz-diabase and the adjoining rock have been impregnated, more or less, by finely disseminated grains of pyrite, arsenopyrite and an occasional speck of copper pyrites. The veins of calcite and quartz, bearing galena, zinc blende and pyrite, which are situated a little more than half a mile from the northern end of Poirier Lake, are genetically related to the diabase. About two miles westward from the northern end of Wabuskus Lake, on Quass' and Demers' claims, two parallel dikes of quartz diabase, striking N. 36° E., with average widths of 30 and 85 feet respectively, for a few feet from their contacts, have altered the highly metamorphosed conglomerate and greywacke to a dense hornstone and impregnated them with arsenopyrite. Some of this mineralized hornstone was assayed, returning not a trace of silver or gold.

Variations in appearance of specimens of the diabase depend in part upon the depth within the dike which the present surface represents, in part upon the width of the dike and the distance from the contact at which the specimen was collected, and likewise upon magmatic differentiation which has evolved types of different mineralogical composition. These dikes have all emanated from some indeterminable depth beneath the basement of intrusive granite upon which the remaining rocks of the district rest. In general, where they intersect granite areas or those where Keewatin rocks cover the granite to no great depth, they are usually coarse-grained, becoming somewhat less coarsely crystallized as this cover increases in thickness. In immediate conjunction with the intruded rocks, the diabase is black and so fine-grained that as a rule no crystals are discernible to the naked eye, except possibly a few spicule-like crystals of plagioclase. Within six inches from the contact, these minute crystals of plagioclase become quite abundant, and within two to six feet the rock displays that uniformity of appearance which usually characterizes the central portions of the intrusions. About two miles northwest of the western end of Keekeek Lake, a dike of quartz-diabase, presumably an extension of the larger dike mentioned in the last paragraph, contains crystals of the so-called "huronite" near its margin. These yellowish-green crystals, some of which displaying almost perfect crystal outlines, others assuming irregular forms, vary in size up to slightly more than an inch across. They are very numerous near the contact, becoming less abundant for two feet within the dike where they cease to be present. It was impossible to determine for what distance the contact is characterized by their presence. As has been observed by those who have investigated similar occurrences in other localities, these crystals, in thin section under the microscope, proved to be labradorite very much altered to sericite, epidote and zoisite, but in a few individuals still retaining small remnants of the fresh, glassy plagioclase.*

These dikes and small stocks are composed of two distinct varieties of diabase, one containing olivine and the other quartz. Locally both types are very fresh and become so coarsely crystallized in the central portions of some of the intrusive bodies as to justify naming them gabbro. They become of a medium to coarse granitoid texture, and have been frequently called "syenite" or "diorite". The two types simulate each other closely, and are each subject to considerable variation in appearance dependent upon local differentiation of the magma from which they have crystallized. Since these two varieties were never noticed in contact, their relative age was not determined. It may be that they are differentiation products from the same magma.

A small stock of very fresh olivine-diabase of coarse grain, about seventy-five feet high, roughly elliptical in form with a longer axis of three hundred yards, is situated two hundred and fifty yards from the west bank of the Kinojevis River, about a mile above Routhier Lake. A few yards from the western shore of this lake, at a point about half a mile from where the Kinojevis enters, another small stock of similar character is situated. Less than two miles south of Kewagama Lake on the winter

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*On some dykes containing Huronite, by A. E. Barlow, the Ottawa Naturalist, Vol. IX. No. 2, pp. 25-47.

road to Keekeek Lake, an irregular stock of olivine-diabase occurs, which is especially rich in ilmenite, biotite and occasional crystals of primary hornblende, up to an inch in length. Upon the northeastern corner of Indian peninsula, olivine-diabase outcrops upon the shore and on an adjacent island, these outcrops apparently being portions of a dike which extends almost the whole length of this peninsula. The two small bodies of coarse diabase breaking through the iron formation south of Newagama Lake presumably belong to the olivine-bearing variety.

In thin section under the microscope, the quartz-diabase is found to be chiefly composed of labradorite and augite, exhibiting the characteristic ophitic structure, and variable amounts of quartz which is micrographically intergrown with the labradorite in a most intricate manner. Variable amounts of black iron ore, apatite, biotite and sphene are present as accessory minerals. Chlorite, secondary hornblende, sericite, epidote, zoisite, calcite and leucoxene are common secondary minerals.

Where the large dike of quartz-diabase to the east of Kewagama River intersects the granite, it is traversed by a small dike of aplite, up to four inches in width, which is identical in character with a similar phase of the diabase so frequently met with in Gowganda and other districts. It consists essentially of micrographic intergrowths of quartz and oligoclase, which in thin section often resembles microcline, together with a little chlorite and sphene.

On the eastern side of Lake Poirier, a large dike of diabase, ranging up to at least three hundred feet in width, follows approximately the general trend of the lake so closely that at intervals it appears along the shore. A few hundred yards south of where a large brook empties into the lake, near the entrance of the bay leading to the portage across the northern end of Indian peninsula, towards the middle of this dike the diabase passes very gradually to a red rock which bears no resemblance to a diabase. This red rock is chiefly composed of hornblende, biotite, andesine and a large amount of quartz, the last two minerals mentioned exhibiting remarkable micrographic structure. These facts demonstrate that the quartz-diabase is the same as that of Cobalt and adjacent districts, where it has been found to be subject to analogous variations in petrographical character and where, in contrast with the older diabase of Keewatin age, it is called 'the newer diabase' and is definitely known to be Post Middle-Huronian and very probably of Keweenawan age.

Quaternary—

During the last glacial invasion of this district, the ice moved S. 12° W., this direction being subject to local change according to the contour of the floor over which the ice advanced. At least two older series of striations were noticed in a considerable number of localities, but an attempt to correlate them proved futile. Roches moutonnées and smooth striated rock exposures, as are excellently developed on the southern shores of Kewagama and Routhier lakes, are a very characteristic feature of the region. In general, bed rock is best exposed upon the northern slopes and the tops of the hills, since the ice in riding up over them scraped them quite bare and frequently dumped sufficient glacial rubbish upon their lee or southern slopes as to conceal the rock beneath. Upon the majority of the islands rock is best exposed upon northern shores; on the other hand, exposures of rock are more numerous on the southern than along the northern shores of lakes.

Boulder clay and boulders were irregularly distributed beneath the ice-sheet, from the margin of which, during its recession, sands and gravels were also washed. These out-washed sands and gravels occasionally accumulated in the form of prominent kames such as the "Gravel Hills" on the outer side of the southward bend of the Kinojevis River about midway between the Cascade and the Clay rapids; in some other places they form a comparatively thin coating upon some of the rocky ridges. To the east of Wabuskus Lake, kames are associated with low ridges of sand and gravel which possibly are eskers, a form developed by streams flowing beneath the ice.

The major portion of the area owes its present uniform surface to the deposition of post-glacial stratified clays, presumably of lacustrine origin. Some of the best exposures of these clays occur along the shores of the southern portion of Indian peninsula in Kewagama Lake, (See Plate XXVI) upon the shores of

PLATE XXVI.

STRATIFIED POST-GLACIAL CLAYS. (Eastern shore of the southern portion of Indian Peninsula.)

PLATE XXVII.

QUARTZ VEINS ON McCORMACK'S CLAIM
(North side of Kinojevis river, above Cascade rapids).

Poirier Lake, the western shore of Valiquette Lake, the southern shore of Newagama Lake, etc. Widespread areas in the vicinity of Kewagama Lake, which rise to elevations up to 25 or 30 feet above its level, are generally underlain by these tenacious and almost impalpable clays. The stratification of the clay is much accentuated by the regularity with which, upon exposed surfaces, reddish and light gray layers alternate, seldom varying more than from one-third to one-half of an inch in thickness. In many localities, this clay contains numerous calcareous concretions, the majority of which are discoidal, although many have assumed peculiar shapes.

