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GEOLOGICAL EXPLORATION ON THE NORTH SHORE, BETSIAMITES TO MANICOUAGAN, PART D

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PROVINCE OF QUEBEC, CANADA

BUREAU OF MINES

Honourable J. E. PERRAULT, Minister of Mines

J. L. BOULANGER, Deputy-Minister

A. O. DUFRESNE, Director

ANNUAL REPORT
OF THE
QUEBEC BUREAU OF MINES
FOR THE CALENDAR YEAR
1932

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by Carl Faessler

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**GEOLOGICAL EXPLORATION ON THE
NORTH SHORE, BETSIAMITES (BERSIMIS)
TO MANICOUAGAN**

by Carl Faessler

INTRODUCTION

Geological exploration on the North Shore of the St. Lawrence river was resumed in 1932 at the mouth of the Betsiamites river^①, the eastern limit of the territory explored in 1931^②, and was thence continued to the Manicouagan river. The village of Betsiamites is 190 miles from Quebec city and 81 miles from Tadoussac. The distance between Betsiamites and Lebel Point (Pointe Lebel), where the Manicouagan enters the St. Lawrence, is about 27 miles in a direct line. The mouth of the Manicouagan is therefore 217 miles from Quebec^③.

PREVIOUS WORK

In 1869, James Richardson^④ explored the north shore of the St. Lawrence from the mouth of the Saguenay to the bay of Seven Islands. Besides examining the coast line, Richardson had instructions to ascend some of the principal rivers. Choosing the Betsiamites and Manicouagan for such exploration, he examined the former for 30 miles and the latter for 40 miles from the coast.

In 1884, A. P. Low went up the Betsiamites, and in 1895 up the Manicouagan, on voyages of exploration to the interior of Labrador^⑤.

In 1908, J. H. Valiquette^⑥ ascended the Manicouagan for 70 miles and thence crossed to the Outardes river; he gave a full descrip-

^① This river and the village situated at its mouth also bear the name Betsiamis. The inhabitants of the region always say 'Bersimis'.

^② Que. Bur. Mines, Ann. Rept., Part B, 1931.

^③ According to A. P. Low, the distance is about 240 miles; Geol. Surv. Can., Ann. Rept., Vol. VIII, Pt. L., 1895, p. 7.

^④ Geol. Surv. Can., Rept. of Progress, 1866-69, p. 305.

^⑤ Geol. Surv. Can., Ann. Rept., Vol. I, Pt. D, 1885; Vol. VIII, Pt. L, 1895.

^⑥ Que. Bur. Mines, Ann. Rept., 1908.

tion of the latter from the point at which he reached the river up to Plétipi lake. For information concerning the geology along the Manicouagan river, he referred to the description by Low in the report already cited. Low's report of 1895 also mentions other explorations in the region not of geological character.

LOCATION OF AREA

The territory examined in the season of 1932 lies between the Betsiamites and Manicouagan rivers, two large tributaries of the St. Lawrence, and extends northwesterly for an average distance of 12 miles from the coast. It comprises the townships of Raffeix, Rague-
nau, and Manicouagan, the Indian Reserve (known also as the township of Papinachois), and a certain area of Crown lands. The most northerly point reached on the Betsiamites was the mouth of Dubé river, 16 miles from the St. Lawrence; on the Papinachois, the head of lake Papinachois; on the Outardes, the mouth of Georges Tremblay river; and on the Manicouagan, the Caribou island. The territory thus explored has an area of 320 square miles.

SETTLEMENTS AND POPULATION

This is one of the most populous sections of the North Shore between the Saguenay and Blanc Sablon. At one time, during a period of activity in lumbering, there were not less than 2,750 people in the area^①, but with the cessation of these operations in recent years, the number has been much reduced. However, since the autumn of 1931, a considerable number of new settlers have arrived, who, with their families, are now established on lots recently opened by the Provincial Department of Colonization, principally in ranges II and III of the township of Rague-
nau, between the rivers aux Vases and Outardes. Others are settled in the Manicouagan peninsula, along the shore between the village of Outardes Falls and the first rapid of the Manicouagan.

^① Edgar Rochette, *Notes sur la Côte Nord*, Quebec, 1926.
A. P. Low, *loc. cit.*, 1895.

Raoul Blanchard, *Etudes Canadiennes III*, Revue de Géographie Alpine, Vol. XX, 1932 (Grenoble, France).

The largest village in the district is Betsiamites, the village of the Papinachois Indians, situated on the banks of the Betsiamites river. It is the *chef lieu* of the municipality known as the Seven United Townships, which has the municipal authority of a county. This municipality extends from cap Colombier, 13 miles above Betsiamites, to Petit Mai, 72 miles below Betsiamites, and includes the townships of Betsiamites, Raffeix, Papinachois, Raguenu, Manicouagan, Laffèche, Bourdon, Franquelin, and Demonts.

The township of Papinachois is the Indian Reserve of Betsiamites. In addition to Indians, there are at present ten families of white people living in the reserve, besides the curé, the nuns of the convent, and two or three members of the Royal Canadian Mounted Police. The white families are those of officials of the public services and of merchants.

Betsiamites has a post-office, a branch of the Banque Canadienne Nationale, an office of the Canadian Government Telegraphs, a post of the Hudson's Bay Company, and three other well equipped stores. Besides the church there is a presbytery and a school for both Indian and white children.

The Indians of the Betsiamites reserve number about 500. They belong to the Montagnais tribe, of which there are also some families at Pointe Bleue, on lake St. John, and at Escoumains, a short distance below Tadoussac. Their language is said by A. P. Low to be a mixture of the Cree and Ojibway tongues. Nearly all of them speak French and all profess the Roman Catholic religion. Although generally short in stature, they are very sturdy and muscular and it would be hard to find better portageurs. They are widely appreciated as guides, canoe-men, and packers. For journeys into the interior of Labrador, Indian guides can be procured at Bersimis who have travelled all the principal rivers between Hudson bay and the Atlantic coast, and who speak French, English, and several Indian and Esquimau dialects. Some of these men have even received a good classical training in the seminaries of Quebec.