The development of a rejuvenated drainage system, the streams of which are characterized by long stretches of almost dead water alternating with occasional rapids and shallow lakes, the modification of the lake shores by waves and by the expansion of ice in winter, the development of widespread swamps, the clothing of the surface with trees, shrubs and a heavy blanket of moss constitute the most important events in the most recent chapter of the geological history of this as well as that of adjacent districts.

ECONOMIC GEOLOGY.

Gold—

Within the metamorphic rocks of a more or less schistose character, quartz veins are of very frequent occurrence. In a very few instances they assume the form of very large irregular bodies or veins, from which smaller veins, in a perfect tangle or network, emanate in all directions. As an example of this type of occurrence, a brief description will be given of the most remarkable display of quartz observed within the area. This occurs on what is known as McCormack's claim, on the northern side of the Kinojevis River about a third of a mile above the Cascade rapids. Here a ridge, 330 yards long and extending approximately east and west, is situated about 450 yards from the river. It is chiefly composed of greenish mica-schists traversed by large quartz veins. For 65 feet along its crest, near the western end, a body of quartz, enclosing but little schist, has a maximum width of 105 feet; from this mass myriads of reticulating stringers extend in all directions. Upon the southern slope and towards the eastern end, an upper quartz vein with a maximum width of 4 feet can be traced for 72 yards; a lower vein with a maximum width of 18 feet for 78 yards. Both of these veins are striking approximately east and west and dipping towards the north. (See Plate XXVII). When traced eastward they are found to merge in an irregular body of quartz, 45 to 50 feet wide. The quartz is milky-white in colour, very hungry in appearance, and but rarely contains a few specks of pyrite which, upon weathering, impart a local rusty appearance to the quartz. In one of the smaller veins, a few needles of black tourmaline and a little feldspar graphically intergrown with the quartz forcibly suggest that the occurrence is of pegmatitic origin. Its character is such that it might well be described as an irregular intrusive body of quartz from which an anastomosing series of quartz dikes, large and small, have been injected into the adjacent rocks. An assay of many small fragments, which were considered to represent the most promising material, did not yield a trace of gold.

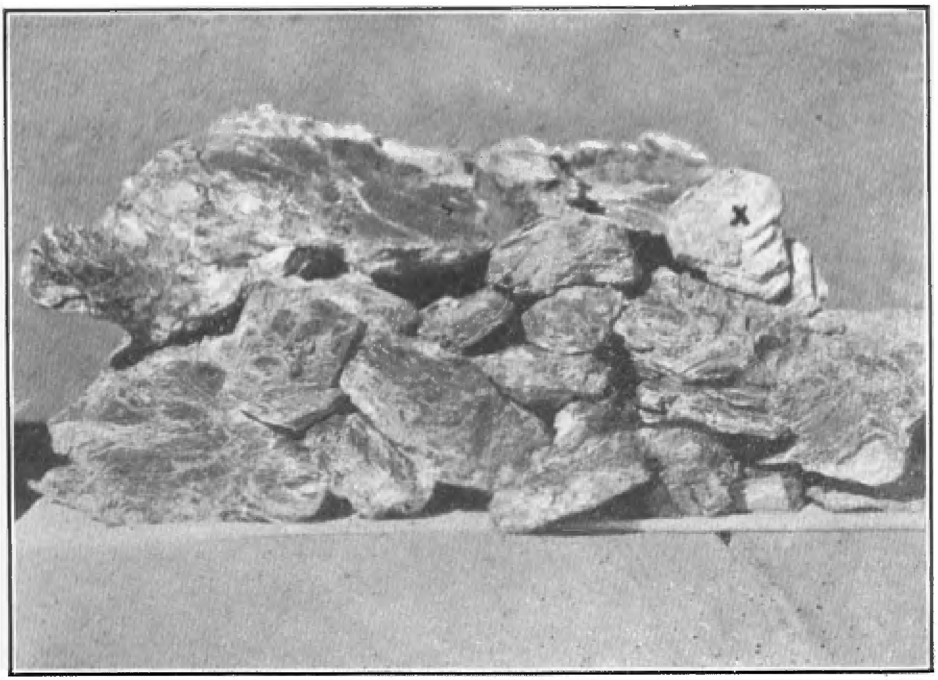
Similar occurrences of quartz, though developed on a very much smaller scale, were examined on Obalski Mountain, a hill about 125 feet high rising abruptly on the south bank of the Kinojevis River, about six miles below the forks, and also on a claim held under the name of D. Periard, about a mile and a half north of the creek joining Keekeek and Wabuskus lakes. An assay of typical quartz containing a little pyrite, from the former locality, did not give a trace of gold. Five assays from the mineral claim mentioned yielded the same result, although reports were widespread that rich gold values had been obtained by others.

In general the quartz veins are better described as stringers of very irregular width, trending in a direction parallel to the strike. Each stringer seldom has a length of more than a few feet, and a width up to three or four inches. Occasionally they assume an irregularly lenticular form, attaining a maximum width up to slightly more than two feet, tapering to nothing within a few yards in either direction. They are often wavy or folded in a manner corresponding to the crenulations of the schistose rocks; less frequently they have been pulled out so that they appear as a succession of small lenses. The largest veins of blue

PLATE XXVIII.

TYPICAL QUARTZ VEINS OF KEEKEEK DISTRICT, SUMMIT OF HILL ON SOUTH SHORE AND NEAR EASTERN END OF KEEKEEK LAKE.

PLATE XXIX.



MOLYBDENITE CRYSTALS, FOM THE PROPERTY OF THE "HEIGHT OF LAND MINING CO.", KEWAGAMA RIVER.
(The crystal marked X is two inches across.)

quartz noticed within the area occur about two miles slightly south of east from the falls on Blake River; an assay yielded mere traces of gold.

In the vicinity of Keekeek and Wabuskus lakes, (see Plate XXVIII), stringers of a deep blue or smoky quartz are especially abundant in the squeezed conglomerates, graywacke and biotite-schists. The quartz veins often contain a little calcite, occasionally a few grains of pyrite and very rarely minute specks of copper pyrites. Similar veins occur eastward from the Blake River above the falls, and on the northern portion of Iron Mountain to the south of Newagama Lake. They also occur along a belt of irregular width eastward to the Kinojevis River. Upon some of the claims, two to three miles west of Wabuskus Lake, quartz veins of this character contain a considerable amount of arsenopyrite.

Two specimens of quartz of the deepest blue colour were examined in thin section under the microscope. They were found to be composed of a mosaic of very large quartz individuals invariably exhibiting strong strain shadows, some of the grains also being granulated at their margins. Small cavities containing minute bubbles are abundant, and a few small dark needles, which may possibly be rutile, were noticed to be present. It seems certain that at least the great majority of the quartz veins of this district represent the silicious extreme of the pegmatite dikes which were intruded during the time when the lower portions of the batholiths of granite were cooling.

Unfortunately it would be inexpedient to fill pages with detailed descriptions of individual claims staked for gold in the vicinity of Keekeek and Wabuskus lakes. Suffice it to say that nearly all of the claims were examined, especial attention naturally being devoted to those which were reported to be of promise.

As disappointing as it may seem, not a speck of native gold was noticed in the very large number of quartz veins, stringers and lenses which were examined. It is certain that not a single claim, at the present time staked for gold within the area discussed in this report, is worthy of the serious attention of mining interests. Of all samples collected, including those from the most "promising" prospects, the best assays show the presence of only $1.20 per ton in gold and a trace of silver. The whole area has not been prospected, and there remains the possibility that native gold may yet be found within some of the multitudinous quartz veins of the region.