Between the village of Betsiamites and the mouth of the Rosiers river, a distance of ten miles, there is only one family that lives all the year in the district. This family occupies the abandoned depôt of

the Brown Corporation at the mouth of the Papinachois river. Below the Rosiers, houses appear at intervals along the St. Lawrence to the vicinity of the Manicouagan. First there is the hamlet of Les Iles, or The Islands, at the mouth of the river aux Vases, where there is a post-office, school, stores, and quite a flourishing lumber industry, with a saw-mill and a yard for building boats. At the head of the estuary of the Outardes is the village of Outardes Falls, about eight miles from the St. Lawrence. Here, in 1926, the Ontario Paper Company, of Thorold, Ontario, which owns timber limits on the Manicouagan, began the construction of a hydro-electric plant designed to furnish power for the use of a pulp mill of 300 tons daily capacity and for other purposes. It was planned to build a mill at Comeau bay, 13 miles from the falls. Unfortunately, work at both sites has been suspended during the past two years. That already completed has included the building, at a point two miles above the village, of a dam which extends, in four sections, from one shore of the river to the other by way of three islands. By this dam the water of the river is backed-up for a distance of about nine miles, as far as the mouth of the Georges Tremblay river, and a rapid which formerly necessitated a portage is submerged. A railway has been built from the dam to the wharf at the village. An auxiliary electric plant of 1,500 h.p. capacity has been installed, which furnishes light for the village and for construction works when needed. Besides construction camps, the Company has built eight permanent houses. The village is provided with a water system

The total population of the township of Raguenaud, including The Islands and Outardes Falls, is now about 1,000 people, who are distributed along the shore for a distance of twelve miles.

In the township of Manicouagan, which occupies the peninsula formed by the near approach of the Manicouagan and Outardes rivers, some ten miles above their entrance to the St. Lawrence, are two hamlets, Outardes Point and Lebel Point. Outardes Point is twelve miles by water from Betsiamites. Thirty-two families live in this hamlet, which has a post-office, several stores, a school, and a chapel. The coast between Outardes Point and Lebel Point, a distance of nearly twenty miles, is sparsely occupied, principally by newly arrived settlers. At Lebel Point, at the mouth of the Manicouagan river, there are two stores and a post-office.

According to their occupation, the people of this district fall in three rather distinct groups. The first group, the Indians, live entirely by hunting and fishing. From the first of September to the end of May they stay, with their families, in the interior of Labrador, hunting game and trapping. On their return they sell their catch at Betsiamites river, where the salmon-fishing rights are reserved for them by the federal government. The Indians do no farming.

The second group are farmers, largely settlers who have arrived in recent years and are still occupied in cutting the timber, almost wholly pulpwood, off their lots. This is sold to the Ontario Paper Company and is shipped to Thorold for manufacture. There are, however, a few farmers longer established in the locality who have well cultivated farms and raise cattle. The farm products are mainly hay and oats; potatoes also grow well in the district. Some farmers put out trap lines in the interior, ten to twenty miles from the coast, where they hunt in winter months.

The third group comprises employees of the lumber companies, officials of the public services, merchants, and traders.

Both the second and third groups do a good deal of fishing in the St. Lawrence. According to older inhabitants, there was formerly a small plant at Paradis Point, on the Manicouagan peninsula, for the recovery of fish-waste for use as a fertilizer. Hunting porpoises gives work to a few hardy fishermen of the coast, since the provincial government has provided a bounty for their capture.

MEANS OF COMMUNICATION

In summer, the only practical means of communication between Betsiamites and the Manicouagan is by water. There are bridges over all the intervening rivers—except the Outardes, which can be crossed on the dams—but there is no waggon road, save in certain of the better-peopled sections.

The 'Chemin maritime', or shore route, is a trail that generally follows the telegraph line. Over long distances it is in such poor condition that it is quite impracticable to travel over it by waggon. In winter, this route is followed by the mail carrier.

The absence of a waggon road compels all summer traffic to go by boat on the St. Lawrence. This is hazardous, even dangerous, for the sea is rarely calm and along this section of the coast there is not a single good harbour. Moreover, the big rivers—Betsiamites, Outardes, and Manicouagan—deposit large sand-bars, which compel boats to go out two to four miles off shore. A boat of more than 8-foot draft cannot land at the quay of either Betsiamites or Outardes Point at low tide. It is for these reasons that the inhabitants so urgently desire a waggon road.

A lumbering road extends along the Papinachois from its mouth to the lake, a distance of nine miles; but this road has been abandoned since the suspension of work by the Brown Corporation, and some of the bridges are beginning to fail. There is also a settlers' road along the shore of this river in the better settled sections, and also up the river aux Vases from its mouth to range III of the township of Raguenu and thence between ranges II and III to the river la Truite. One road, the 'Nipi River portage', leading from Betsiamites to the Nipi river, can be used by waggons for a length of four miles.

Communication with the South Shore is provided for this district by the Clark Steamship Lines, whose steamer, *Manicouagan*, plies twice a week between Rimouski on the South Shore and Betsiamites, The Islands, Outardes Point, and Lebel Point on the North Shore. The *Manicouagan* also carries mail for all post-offices in the district.

In winter, communication with the outside world is made possible by the service of the Bras d'Or Bay Navigation Company, of Quebec, whose boat, *Sable I*, makes periodical tours of the gulf of St. Lawrence, and by aeroplanes of Canadian Airways, Limited. Mail is distributed along the coast in winter by dog teams, by 'cométiques', or, more rarely, by sleighs.

ORGANIZATION AND ACKNOWLEDGMENTS

The season's exploration was commenced at Betsiamites on June 3rd and was brought to a close at Lebel Point on September 8th, 1932. The party consisted of eleven men—the writer, with two senior assistants, Alfred Potvin and Paul Emile Auger, seven junior assistants, and a cook. The assistants, with the exception of two

juniors, were students of Laval University. Mr. Auger, with three assistants, was employed throughout the season in sampling and measuring deposits of ochre, described on a later page of this report.

The base for the geological map that accompanies this report was prepared by the Quebec Surveys Branch, Department of Lands and Forests, from aerial photographs. The region was photographed during the summers of 1930 and 1931.

Officials of the Brown Corporation at Papinachois, and of the Ontario Paper Company at Outardes Falls, gave much valuable information and also placed their maps at our disposal. I wish to express my warmest thanks to the officials of both Companies for their courtesy.

TOPOGRAPHY

The broad features of the map-area are the large plain, or plains, that everywhere border the St. Lawrence river, and the hills of Laurentian type that rise from the plain rather abruptly on the northwest. The boundary between the plains and the hills follows roughly a straight line drawn from the mouth of the Nipi river to the mouth of the Blanche.

THE PLAINS

The plains may be conveniently termed the Champlain plain, or plains, from the geological period in which they were formed. They are from two to twelve miles in width, measured from the St. Lawrence. Their surface is flat, or nearly so, and the drainage is generally poor. Over large areas they are composed of sand and bear only a scanty vegetation. Such sand areas have no likely value as farm lands.

In some sections the soil of the plains is clay at the surface, and here the water from rain and melted snow collects in shallow lakes, where it may remain stagnant. Peat bogs, some of them large, are formed in such places. In some parts of the Betsiamites plain, peat is already twelve feet thick.

The best tillable land is where clay is overlain by a thin bed of sand, so that the two may be mixed by the plough. These lands are generally swampy, since the plains lack sufficient slope for natural

drainage. A number of settlers have been placed on such lands during the past two years, especially in the township of Raguenu. But despite the fact that the land is of good quality, it needs drainage. As it is of little use for one farmer to drain his land artificially unless his neighbours do the same, a broad general system of drainage must be planned to take in a wide area. It would then remain for the individual settler to connect his own drains with those of the general system.

THE LAURENTIAN PLATEAU

The hilly country on the northwest of the Champlain plains is part of the vast region of northern Canada that is known as the Laurentian plateau. These highlands in places rise abruptly to a level of several hundred feet above the plains. In general, however, there is a transition from the plains to the plateau, in which a zone of low hills first appear as islands rising only a little way above the plain-level, and these are followed to the northwest by others that are successively higher until the plateau level is reached.

The highest elevations are near the '15 Miles' of the Betsiamites and in the vicinity of Lac Salé, between the Outardes and Manicouagan rivers, where the hills rise to 700, and even 800, feet. But in general they are lower and the plateau has the characteristic aspect of the 'Canadian shield'—rounded buttes of low elevation with smoothed surfaces, separated from one another by wide valleys. The cover of vegetable matter is thin and in brûlés or on exposed surfaces is lacking altogether.

DRAINAGE

LAKES

Within this area of 320 square miles there are more than 200 lakes, without counting the innumerable swamp-ponds in the Manicouagan peninsula. Nearly all of them are in the Laurentian plateau, and as this occupies only about one-half of the map-area, there are thus approximately 200 lakes in 160 square miles. They are, of course, small. The largest are Nipi and Salé lakes, each 3 miles long; Henshaw lake, 2½ miles long; and la Truite, Papinachois, and Mignault lakes, between 1½ and 2 miles long.

All of the lakes in the plateau are of glacial origin and, generally, they owe their existence to the blocking of valleys by moraines. Lake Mignault and some others along the river aux Vases are wholly in the plains section of the area.

The fish in the larger lakes are mainly pike, but salmon-trout abound in some of the smaller lakes, and especially in those that are separated from the larger lakes by falls. Pike are most abundant in Nipi and Salé lakes, and trout in lake la Truite and in the lakes at the head of Barthélémi river.

RIVERS

Three large rivers cross the region. These are the Betsiamites and the Manicouagan which form the west and east boundaries of the map-sheet, and the Outardes which flows between them. They are the three largest tributaries of the St. Lawrence below the Saguenay.

BETSIAMITES RIVER:

This river, which is 240 miles in length, has its source in the region between the headwaters of the Outardes, a tributary of the St. Lawrence, and the Peribonka, which runs into lake St. John. It is the river most frequented by the Indians in their salmon fishing and in going to their hunting grounds. Salmon are plentiful up to the first fall, 42 miles from the St. Lawrence, and the river is navigable to this point by large motor boats. The principal tributaries in this lower section are the Nipi and the Henshaw, which enter the main river at points $4\frac{1}{2}$ miles and $1\frac{1}{2}$ miles, respectively, above the village of Betsiamites. Tides reach as far as the mouth of the Henshaw. The latter stream is not navigable, but above the portage from Betsiamites, the Nipi may be travelled by canoe as far as lake Nipi^①.

OUTARDES RIVER:

This river rises between the sources of the Peribonka and the Manicouagan, beyond the 52nd parallel of latitude, and reaches the St. Lawrence after a course of 270 miles. Navigation is difficult at its mouth owing to enormous sand shoals. At low tide even small boats must follow the channel closely in order to enter the mouth of

^① For detailed descriptions of the Betsiamites river see reports by J. Richardson and A. P. Low (1885) already cited.

the river. The course of the channel and the nature of the sand-bars seem to indicate that the terraces of Manicouagan peninsula have been separated from the neighbouring shore by wave action in somewhat recent time. The Outardes is rarely used by the Indians as a route of travel.

J. H. Valiquette (*loc. cit.*) has given a good description of the river as a travel route and also of the geology of the country along its upper course. The lower section, for some seventy miles from the mouth of the river, had not been studied geologically prior to the writer's visit.

The first falls of the Outardes are eight miles above its entrance into the St. Lawrence. Boats with draft of eight feet or less may ascend at high tide to this point, which is the site of the wharf and village of Outardes Falls. Above the falls are the Ontario Paper Company's dams and projected power development.