Molybdenite and Bismuthinite—

In 1901, Mr. J. F. E. Johnston of the Geological Survey of Canada, reported the presence of molybdenite and bismuthinite in quartz veins exposed on the shore of Indian peninsula in Kewagama Lake. Presumably from his description, the discovery was made at Nose Point on the eastern side of the peninsula, upon what is now known as the Hervey claim. He writes as follows :—. . . . "there is a very quartzose altered granite intersected by numerous veins of white translucent quartz of various sizes. Of this quartz several specimens were broken off at random from the top. One of these, carrying considerable iron pyrites, was assayed under Dr. Hoffman's direction and gave 0.117 of an ounce of gold to the ton of 2,000 lbs. Others quite close carried molybdenite and bismuthinite."

Since 1901, these two minerals have been found to be of frequent and widespread occurrence in the projected township of Preissac. Their distribution is coincident with those areas which are occupied by intrusions of a biotite-muscovite granite, and the dikes or veins which intersect the schists in the immediate vicinity of the contacts of these intrusions.

The occurrence of these minerals is further restricted to pegmatitic and aplitic facies of the granite, and more especially to quartz veins which, in large numbers and frequently of large size, traverse the granite.

In some places near their contacts, these intrusions of granite have developed types of granite and diorite with which deposits of these minerals are not associated. The typical granite with which they occur is usually light grey or white in colour, occasionally assuming a slightly reddish hue. In the hand specimens much quartz, feldspar, biotite and muscovite are discernible, either one of the micas sometimes occurring to the exclusion of the other. Two varieties of feldspar can occasionally be distinguished. Small red garnets, seldom larger than the head of a pin, are more or less abundantly scattered among the other constituents. In some cases, the normal granite passes gradually into coarse-grained pegmatite on the one hand and fine-grained aplite on the other. In rare cases, in the neighbourhood of its contacts, the granite displays a faint gneissoid structure, or a tendency towards a porphyritic structure in which the phenocrysts are feldspar.

When the typical granite is examined under the microscope, the predominant feldspar is found to be plagioclase, while some orthoclase and microcline are also present. By using Wright's method for the determination of feldspars, the plagioclase was found to be oligoclase. Both the feldspars and the quartz exhibit distinct evidences of the pressure to which the rock has been subjected; the grains of these minerals are frequently traversed by cracks, granulated about their margins and quite universally display strain shadows. Sometimes the twinning lamellae of the oligoclase are bent, thus accentuating the undulatory extinction. In many of the thin sections examined, the quartz is micrographically intergrown with the feldspars. Numerous long and slender crystals of apatite, frequently broken, are present. Small garnets, a few irregular grains of epidote, minute particles of magnetite and some tiny zircon crystals are so irregularly scattered through the rock that they are present in some sections and not in others.

Granite of this description occupies an area to the east of the Kewagama River, extending eastward beyond the boundary of the district here described; the middle portion of Indian peninsula in Kewagama Lake; portions of some of the islands in East Kewagama Lake; and the major part of Portage peninsula on the east side of this lake, extending eastward for an undetermined distance beneath an area heavily covered by clay.

The numerous quartz veins which traverse the areas underlain by these granites and the schists in contact with them are really pegmatite dikes. Except at the contacts, where they usually trend in a direction corresponding to the strike of the schists which enwrap the batholiths, the strike of the veins seldom varies more than from E.-W. to N. 50° W., their dip usually being either vertical or steeply toward the northeast. On Indian peninsula such veins or dikes are so numerous that they are absent from relatively small areas of the exposed granite. They range from a fraction of an inch to 15 feet in width. Some of the larger veins are remarkably continuous. One vein toward the western portion of Indian peninsula, varying from 8 to 15 feet in width, was traced for 150 yards, and at either end, where it passed under bracken, showed no signs of coming to a sudden termination. It is, however, certain that those veins, which are thought to be very important, are not even approximately as continuous as some interested persons proclaim.

Often these veins are entirely composed of quartz, more or less translucent and usually so tinted as to properly be called "rose-quartz". They are occasionally bordered by a selvage of muscovite, from a mere film to ten inches in thickness, in which small flakes of mica are arranged either parallel or perpendicular to the walls of the veins. Flakes of the mica are often scattered irregularly through or gathered together in compact aggregations, several inches across, within the quartz. On the mineral claim on Indian peninsula held by R. O. Sweezy, in a large vein or dike at the contact between the granite and the schist, biotite partially takes the place of the muscovite. Sometimes a little feldspar is present in these veins, generally being closely associated with the mica. Though usually possessing sharply defined walls, these veins in a few instances were noticed to pass into pegmatite containing much muscovite and feldspar. Especially pegmatitic are the margins of the granite intrusions near their contacts with the schists along the west side of the Kewagama River and along the northwestern portion of the boundary of the granite on Indian peninsula. In the latter locality, at a point on R. O. Sweezy's claim, near the forge, a small body of pegmatite contains crystals of muscovite up to two inches across; farther east on S. G. Smith's claim, near Butler's post No. 4, a body of pegmatite is exposed in which crystals of feldspar, four or five inches in length, are of frequent occurrence.

In addition to the minerals mentioned, the quartz veins frequently contain molybdenite, bismuthinite, chlorite, fluorite and pyrite. Upon the property owned by the Height of Land Mining Company, on the west bank of the Kewagama River, beryl, chalcopyrite, native bismuth, zinc blende and phenacite were noticed to be present in small quantities. All of these minerals are very irregularly distributed within the veins. The pyrite occurs in irregular granular aggregates, or, more frequently, in the form of cubes, which attain a maximum size of about two inches across. The fluorite is of a very deep purple hue, appearing as widely separated grains, or as a film on slicken-sided surfaces. Upon the property mentioned, beautiful hexagonal crystals of beryl, up to three or four inches across, are found in nests, tightly packed about by a mass of flaky muscovite containing a little feldspar.

Since the pegmatites and quartz veins were injected , they have been subjected to strong pressure. Slicken-sided surfaces are of common occurrence within the veins; often crystals of molybdenite have been smeared out upon the surface of these planes of movement. The quartz itself has been so sheared that it often breaks most readily in a definite direction, thus displaying an appearance which closely simulates cleavage. Crystals of beryl are frequently found which are slightly bent or much broken.

Of the two minerals, molybdenite and bismuthinite, the former is by far the most abundant. Comparatively few of the quartz veins contain bismuthinite, which occasionally appears in the form of narrow blade-like crystals, the largest of those noticed being eleven inches in length, about half an inch wide and very thin. The bismuthinite tends to occur along fracture planes within the veins, often along minute cracks within the pyrite, and was noticed to include minute crystals of molybdenite. These facts, in conjunction with a pseudomorph of bismuthinite after molybdenite, which in 1907 was collected by Mr. J. A. Dresser from the property of the Height of Land Mining Company, and presented to the Peter Redpath Museum of McGill University, suggest that the deposition of bismuthinite was due to exhalations or solutions emitted during the closing stages of the pneumatolytic processes to which these deposits owe their origin.

The molybdenite occurs in the form of hexagonal crystals or irregular flakes, which are either irregularly disseminated through the quartz, or, as is most frequently the case, intimately associated with the mica. Upon the property of the Height of Land Mining Company, the crystals are often from one to two inches in diameter, and sometimes about an inch thick; elsewhere the crystals are rarely an inch across, and usually very much smaller. The molybdenite not only is found in the quartz veins, but also as rosette-shaped crystals and flakes in aplite, as at S. G. Smith's discovery post and at Nose Point on Indian peninsula; likewise its presence was noticed in the more coarsely crystallized facies of the granite. The surfaces of the veins and of the adjoining granite are occasionally of a yellowish colour because of the formation of the oxide of molybdenum, called molybdite; but in several instances flakes or crystals of the molybdenite were noticed standing out in relief upon the weathered surface of the veins, and not a trace of molybdite in their vicinity.