MANICOUAGAN RIVER:

This is the largest river flowing into the St. Lawrence on the North Shore below the Saguenay. It has a length of 310 miles. According to A. P. Low, the volume of water passing over the first falls is more than half that at the Chaudière falls on the Ottawa river. This first chute is seven miles from the mouth. The river is much used by the Indians in travelling to and from their hunting grounds and the Hudson's Bay posts in the interior. The Indians of Betsiamites do not enter the Manicouagan at its mouth, however, but avoid the detour of Manicouagan peninsula by going up the Outardes about a mile above the dams and there crossing to the Manicouagan by a portage of two miles^①.

OTHER RIVERS:

Other tributaries of the St. Lawrence in this map-area are the Papinachois, 35 miles in length, and the Rosiers, 20 miles, both small, rapid streams which can only be travelled in small canoes. The Rosiers is the eastern limit of the Indian Reserve, which is bounded on the west by the Nipi. Other streams are the Barthélémi and the aux Vases, neither of which is navigable.

^① For a detailed description of the Manicouagan river see A. P. Low, *loc. cit.*, 1895.

WATER-POWERS

The following table of water-powers in the area mapped is compiled from *Water Powers in the Province of Quebec*, 1928, published by the Department of Lands and Forests, Quebec.

RIVER	Length (miles)	Site	Fall (feet)	Drainage area (sq. mi.)	Est. h.p., ordinary flow	Remarks
Nipi.....	15	At mouth.....	100	40	138	Not dev.
Henshaw.....	10	Outlet of lake Henshaw.....	100	20	69	"
		1 m. from mouth...	140	38	183	"
Papinachois...	35	Mouth.....	20	205	142	"
		1 m. from mouth..	20	205	142	"
		3 m. from mouth..	15	200	103	"
		3½m. from mouth	20	200	138	"
Rosiers.....	20	Mouth.....	15	70	35	"
		1 m. from mouth..	10	70	24	"
		3 m. from mouth..	30	65	68	"
Outardes.....	270	10 m. from mouth..	175	6,300	38,086	Ont. Pap. Co.dams.
Manicouagan.	350	7 m. from mou ..	77	18,990	39,879	Manic. and Eng- lish Bay Export Co. Not devel.

GEOLOGY

The consolidated rocks of the map-area are all of pre-Cambrian age, and include both intrusive and highly metamorphosed sedimentary types. Over a large part of the area these are buried beneath unconsolidated Quaternary deposits of sand and clay. The several formations met with, and their relative ages, are indicated in the following table:

TABLE AND FORMATIONS

QUATERNARY.	Recent.....	River and swamp deposits, including beds of ochre
	Champlain.....	Stratified sands and clays of marine origin
	Glacial.....	Moraines and erratic blocks
<i>Great Interval</i>		
PRE-CAMBRIAN.	Granite Series..... (Post-Grenville intrusives)	Granite, diorite, pegmatite, aplite, porphyry, gneiss
	<i>Intrusive Contact</i>	
	Grenville Series..... (Sedimentaries)	Paragneiss, quartzite, crystalline limestone

DESCRIPTION OF FORMATIONS

PRE-CAMBRIAN

All the hilly region is underlain by pre-Cambrian rocks, which for the major part belong to the Granite series. Some very restricted areas only are occupied by rocks of the Grenville series. Where the pre-Cambrian rocks are highly metamorphosed and gneissoid, as they commonly are, it is often difficult to determine to which series they belong. Faults are numerous, their prevailing direction being N50°W.

GRENVILLE SERIES:

Rocks of this series have been observed in only four places, *viz.*, at the '15 Miles' on the river Betsiamites, an exposure mentioned in my report of last year; at lake Henshaw; at lake Jeanne d'Arc; and along the Manicouagan river in the vicinity of Caribou island. The first three of these are in a direct line and are probably part of a single band of Grenville. The largest occurrence is that along the Mani-

couagan, where an area of nearly five square miles is occupied by rocks which, in the main at least, are Grenville, as indicated on the accompanying map. Some of the rocks in this area are of doubtful origin, however. Those which certainly belong to the Grenville series occupy a relatively small area to the west of the Manicouagan, just opposite Caribou island, where they consist of garnetiferous mica-gneiss, finely banded. According to Richardson^①, also, there is a band of crystalline limestone of Grenville age in this vicinity, but we were not able to find it. Possibly it is on the east side of the Manicouagan, outside the limits of this season's work. The other rocks along the Manicouagan between its mouth and Caribou island are of rather doubtful origin. For the present they are referred to the Grenville, in conformity with the view of A. P. Low^② and on account of their micaceous character, although some doubt is felt as to their sedimentary origin because of the entire lack of banded structure, the rock being extremely uniform over large exposures. However, microscopic study of the rocks supports Low's view. Five thin sections were examined. They all contain garnet and mica, but no primary hornblende. Plagioclase is always present and may be in considerable amount, and microcline was noted in two samples from lake Salé.

The three other occurrences of Grenville rocks referred to above are of very small extent. There are four outcrops on the east side of lake Jeanne d'Arc, a tributary of lake Nipi. One is 200 feet from the outlet and the others are within 800 feet, towards the north. In each outcrop, the rock strikes nearly due north-south and the dip is towards the east, at 60 to 75 degrees. The uniformity of attitude indicates that they are parts of a single body, with dimensions 800 by 300 feet. The rock is Grenville limestone, consisting now almost entirely of augite and other pyroxenes, and cut in places by dykes of pegmatité. No graphite was seen in the rock.

At lake Henshaw there is an exposure, measuring some 100 square feet, on the west side of the lake. The rock is micaceous paragneiss, dark in colour.

At the '15 Miles' of the Betsiamites river, Grenville rocks are exposed in the nearly vertical walls over which two creeks, 1,000 feet apart, cascade into the river by a descent of more than 400 feet.

^① *Loc. cit.*, p. 306.

^② *Loc. cit.* (1895), p. 199.

The rocks are in beds that stand vertically and they are exposed in places for nearly 200 feet. The river shore between these two creeks is largely covered by sand and clay of the Champlain period, but it is very probable that the Grenville rocks are continuous beneath this cover. The other rocks of the vicinity are granite gneiss.

The Grenville rocks at this locality consist of crystalline limestone, in places largely altered to augite and diopside; quartzite, impure from the presence of biotite and in places of garnet; and paragneiss containing biotite, quartz, pyroxene, and garnet. These several phases blend into one another. They are invaded, or in places enclosed, by intrusions of pegmatite and of granite, of which rock a near-by hill called 'Square mountain' (Montagne Carrée) is formed. All the Grenville here seems to contain more or less lime, and it is of interest to note that the rare orchid *Calypto bulbosa*, a plant strictly dependent on lime, occurs here and was not seen elsewhere in the district.

The rocks of Grenville age in this map-area are tongue-like, un-eroded remnants of the basal part of the series. They have been disturbed, tilted up, and invaded by intrusions of granite and pegmatite. Their original mineral composition has also become much altered. The rarity of calcite in the pyroxene rocks is indicative of the extreme metamorphism they have suffered and suggests that these rocks represent beds that were at the very base of the series and so came in close contact with the intruding granitic batholith. On the other hand, the presence of microcline and of quartz with wavy extinction in the granite gneiss of this district indicates that these Grenville rocks were also subjected to great compression. It therefore appears that the rocks of the Grenville series have been altered both by igneous intrusions and by dynamic agencies.

The course taken by the metamorphism has been mainly determined by the original nature of the sediments. Limestone was changed to pyroxenite, and sandstone to garnetiferous quartzite; beds which contained alumina and silica became garnet gneiss, and this more and more resembles ordinary granite gneiss as the granite intrusive is approached.

GRANITE SERIES:

Apart from the few small occurrences of altered Grenville sediments that have been described above, all the rocks of the area belong to the 'Granite series'. These include granite, diorite, pegmatite, aplite, and porphyry, as well as granite-gneiss. The most abundant type is a reddish hornblende-gneiss, although, in the vicinity of lake Nipi, coarse-grained biotite-gneiss is the characteristic rock.

The several rock types of the Granite series and their age relations may be best studied in the vicinity of Outardes Falls, where construction work of the Ontario Paper Company has afforded some fine exposures. The latest intrusion here is coarse-grained red granite or pegmatite, which forms large dykes, some of which consist almost entirely of quartz. Where the dykes narrow they become fine grained, passing into red aplite and finally into mere tongues and veinlets of porphyry. These dykes and tongues cut pinkish augen gneiss which, by gradual transition, becomes first a red porphyritic gneiss and finally, within a distance of about forty feet, a grey granite gneiss of coarse texture, which is the predominant rock at this locality.

Diorite also occurs at Outardes Falls. It is a dark, massive rock of fine texture, and is older than any of the types described above. Augite (some faintly pleochroic), hornblende, and biotite together make up more than fifty per cent of the rock, and in addition to plagioclase there are present a few grains of quartz and of black iron ore.

Pegmatite dykes, similar to those at Outardes Falls, are common in other parts of the map-area. They are wide and in general are highly acid in composition, some of them, as already stated, consisting of quartz with little or no feldspar or other mineral. Such dykes may be seen on Ile de la Mine and on Ile Blanche, which was so named because of its white quartz dykes. There is much vitreous white quartz also between Lakes A and B, near the '15 Miles' of the Betsiamites river, and at lake Acid and along the river Rosiers above the big bend.

QUATERNARY

GLACIAL:

The traces left by the Quaternary ice-age are glacial striæ, glacial grooves, moraine deposits, and valleys showing erosion by ice. Striæ are especially well marked on the polished surfaces of rock exposures

along the St. Lawrence. Their general direction, indicative of the course of the glacier which caused them, may be taken as S.40°E. Actual measurements at various points were as follows:

- S.42°E.—First outcrop on Manicouagan.
- S.35°E.—Mouth of Papinachois river.
- S.38°E.—Mouth of aux Vases river.
- S.45°E.—River Barthélemi.
- S.60°E.—Outardes Falls.
- S.20°E.—Between Papinachois and Barthélemi rivers.

Well developed glacial grooves may be seen along the shore of the St. Lawrence between the Papinachois and aux Vases rivers.

Moraines are numerous. In many places they have obstructed valleys, which accounts for the large number of lakes in the area.

U-shaped valleys showing glacial sculpture are well developed in the vicinity of lake Nipi.

CHAMPLAIN:

The Champlain period is represented by wide plains of sand and clay, in which are found marine shells of the genera *Tellina* and *Leda*, thus proving their age. During this period, which was one of submergence, river valleys in the pre-Cambrian plateau, which had been deepened by glaciers, were occupied by the sea. They thus became fiords, often tens of miles in length. Rivers entering these fiords deposited in them the sediments which form large parts of the Champlain terraces or plains. According to A. P. Low^①, these terraces extend up the Betsiamites and the Manicouagan rivers for more than fifty miles at an elevation of 400 feet above present sea-level. The accumulation of these sediments has effectually masked the true nature of the fiords in places, especially along the St. Lawrence, where the plain is often ten to fifteen miles wide^②. But if we examine the foot of the Laurentian plateau, where rivers enter the St. Lawrence plain, the fiord structure, in the writer's opinion, is obvious. Although the rivers have cut trenches in the sediments, they have not yet excavated their channels to the levels they occupied before these sediments were deposited. They still run on beds of clay more or less mingled with débris brought down by the rivers. Thus the original floors of the fiords have not yet been uncovered; they are far beneath the present channels.

^① *Loc. cit.* (1895).

^② See R. Blanchard, *loc. cit.*, p. 16.