The deposits of molybdenite and bismuthinite are very erratic in character, occurring, as they do, in "pockets" or "streaks" within the quartz veins. In general, crystals and flakes of molybdenite are very irregularly disseminated throughout a certain portion of a vein, a higher percentage of molybdenite being present in the more micaceous parts. Occasionally the quartz is quite barren, while the aggregations and selvages of mica are very rich in molybdenite. In following these veins, large and small, many are found to be barren. In many instances a single flake or a group of small crystals may be found, but a search for a repetition of their occurrence will be fruitless.

On the other hand, on the property of the Height of Land Mining Company, Kewagama River, where the most spectacular pockets of ore as yet known within the area have been found, five hundred pounds of remarkably pure molybdenite are said to have been removed from a single pocket of comparatively large size. The molybdenite crystals were liberated from the enclosing mica and quartz by breaking the ore with a hammer.

So very irregular are the deposits that, except by mere acident, analyses of individual samples taken from any of the veins will give a misleading conception of the ore content. In determining the amount of molybdenite present, it is essential to take into account the amount of deadwork which will have to be performed to recover the irregularly distributed ore. This can only be done by persistently working one of the best mineralized veins, and after systematically sampling the hand-picked ore, calculate the percentage in terms of the amount of rock handled. With the exception of the O'Brien claim, where a small trench has been made, work done upon the claims of Indian peninsula consisted of stripping and the discharging of blasts in the surface of a large number of the quartz veins. Two weeks before our departure from Kewagama Lake, a group of men arrived and began work upon two of the promising veins on R. O. Sweezy's claim. Upon one of these veins they sank a small shaft which then was about eight feet deep and showed that the vein in question to that depth holds about one per cent. of molybdenite. A very considerable quantity of high grade ore can be assembled from the known occurrences of molybdenite on Indian peninsula; but it is certain that the persistent working of an individual vein, dependent for its success upon the frequency with which rich streaks and pockets may be encountered, will be very disappointing to those placing confidence in the rumours and some of the reports emanating from this district.

In his excellent report on the 'Molybdenum Ores of Canada,'' Dr. T. L. Walker, of the University of Toronto, makes the statement that "the preparation of the crude ore for the market is one of the most difficult problems in ore dressing." With reference to the ore from the property of the Height of Land Mining Company, he makes the following statement:—"The presence of so much bismuth in the ore offers a new problem, since up to the present there is no market for molybdenum ores carrying more than a trace of this metal. Some method of separating these two valuable constituents will be necessary before the ore can find a ready market."

To be marketable, the ores of molybdenite must be so concentrated as to contain 90% of this mineral. Concentrates carrying 90 to 95 per cent. of molybdenite, free from copper, arsenic and tungsten, are now worth 30 cents per pound; those containing over 98 per cent. bring 35 to 38 cents, according to the character of the impurities. Possibly a means of separation of the bismuthinite and molybdenite has been devised, since the Primos Chemical Co., of Primos, Pa., have informed the writer that "the bismuthinite would detract from the value of the ore as far as the price schedule goes, if it brings the same below 90%"; that "nothing is paid for the bismuthinite unless it runs into considerable percentage, when its price would depend upon the total composition of the ore."

The world's consumption of concentrates carrying over 90% molybdenite probably does not exceed more than 100 tons per year. The low production and the high price have been largely due to the fact that there has ever been more or less uncertainty as to the quantity of ore available.

The following more detailed descriptions of some of the molybdenite deposits will serve to illustrate more fully the character of these deposits:

The Height of Land Mining Company, Kewagama River—

In descending the Kewagama River two rapids are encountered, situated a mile and a half and two miles and a quarter, respectively, from its outlet from the large lake bearing the same name. In the vicinity of the first rapids, hornblende schists, intersected by numerous quartz stringers, cross the river striking N. 15° W., with steep dips toward the south. About 600 yards above the second rapids, biotite-schists appear from beneath the heavy blanket of stratified clays on the west side of the river, extending as a succession of outcrops for a distance of about a mile and a half. These schists, dipping very steeply toward the west, are traversed by dikes of granite and pegmatite and large quartz veins of pegmatitic origin, which trend in a general north-northeasterly direction, corresponding to the strike of the schists.

The reason for this rather sudden change in the strike of the schists at these two localities is to be found in the presence of a batholith of granite on the east side of the river, the presence of which is to-day effectually concealed from the river by wooded slopes. About this batholith the schists are wrapping, and from it and its extension far beneath the schists, the dikes upon the west side of the river have emanated. For a considerable distance the river follows very closely the western periphery of this batholith, with low clay lands to the west and hilly slopes to the east. For about 400 yards above the lower rapid, the outcrops of the biotite schists and of the dikes which intersect them are quite continuous along the west bank of the river, rising in places twenty to thirty feet above the river.

It is here that the molybdenite and bismuthinite deposits now owned by the Height of Land Mining Co., were staked by Mr. C. S. Richmond on August 26th, 1906. In the month of June in the same year, Mr. J. Obalski, then the Superintendent of Mines in Quebec, noticed a "little quartz and molybdenite in an outcrop of gneiss of Laurentian character in this locality."

Upon this property the individual dikes of granite and pegmatite are very irregular in width, as well as in linear extension. In so far as present outcrops are concerned, they occur along a zone which varies up to about ninety feet wide along the margin of the river. Toward the northern end of the property at least three dikes, with variable widths up to fifteen feet, are distinguishable. The dikes of granite, which occasionally show gneissoid or porphyritic tendencies, are intersected by those of pegmatite rich in feldspar, while both are traversed by the dikes or veins of quartz containing more or less muscovite. On the other hand, in certain instances, the granite was noticed to pass very gradually into pegmatitic and aplitic facies.

Especially at the southern end of the succession of outcrops, where a shaft has been sunk, the granite and pegmatite are so in predominance over the schist that they may be considered as the true marginal portion of the batholith, which includes irregular bands of the intruded schists. At this point a large quartz vein, fifteen feet wide, rises from the river, intersecting the granite and dipping at an angle of 58° toward the east. At the time when our examination wa s made only the granite foot-wall and a portion of the vein were visible. In contact with the granite this vein or dike is bordered by an irregular selvage of muscovite, from a mere film up to several inches in thickness, which contains large crystals of molybdenite. A few crystals of this mineral are likewise scattered through the quartz near the foot-wall, but toward the middle of the vein and its hanging-wall, bismuthinite, together with a very little molybdenite, is irregularly scattered. The foot-wall of this quartz dike is 35 feet, S. 60° E. from the collar of the shaft.

The shaft has a depth of seventy-four feet, and at this depth two drifts have been driven in opposite directions, one extending S. 60° E. for 60 feet, the other N. 60° W. for 27 feet. Being very nearly at right angles to the general strike of the schists, these drifts afford a section from the contact of the batholith inward. The face of the western drift is biotite-schist and, in succession towards the shaft, the following rocks are displayed:—

(1) granite, which is slightly pegmatitic, 7.5 ft.;

(2) biotite-schist, 4.5 ft.;

(3) a pegmatite dike carrying a few flakes of molybdenite and a little bismuthinite, 2.5 ft.;

(4) normal granite intersected by a vein of quartz, 7 in. wide at the roof and tapering to nothing 3 ft. below, 12.5 ft.

At this depth the shaft is in:—

(5) granite of variable grain, an aplitic streak with banded appearance, due to the development of extremely minute red garnets along certain planes being a prominent feature.

Continuing from the shaft, the eastward drift displays:—

(6) normal granite, 3.5 ft.;

(7) a pegmatite dike, containing quartz, feldspar, muscovite, a little bismuthinite, occasional crystals of molybdenite up to 1½ in. across and a few crystals of beryl, 3 ft.;

(8) biotite-schist, 16 ft.;

(9) quartz vein containing muscovite, a little bismuthinite, a few flakes of molybdenite and some crystals of beryl, 17 ft.;

(10) the remaining portion of this drift being in solid granite which, near the face, is traversed by

(11) a quartzose pegmatite dike, 8 in. wide. This narrow dike (11) is dipping steeply toward the southeast, while all of the other dikes, veins and bodies of schist are dipping at high angles toward the northwest. The walls of the shaft are partially timbered, and geological relations are further obscured by wash from the surface; but, in general, it has been sunk through granite intersected by two or three pegmatite dikes carrying some

crystals of molybdenite. The narrow vein of quartz in (4) was much wider where encountered in the shaft and carried a very considerable quantity of rich ore. Mr. J. Obalski, (1) who visited this property in September, 1907, when the shaft was 35 ft. deep, reports that "the shaft first cut through a vein of pegmatite six feet thick and afterwards another at the bottom." The shaft has served to demonstrate that these deposits are as irregular at depth as at the surface.

Toward the northern end of the property a shaft, eight feet deep, has been sunk in a quartzose pegmatite. The shaft was full of water, but from an examination of the dump it was found that the quartz contained more chalcopyrite than was noticed in any other occurrence within the area. The quartz is often drusy, the cavities being partially filled by minute crystals of quartz that have grown inward from all sides. Crystals of molybdenite, abundant flakes of muscovite, grains of chalcopyrite and fluorite are irregularly disseminated through the quartz. A few yards southward, presumably in the same dike as that which the shaft penetrates, a rich pocket of ore was found from which 500 lbs. of large crystals of molybdenite are said to have been taken. Forty or fifty yards farther south, at a point where the micaceous selvage on the side of a dike was exceptionally thick, Mr. C. S. Richmond opened another pocket during the past summer in which crystals of molybdenite, up to 2 inches across, as well as large hexagonal crystals of beryl proved to be abundant. Small aggregations of chlorite are occasionally found in the quartz, within some of which minute transparent, colourless crystals of a very hard mineral were observed. Mr. R. P. D. Graham, Assistant Professor in Mineralogy at McGill University, has determined this mineral to be phenacite, a rhombohedral silicate of berylium. If crystals of sufficient size are found, they will be of value as gems. Special interest is attached to this occurrence, since it is the first time that the presence of this mineral has been recognized in Canada.

McLaren's Claim, Kewagama River—

North of the property of the Height of Land Mining Co., on

(1) Mining operations in the Province of Quebec, 1907.

the west side of the river, David McLaren and his brother have made two deep trenches to bed rock in the heavy covering of stratified clays. They have encountered two parallel dikes of granite, slightly pegmatitic in character, cutting the biotite-schists and intersected by small quartz veins carrying a very few flakes of molybdenite. The dikes of granite are striking north-northeast and dipping steeply toward the west.

Small's Claim, Kewagama River—

This claim is reached by a trail which begins on the east side of the river at a point 500 yards above the southern shaft on the property of the Height of Land Mining Co. After following the trail in a southeasterly direction for half a mile, a point is reached where some stripping has been done and a few blasts discharged in the surface of quartz veins. A shallow trench, 20 ft. long, exposes a quartz vein, 8 feet wide, striking N. 30° W. Seventy yards to the southeast another quartz vein, about 2 feet wide and striking N. 60° W., has been exposed for 15 feet, being cut off by a large dike of newer diabase which is 320 feet wide. Both veins intersect schists in the immediate vicinity of the contact with the batholith of granite. In these, as well as in other veins yet discovered on this side of the river, very little molybdenite is present.

On Indian peninsula five claims, comprising an area of 720 acres, are held by the St. Maurice Syndicate, while six others, with a total area of 650 acres, have been staked by the Peninsular Mining Syndicate. Brief descriptions of those belonging to the St. Maurice Syndicate will now be given.

The O'Brien Claim, Indian Peninsula—

This claim is located on the southeastern side of the peninsula, its position being marked by a very prominent outcrop of granite which rises abruptly for about fiften feet above the water of the lake. Roughly parallel with the shore and on top of the outcrop, a trench, four feet wide, five to seven feet deep and twenty-five feet long, has been driven in the solid rock, exposing four quartz veins or dikes, striking N. 55° W. and dipping 35° to 45° towards the northeast and intersecting muscovite-granite with pegmatitic tendencies. The most southerly of these veins is three inches wide, while the remaining three average about one foot and a half in width. Northeast of the trench, another quartz vein three feet in width traverses the outcrop with the same dip and strike. A few yards southward along the shore two other similar quartz veins, the largest of which has a maximum width of a little over three feet, traverse more lowly outcrops of the granite. All of these veins are composed of massive rose-quartz containing varying amounts of disseminated molybdenite and muscovite, together with a little feldspar, bismuthinite, pyrite and fluorite. Too often, however, quartz is present to the exclusion of the other minerals mentioned.

The mica occurs on either side of the veins as almost continuous selvages, or as clotted masses within the quartz, one of which noted was eight inches in length and five inches across. A little fluorite of very deep purple colour occurs in the form of minute, widely disseminated grains, in one case being observed to form a thin film upon a slickensided surface.

Brilliant little crystals of molybdenite, usually about one-third of an inch across, are very irregularly distributed not only in the quartz veins, but likewise in the adjacent granite, especially if the latter becomes fine-grained and aplitic in character. Molybdenite was noticed within such granite at a maximum distance of about two feet from the wall of a quartz vein. So irregularly scattered are the flakes of molybdenite that in the course of working at the face of one of these veins, at one time scarcely a particle of this mineral may be seen, while continued work may reveal irregular areas, usually characterized by the presence of considerable mica, in which the crystals of molybdenite are fairly abundant.

About two hundred yards northwards along the shore is the remnant of a small forge, inland from which a trail extends to three other quartz veins with maximum widths of 3, 5 and 10 feet, striking N. 75°-80° W. and dipping steeply toward the north. For the most part, these large veins are composed of massive barren quartz; molybdenite occurs as widely separated flakes or associated with aggregations of muscovite flakes from which remarkable samples may be collected. Bismuthinite is more abundant in these veins than in any of the others examined on the peninsula. Its distribution has been determined by fracture planes within the quartz, along which blade-like crystals of bismuthinite have developed. Within the cubes and irregular grains of pyrite, the mineral seems to be included, but upon closer examination is found to be developed along cracks which traverse this brittle mineral. Near the margins of the largest vein the molybdenite content is quite high.

The Hervey Claim—

Upon the extremity and on the northern side of Nose Point, on the eastern side of Indian peninsula, exposures of granite are traversed by several quartz veins. Of irregular width and sending forth branches and small stringers, the major veins have a general strike N. 60° W., dipping steeply toward the northeast. A few blasts have been discharged in the surfaces of seven veins, the largest of which is 4 feet in width. Within these veins rose-quartz is the predominant mineral, together with muscovite, very irregularly disseminated flakes or small crystals of molybdenite, large cubes of pyrite up to two inches across, a little bismuthinite, fluorite and more feldspar than is usually present. Large empty cubical cavities, of frequent occurrence in the surfaces of the quartz, represent the spaces formerly occupied by pyrite. Small irregular druses within the quartz are lined with minute crystals of quartz and molybdenite. Adjacent to these veins or dikes, the granite is often either pegmatitic or aplitic, both facies containing extremely variable amounts of molybdenite. The surfaces of the dikes and of the adjacent granite are partially stained red or yellow, because of the oxidation of the pyrite and molybdenite.