As to the depth of clay, or other deposits, remaining in the channels, no precise means of measurement are available. However, some salt springs along the Manicouagan river indicate that a considerable thickness of clay still remains, probably not less than eighty feet. One of these springs is just below the first chute of the Manicouagan, a few feet above the level of the sea, and two others, three miles distant, are at the foot of Montagne Salée, ten miles from the mouth of the river and about eighty feet above sea-level. The springs, which are saline, break out of the clay where it is crumpled against the steep walls of Montagne Salée. They discharge throughout the entire year and, according to the inhabitants, never freeze over, which suggests that they come from a considerable depth. The natural source of the springs is in beds that enclose salt, and such are most likely to be found in the pre-glacial valley of the river. In order to have resisted complete solution by the water of the river since the retreat of the Champlain sea, these salt-bearing beds must have been protected by impermeable clays of considerable thickness. Since the beds are probably horizontal, and the spring at the first chute emerges nearly at sea-level while those at Montagne Salée are eighty feet higher, it follows that the present channel of the Manicouagan at the latter point is still not less than eighty feet above its floor at the beginning of Champlain time. Moreover, the steep slope of the rocks of the walls here, indicates a valley that may be very deep^①.

ECONOMIC GEOLOGY

The area occupied by pegmatites and rocks of the Grenville series—the rocks most likely to contain minerals of economic value—is small. Consequently, the district offers no great interest for prospectors. The only minerals or mineral products of possible value that were observed are quartz, iron sands, peat, ochre, and mineral waters.

QUARTZ.

Quartz of a high degree of purity is found in enormous quantity at several places already mentioned. The most easily accessible is that on the Ile de la Mine, situated in the bay of Outardes river. The

^① The inhabitants claim that the springs take their rise in the rocks of the mountain, to which, as well as to the neighbouring lake, they have given the name Salée, or salty.

island is occupied in nearly equal parts by granite gneiss and pegmatitic quartz, which intrudes the gneiss. The quartz outcrop is 2,300 feet long and has an extreme width of 450 feet. It rises to fifty feet above the sea. An analysis of this material gave: silica, 98.69%; met. iron, 0.09%. Situated in mid-channel of the river Outardes, the island, which is the property of the Ontario Paper Company, of Outardes Falls and Thorold, Ontario, takes its name from a mining prospect said to have been opened on it some fifty years ago, when gold was reported. In an old mining pit, I found a little pyrite lining a narrow fissure in quartz, but this was the only trace of mineralization observed. Assays of two samples of the pyritized quartz gave no trace of gold.

MAGNETIC IRON SANDS

The deposits of iron sands which occur along the shore of the St. Lawrence between the Betsiamites and Papinachois rivers have been described or mentioned in several official reports^①. The largest deposits of this kind occur between the church of Betsiamites and Little River, two miles below Betsiamites. The sands consist of a mixture of magnetite, ilmenite, garnet, and quartz. Dulieux describes them as "black, heavy sands very rich in magnetite, forming a band along the sea at the foot of sand banks and terraces. Usual tides scarcely reach them, but high tides about the full moon partly cover them. They are covered and re-worked by the high tides of the equinoxes. In general, they are not found on the lower beaches. They are derived by concentration from the sands of the high banks which are reached by the waves only at very high tides"^②.

^① Sterry Hunt, Geol. Surv. Can., Rept. of Progress, 1866-69, pp. 271-336.
James Richardson, *ibid.*, p. 340.

A. J. Rossi, Geol. Surv. Can., Ann. Rept., 1895, Pt. J, Appendix II.

J. A. Dresser and A. Stansfield, Geol. Surv. Can., Mem. 92, 1916.

J. Obalski, Que. Bur. Mines, Ann. Rept., 1898, 1902, 1903.

E. Dulieux, *ibid.*, 1911, 1912; *Les mineraux de fer de la Province de Québec*; Que. Bur. Mines, 1915.

^② *Op. cit.*, p. 138.

In this locality, the iron sands form a rather continuous band about five feet wide with a maximum thickness of two and a half feet. The thickness is always greatest at the highest point of the beach and diminishes rapidly in going towards the sea. If we take one foot as the mean thickness of this deposit, which is one and a half miles long, the total quantity is about twenty thousand cubic feet of sand, a quantity that is commercially insignificant.

Trials I made show this sand to be composed of:

- 54.27 parts of magnetite
- 16.36 parts of ilmenite
- 29.37 parts of quartz, garnet, etc.

With an ordinary magnet one may extract, in one operation, a concentrate containing:

- 87.3% of magnetite
- 11.5% of ilmenite

leaving tailings of the following composition:

- 37.2% of magnetite
- 18.9% of ilmenite.

The proportion of concentrate for three samples of good quality was 34.1%, 34.4% and 34.2%; two poorer samples gave 22.4% and 28.7% of concentrate.

The figures given above as well as the following analyses refer to the sample which gave 34.1% of concentrate.

ANALYSES OF CONCENTRATE AND TAILING

	Concentrate	Tailing
Fe.....	67.52%	33.90%
TiO ₂	6.12%	9.96%

The source of this magnetic iron sand as well as of the ochre is the ferruginous sand of the Champlain plains. Twenty-eight samples of this sand were analysed and gave the following average result:

Fe ₂ O ₃	FeO	Mn	TiO ₂
1.36%	0.62%	0.0026%	0.36%

The percentages of Fe₂O₃ and FeO exclude the ilmenitic iron content.

PEAT

There are several large peat bogs in the plains of Betsiamites and of the Manicouagan peninsula. One, which extends along the St. Lawrence between the village of Betsiamites and Little river, has been systematically drilled by Paul Emile Auger with three assistants. This bog has a length of 4,000 feet along the St. Lawrence and a width in places of 1,400 feet, with a thickness apparently between 7 and 12 feet. Its extent is well marked owing to the absence from its surface of forest vegetation, except around its margin. The peat is quite homogeneous throughout the thickness of the bog. It is only for a foot or less at the base that woody roots and stumps are found.

OCHRE

Ochre occurs in numerous places in the district, especially in the Manicouagan peninsula, but in general the deposits are not large. The largest, that on Paint bay, was sampled and is described on a later page. We also continued the sampling of the ochre deposits on Islets Jérémie, in the township of Betsiamites^①. The principal occurrence in that locality was sampled during the season of 1931.

ISLETS JÉRÉMIE OCHRE DEPOSITS:

Figure 1 shows the location of the ochre deposits on Islets Jérémie. Those marked *A* and *D* were sampled in 1931. During the 1932 season, deposits *B* and *C* were sampled and some additional drilling was done on deposit *A* where the depth had not previously been ascertained. A depth of eleven and a half feet was obtained, which is the maximum for the entire Grande Savane field.

Deposit *B* is situated on a ridge to the west of Block *H*. The ochre here is generally red in colour. The deposit is not large, there

^① For description of these deposits, see Annual Report for 1931, Part C, with accompanying map.

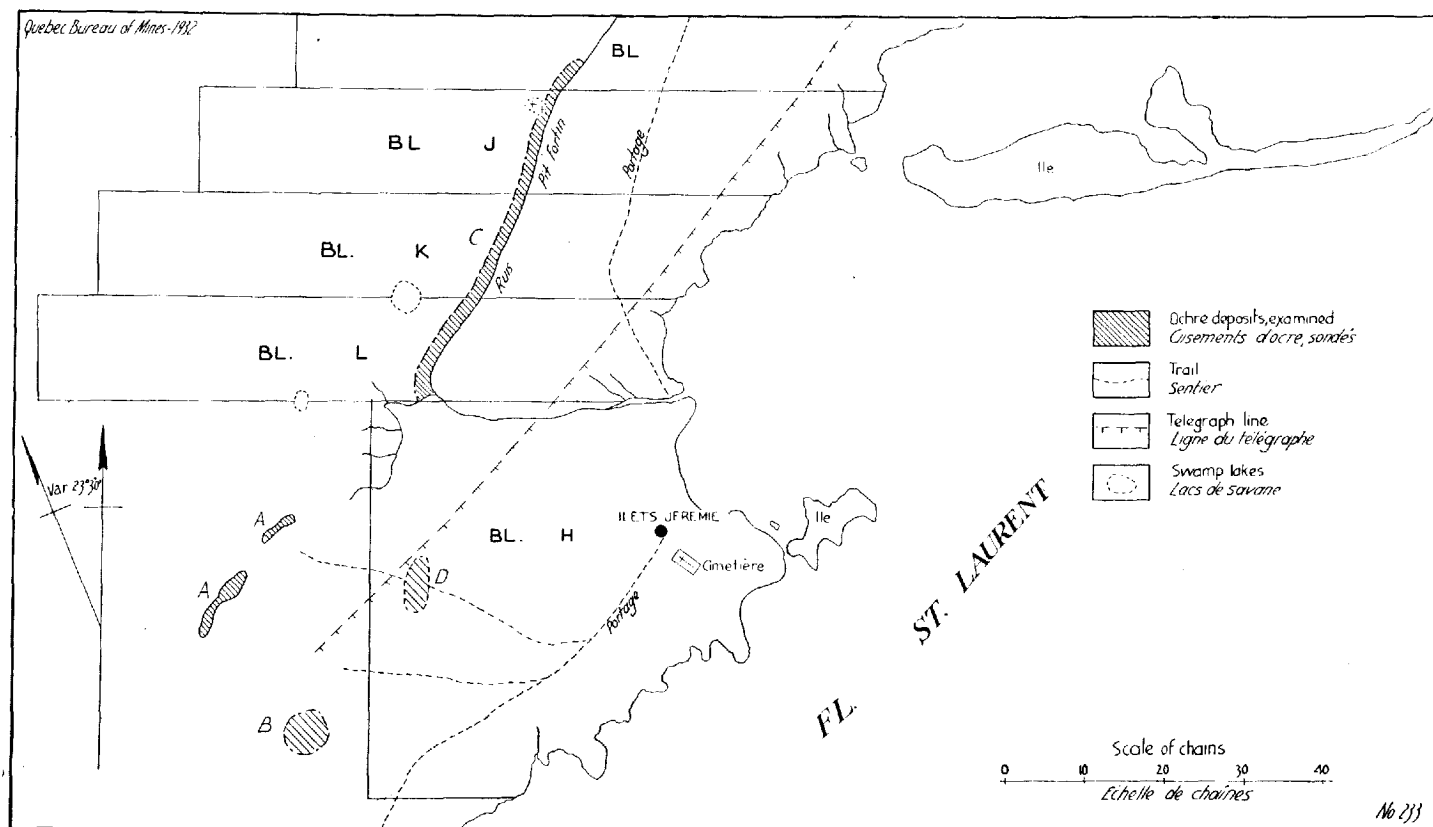


FIGURE 1.—Islets Jérémie ochre deposits, Betsiamites township.

being an area of about 6,000 square feet in which the depth is more than one foot with a maximum of four feet. The ochre rests on sand. The mean of seven analyses is as follows^①:

Organic matter... .	29.60	Fe ₂ O ₃	69.84
SiO ₂	26.67	Mn.....	0.023

Of the Islets Jérémie ochre deposits, the largest, but also the least favourably situated for operation, is deposit *C*. This lies along Pit Fortin brook, which is in a deep, narrow valley cut in the Champlain sediments. The banks of the brook are steep and the ochre is deposited between water-level and a height of thirty to eighty feet up the slope, by a great number of seepages from a large swamp adjacent to the valley. Due to the steepness of the slopes, much of the ochre is carried into the stream and thence to the St. Lawrence.