The Sweezy, Doucet and Huestis Claims—

These claims are situated on the northern slopes of Burnt Mountain, on the western side of the peninsula, where a widespread area of exposed granite is traversed by a remarkable display of these quartz veins. From a few inches to 12 feet in width, these veins strike in a general northwesterly direction and dip toward the northeast. The contact between the granite and schists crosses the northeastern corner of the Sweezy claim, and thence in an irregular curve, convex toward the north, across the Huestis claim.

The strike of the enwrapping schists varies with the contour of the batholith, while their dip is generally more than 40° toward the northeast or north. In the immediate vicinity of the contact, the schists are intruded by apophyses of pegmatite, aplite and quartz veins. Some of these veins were noticed to contain as much molybdenite as is exhibited in the greater number of those veins, farther up the hill, to which some attention has been devoted.

The vast majority of the veins displayed upon these claims are barren; some contain a few flakes, others rich streaks and pockets of molybdenite and occasionally a little bismuthinite. In the surface of a large number of veins a few blasts have been discharged, which, in general, reveal no characteristics different from those which may be gathered from tracing the veins along their strike. In following them, molybdenite may suddenly appear as irregularly disseminated flakes, being more abundant where mica is present. Those veins within one hundred yards from the contact with the schists are usually better mineralized than those farther removed. The veins on top of the mountain seldom contain these minerals. Of the deposits here known at the present time, the best are upon the Sweezy claim.

A few yards from the eastern boundary of this claim, at a point about 350 yards north of S. G. Smith's post No. 4, an outcrop of schists, striking N. 64° W. and dipping 40° toward the northeast, is situated ten yards from the margin of the exposed granite. The intervening space, within which the contact lies, is covered with soil and bracken, with the exception of an outcrop of almost massive pyrite with a little quartz that occupies a space about three feet square. This outcrop seems to be a portion of a body or vein of quartz which is so impregnated with pyrite that the latter mineral is in predominance. Much of the pyrite has crystallized in the form of minute octahedrons. The quartz is often cellular or drusy, containing, in addition to the pyrite, extremely minute crystals of molybdenite and a little fluorite. An assay of a comprehensive sample, including some of the drusy quartz as well as fragments of the solid pyrite, showed the presence of $1.20 per ton in gold and a trace of silver. The exposure of granite is faced by quartz carrying much muscovite and small amounts of feldspar, pyrite and molybdenite.

About a hundred yards westward along the contact near the blacksmith's forge, the margin of the granite is faced for a distance of 75 feet by an irregular body of quartz, the true width of which was obscured at the foot of the exposure where it passes beneath the growth of moss and shrubs. Thick matted aggregates of biotite flakes within the quartz contain much molybdenite, some feldspar and small crystals of pyrite. To a minor degree, all of these minerals are likewise disseminated through the quartz.

Of the other veins upon these claims, the most promising seemed to be the one on the Sweezy claim, near its northern boundary, where a group of men were engaged in sinking a shaft during the latter part of August and the beginning of September. The vein of quartz was about four feet wide, but the values in molybdenite were more or less concentrated along a zone ranging up to eight inches wide.

The Peninsular Mining Syndicate—

Three claims, comprising 300 acres, are situated to the north and west of O'Brien's claim. As far as could be learned, the most work has been done near the eastern boundary of McDougall's claim of 100 acres, where stripping has exposed a large number of quartz veins, in the surface of a few of which blasts have been discharged. In order to express how numerous these pegmatitic quartz veins become in certain localities, a zone, 90 feet wide, was here selected, in which 19 parallel quartz veins, striking slightly north of west traversing the granite, were counted. Of these veins, eleven are less than 3 inches in width, while the largest has a maximum of 18 inches. These veins may usually be traced for several yards when they taper out, others then frequently appearing within the zone. Muscovite is of common occurrence within the quartz. In a few places some of the veins contain a few flakes of molybdenite. A dike of the newer diabase or gabbro, up to more than 400 feet in width, crosses this claim.

Three other claims, belonging to this syndicate, occupy a more central portion of Indian peninsula to the east and south of the Sweezy claim. Upon S. G. Smith's claim, across which the contact between the granite and the schists passes, five localities were visited where quartz veins, carrying small amounts of molybdenite, are exposed. At his discovery post a body of aplite, presumably a minor intrusive body, is traversed by small quartz veins bearing molybdenite. The aplite, composed almost entirely of oligoclase, a little quartz and numerous minute red garnets, contains much molybdenite in the form of primary rosette-shaped crystals up to half an inch across. Near the southern boundary of this claim, in the vicinity of Butler's post No. 4, a body of pegmatite is the most coarsely crystallized of any noticed within the area. Crystals of feldspar are frequently five or six inches in length and associated with abundant quartz, flaky muscovite, a little fluorite and molybdenite. Because of its position with reference to the contact of the batholith, it is possible that other discoveries may be made upon this claim which will be more important than those now known. Quartz veins, locally bearing a little molybdenite, were noticed upon the other claims.

Eastern Shore of East Kewagama Lake--

At a point upon this shore, opposite to Nose Point on Indian peninsula, a quartz vein, 6 inches wide, contains a little molybdenite and bismuthinite.

Galena and Zinc Blende--

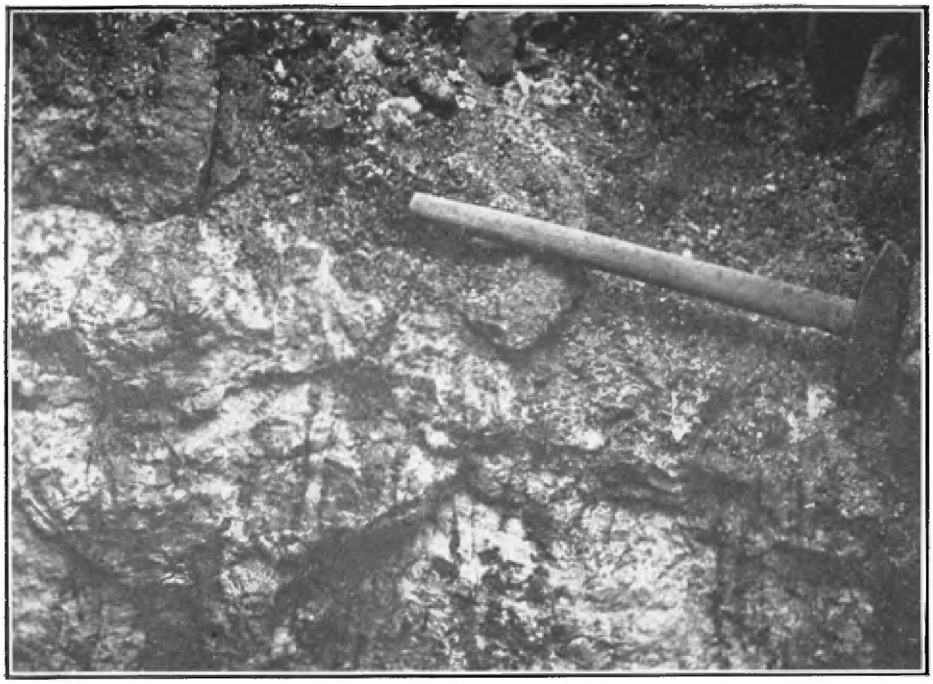
About two-thirds of a mile northward from Poirier Lake, a rocky ridge, which in part is devoid of trees, rises to an altitude of approximately one hundred feet. The ridge extends nearly east and west corresponding to the strike, S. 80° E., of the highly schistose rocks of which it is composed. The schists are traversed by a series of veins or stringers of quartz, frequently containing a little calcite and epidote, and occasionally bearing small amounts of galena, zinc blende, pyrite and a few specks of copper pyrites. Although these veins may seem to recur at widely separated intervals along a definite line, they can seldom be traced for more than a few feet before they become very narrow and finally disappear. They display a maximum width of four feet, but can be traced for only a few yards before they terminate.

A group of mineral claims are situated here, having for their chief centre of attraction a vein, four feet wide, containing a considerable percentage of galena, zinc-blende and pyrite, with an occasional particle of copper pyrites in a gangue of calcite and quartz. At the time of our visit, Mr. George Richmond, who made the discovery, was engaged with a few men in sinking a shaft, which had reached a depth of ten feet. A few feet westward from the shaft, the vein pinches out, but stringers of barren quartz occasionally occur in line with its projection; several hundred feet westward one of these quartz veins, about eighteen inches wide, contains a little galena and zinc-blende. For a few yards eastward from the shaft, the bed-rock is covered, but upon reappearing at the surface there is no evidence of the presence of the vein.

Striking S. 80° E. and dipping 87° toward the south, this vein is situated between a small dike of fine-grained diorite on the north and actinolite schist on the south. Although in part distributed through the gangue of calcite and quartz, the galena, zinc-blende and pyrite occur chiefly along or adjacent to fractures in the gangue. (See Plate XXX). Of the economic minerals present, galena is the most abundant, zinc-blende tends to occur near the walls of the vein, and the pyrite, which is present in very subordinate amount, is crystallized in beautiful, small pyritohedrons. At the bottom of the shaft the vein was seven inches narrower, pyrite was becoming slightly more abundant, and a dike of aplite, three to four inches wide, intersected the southern margin of the vein. In thin section under the microscope this aplite is found to be almost entirely composed of microcrystalline quartz with epidote of bright yellowish-green colour, which apparently has been derived from the alteration of a small amount of feldspar. So analogous is this aplite to similar dikes, which are associated with and genetically related to the "newer diabase" in other districts that it lends emphasis to a belief that the vein owes its origin to the intrusions of quartz-diabase in the district.

I was informed that after our departure from the district, the

PLATE XXX.



VEIN BEARING GALENA AND ZINC-BLENDE.
Two-thirds of a mile north of Poirier lake.

PLATE XXXI.

TYPICAL IRON FORMATION (Steele's claim, south of Newagama lake).

shaft was sunk to a depth of 40 feet, where there was about eight inches of vein matter in the form of stringers "running in all directions."

The body of ore is by no means large enough to even suggest the possibility of its being developed into a mine for lead and zinc. An assay of an excellent sample taken from the shaft at a depth of eight feet, containing small galena, zinc-blende and pyrite, shows the presence of 47 cents per ton in silver and not a trace of gold.

Silver—

The presence of large dikes and small stocks of quartz-diabase, displaying the same petrographical variations as the diabase of Cobalt, Gowganda, etc., suggests the possibility of the discovery of silver. From a careful examination of many of these dikes, the writer does not believe that silver will be found within this area. Certain geological features within the area suggest the possibility that these dikes and small stocks formerly may have fed a more or less mineralized superstructure of sheets and laccoliths which, by prolonged denudation, have been removed. If these large dikes continue, as they certainly seem to do, into adjacent portions, encouragement is given that silver may yet be discovered in some locality where such a superstructure may have been preserved.

Copper—

Small particles of copper pyrites occur occasionally in a few of the quartz veins and, locally, within the schists of the district. They were frequently noticed in the vicinity of the contacts of the dikes of newer diabase. On the southern side of an islet lying close to the west side of Talc Island in East Kewagama Lake, hornblende diorite is intersected by a few gash veins carrying a little copper pyrites in a gangue of quartz, calcite and epidote. A few blasts have been discharged in the face of the exposures. The occurrence is not of economic importance.

Pyrite and Pyrrhotite—

Pyrite is widely disseminated through some of the metamorphic Keewatin rocks, and occasionally a few particles and crystals of this mineral occur in some of the multitudinous quartz veins of the district. Mention has already been made of the large cubes of pyrite which are associated with the molybdenite deposits, and also of the body of pyrite of undetermined extent which is situated at the contact between granite and Keewatin schists near the eastern boundary of R. O. Sweezy's claim on Indian peninsula. An assay of a sample of pyrite from the latter locality shows the presence of $1.20 per ton in gold and a trace of silver. On the eastern shore of East Kewagama Lake, in the vicinity of a small brulé, approximately southeast from Nose Point on Indian peninsula, boulders of pyrite associated with a small amount of quartz are strewn along the shore for about one hundred yards. These boulders, some of which weigh several hundred pounds, have presumably been carried to their present position by glacial ice, from a deposit which probably lies beneath the waters of the lake. An assay of sample shows the presence of $0.15 per ton in gold.

Near the summit of the ridge, on the south side of the Kinojevis River, just below the Cascade rapids, a zone of altered rhyolites is irregularly impregnated with pyrite to a maximum width of twenty feet. The rhyolites seem to have been more or less amygdaloidal, and in the originally more porous portions of the rock the pyrite occurs both in the form of small concretions and irregularly disseminated grains.

At the Cyclone rapids, pyrite is irregularly distributed along narrow bands on both sides of the river in somewhat similar rocks, which have been metamorphosed to slates and schists. Small quartz veins, cutting the slates on the east side of the river, as well as the slates themselves, carry a considerable amount of pyrite. An assay of a sample from some of the quartz veinlets did not give a trace of gold. On the same side of the river, just above the small rapids commonly known as the Shirt Tail Rapid, which is situated a short distance above the Cyclone, two veinlets of pyrite were found about twenty yards from the river. An assay of a sample taken from one of these small veins, the largest of which was 2 inches wide, resulted in disclosing the presence of $1.20 per ton in gold.

Upon the margin of a very small islet in the Kinojevis river, at a point about three miles above O'Sullivan's line, a massive, fine-grained, light greyish-green rock, presumably a porphyrite, is impregnated for a width of about 12 feet with pyrrhotite and pyrite to such an extent that these minerals constitute the major portion of the rock. This deposit, which upon three sides passes beneath the waters of the river, is only visible when the water is low.

It is to be hoped that prospecting along some of these highly pyritiferous bands of rock may reveal the presence of bodies of sufficient size to be of value.

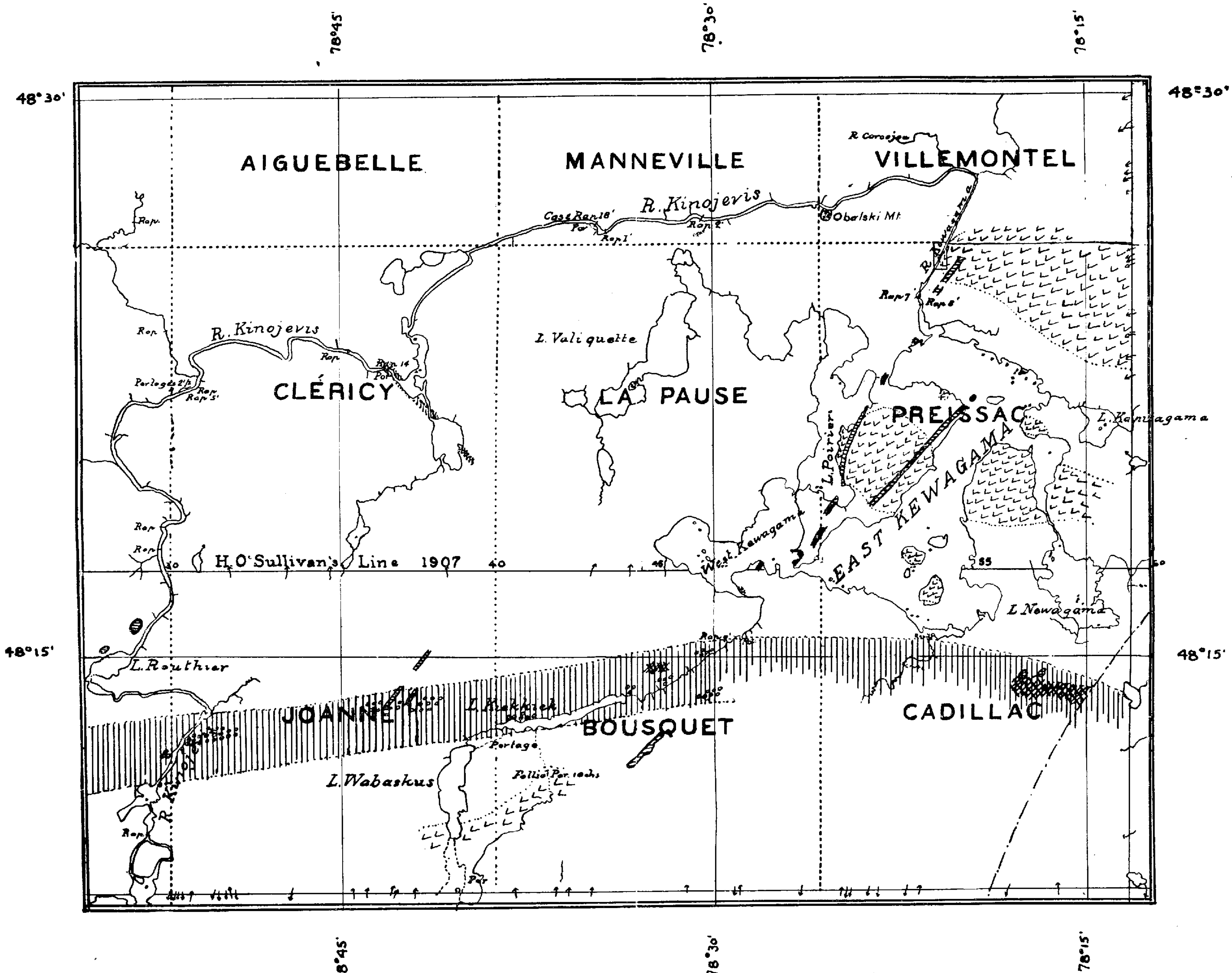
Magnetite—

Upon the southern shore of Newagama Lake a large creek, draining an extended swamp, enters from the south. About ten chains southward it forks, and by following the easterly branch for about the same distance to a point where it suddenly bends towards the east, the beginning of a trail will be reached which extends over low land in a southerly direction for a little more than a mile to the northern slopes of a ridge upon which seven claims have been staked for iron. Rising to a maximum altitude of about 300 feet above the surface of the lake, this ridge forms the most prominent portion of "the height of land" within this area. With a much lower altitude and broken toward its western end by two small brooks, it extends as an ill-defined ridge in an approximately east to west direction for about two miles. On all sides it descends to lower land, much of which is swampy.

The iron ore occurs in the form of bands of impure magnetite, which are so uniform in thickness that often they have the appearance of slates very rich in magnetite. Usually these bands, up to a foot across, are intercalated with a grayish quartzose rock displaying a distinct foliation, together with other slaty and schistose rocks. The whole series strikes a few degrees south of east with a nearly vertical dip. The ribbon-like magnetite-bearing bands, standing out in relief upon weathered surfaces, are present within a zone about 1300 feet wide. With the exception of a very few isolated bands, they are described better as being more or less abundant within a zone about one hundred yards wide, extending across the four most northerly claims, a distance of about two miles. Each of these four claims contains 200 acres, and from west to east each successive claim is offset about 25 chains toward the north. In succession from east to west, these claims are held under the names of Steele, Smith, E. J. Butler and G. A. Butler. Upon the western boundary of G. A. Butler's claim, numerous magnetite-bearing bands were found extending into unclaimed territory. Of the three other claims which lie to the south of those receiving especial mention, only a very few narrow bands of impure magnetite were noticed upon the one held by G. A. Graham.

Near the eastern boundary line of Steele's claim, just before the ridge descends rapidly to low land, the magnetite is more abundant than in any other exposures. Here, as elsewhere, in so far as present exposures are concerned, the iron-bearing bands generally are so separated by the types of rock already mentioned that the deposit is too low-grade; but within two zones of 14 and 28 feet in width respectively, the magnetite-bearing bands are closely packed together. In tracing the formation along the strike, within a short distance, these bands subdivide and include barren bands. A sample, composed of small fragments collected at intervals a foot apart across the wider of these zones, yielded upon anlysis 35 per cent of metallic iron. The zone, 14 feet wide, would probably contain from 25 to 30 per cent. of iron. The whole formation is traversed by numerous small quartz veins, adjacent to which some of the magnetite is partially converted to specular iron ore, in part of micaceous habit. Some of the bands are much richer in iron than others. Two samples were analyzed by Mr. R. P. D. Graham, Assistant Professor of Mineralogy in McGill University, one of which contained 68 per cent. and the other 30 per cent. of metallic iron. These specimens proved to be "free from titanium and sulphur and contained such a small amount of phosphorus that its presence would have to be recorded as hundredths of one per cent.." In the field, a few of the iron-bearing bands were noticed to contain a few specks of pyrite, which implies the occasional presence of a little sulphur in the ore.

The rocks of this iron formation are distinctly of sedimentary character, the magnetite-bearing bands probably representing consolidated black sands which accumulated in the more shallow portions of Keewatin seas. Two of the most common types of rock associated with the magnetite were examined in thin section



Sketch Map of Area Examined

Scale 4 Miles = One Inch

"Newer" Diabase (Keweenawan)?

Granite and Syenite (Laurentian)

Much Metamorphosed Sedimentary Rocks Keewatin or Huronian, possibly some of each

Exposures of Schistose Conglomerate Examined

Iron Formation

Undifferentiated Schistose Rocks: Volcanic and Intrusive Igneous Rocks Keewatin

under the microscope. A dark greenish biotite-schist, a rock which has been recrystallized into quartz, biotite, epidote and small crystals of magnetite, probably represents what was originally a calcareous mud containing iron. A light grayish-green quartzose rock with distinct foliation proved to be composed of small angular and subangular grains of quartz with a few of plagioclase within a recrystallized matrix which is a mosaic of minute particles of quartz. Considerable chlorite, which originally was biotite, some sericite and a few small grains of magnetite and pyrite complete the mineralogical content of this rock, which formerly was probably a feldspathic sandstone.

The iron formation is traversed by a few dark dikes which usually trend parallel to the schistosity of the rocks. Upon the western boundary line of G. A. Butler's claim, and also near his Post No. 1, small intrusive bodies of a coarse-grained diabase, presumably olivine-bearing, occur. Whether portions of dikes or small isolated stocks, it was impossible to determine, but from their petrographical character it is certain that they are of Post-Huronian age.

This Keewatin iron range was discovered late in the autumn of 1910. Exposures of bed-rock are not of frequent occurrence, and at the time when the claims were examined stripping had been done across the strike of the rocks in only a few localities. For these reasons it is impossible to make definite statements pertaining to the economic possibilities of the deposit. It is possible that a large body of low-grade ore may be found which could easily be concentrated by processes of magnetic concentration. At least a reconnaissance magnetometric survey should be made, followed by a selection of the most promising portions of the field for thorough investigation.

A few bands of impure magnetite, within a zone about about 40 feet wide and associated with similar rocks, were found while passing along the winter road from Keekeek to Kewagama lakes at a point approximately a mile from the former lake, and exactly three-fourths of a mile by road before coming to a substantial log-cabin. Those iron-bearing bands which are exposed are quite rich in pyrite, and are not of economic importance. Although about twelve miles westward from the iron range south of Newagama Lake, they probably occupy the same horizon.

ALPHABETICAL INDEX