The ochre frequently rests on sand, which explains the high percentage of silica shown by analyses. It occurs principally in pockets, though in places these are connected beneath surface vegetation. The deposit continues across blocks *L*, *K*, *J*, and enters block *I* for a total length of 2,760 feet, with an average width of fifty feet and a thickness of four and a half feet of ochre. Samples, 117 in all, were taken at 30-foot intervals parallel to the brook and only a few feet from it. Where the bed is more than thirty feet wide a second, and in places a third, line of samples was taken parallel to the first. In this way:

8 samples, Nos. 1-8,	were taken in Block	<i>I</i>
19 " " 9-27	" " "	<i>J</i>
47 " " 28-75	" " "	<i>K</i>
43 " " 76-117	" " "	<i>L</i>

The mean of 117 analyses is as follows:

Organic matter.....	25.00	Fe ₂ O ₃	72.10
SiO ₂	25.66	Mn.....	0.089

The following table gives the results of each of the 117 analyses, with particulars of the thickness of the ochre bed and of the location from which the sample came. Where the bed is more than four feet thick, two samples were taken, one at the surface, the other at the bottom of the bed.

^① In all the analyses of ochre given here, organic matter is determined on samples dried at 105°C.; other constituents in calcined material.

DETAILS OF DRILLING AND ANALYSES OF OCHRE, FIELD C,
ISLETS JÉRÉMIE

(Organic matter in samples dried at 105°C.; other constituents
in calcined material)

Drill Site	Thickness (feet)	Organic Matter	SiO ₂	Fe ₂ O ₃	Mn
Block I					
1.....	1	23.33	10.79	88.31	0.315
2.....	1.5	19.90	9.78	89.53	0.718
3.....	1	26.30	9.45	89.73	0.048
4.....	2	26.95	10.75	88.20	0.128
5.....	1.5	24.24	10.66	88.23	0.148
6.....	1	22.56	21.68	77.58	0.064
7.....	1.5	33.42	7.13	88.11	0.356
8.....	3	13.32	7.89	90.21	0.069
Block J					
9.....	2.5	22.65	8.74	87.75	0.207
10.....	3	20.69	12.24	85.72	0.634
11.....	1	19.39	13.51	82.02	0.029
12.....	4	27.55	36.23	58.80	0.033
13.....	1	22.95	10.62	89.21	0.195
14.....	1	26.87	9.84	89.13	0.096
15.....	1	21.67	8.12	90.42	0.720
15, 1.....	4	27.95	12.40	85.94	0.165
16.....	1	26.89	8.98	89.73	0.257
17.....	1.5	22.54	28.02	67.83	0.091
18.....	1.5	31.41	37.78	58.42	0.051
19.....	4	17.80	43.50	52.70	0.014
20.....	2	23.69	41.42	55.78	0.062
21.....	3	42.94	32.39	62.81	0.028
22.....	3.5	20.51	24.43	70.92	0.105
23.....	1.5	23.38	12.62	86.15	0.053
24.....	2	15.83	34.48	61.67	0.042
25.....	4.5	21.92	17.16	80.67	0.122
26.....	2.5	47.73	26.09	71.00	0.022
27.....	2.5	29.35	20.78	76.02	0.023
Block K					
28.....	1	22.23	12.18	85.27	0.092
29.....	2	16.92	17.84	89.21	0.052
30.....	1.5	33.98	20.12	76.89	0.059
31.....	1	50.47	15.18	81.83	0.009
32.....	1.5	26.03	13.42	85.95	0.015
33.....	1	24.42	13.15	84.04	0.031
34.....	1	22.90	25.22	72.15	0.099
34, 1.....	1	30.55	32.93	64.23	0.083
35.....	1	28.04	31.20	64.98	0.016
36.....	4	49.53	41.25	53.68	0.014
37.....	1.5	46.97	16.24	81.45	0.044

Drill Site	Thickness (feet)	Organic Matter	SiO ₂	Fe ₂ O ₃	Mn
Block K (cont'd.)					
38.....	1.5	64.41	30.47	63.71	0.046
39.....	3	51.22	69.40	29.42	0.034
40.....	1	46.57	20.97	76.23	0.044
41.....	1	30.95	15.04	83.21	0.024
42.....	1.5	23.50	26.48	69.58	0.077
43.....	2.5	18.95	21.15	76.13	0.156
44.....	2.5	17.34	17.36	79.65	0.128
45.....	4	21.63	77.43	22.31	0.006
46.....	4	6.25	86.88	13.42	0.002
47.....	1.5	22.97	26.50	70.48	0.015
48.....	1.5	16.96	16.18	81.24	0.049
49.....	2	23.74	45.40	53.82	0.016
50.....	2.5	27.29	75.87	19.08	0.011
51.....	2	31.18	38.07	58.42	0.016
52.....	2.5	17.29	37.88	58.96	0.022
53.....	2	36.92	32.12	66.51	0.036
54.....	2.5	30.14	24.47	74.87	0.024
55.....	4	18.20	50.35	47.05	0.016
56.....	1	22.04	9.20	89.00	0.013
57.....	2	9.63	60.83	36.17	0.017
58.....	2.5	19.09	22.09	67.62	0.066
59.....	1.5	23.49	25.14	73.11	0.075
60.....	4	26.13	27.88	70.21	0.022
61.....	2	24.12	27.86	70.75	0.069
62.....	4.5	17.51	22.26	75.48	0.021
63.....	2.5	22.86	11.92	87.16	0.059
63, 1.....	4	13.09	51.73	46.18	0.046
64.....	1	23.01	26.98	17.17	0.385
65.....	2.5	19.16	25.05	73.79	0.081
66.....	3	22.53	14.96	84.32	0.184
67.....	1	19.66	23.36	75.61	0.113
68.....	2.5	19.84	25.14	74.07	0.053
69.....	2	18.46	17.77	80.93	0.013
70.....	2.5	30.76	10.01	88.97	0.151
71.....	1	17.29	38.88	61.03	0.274
72.....	1	30.08	28.79	70.63	0.040
73.....	1	19.37	49.63	47.88	0.038
74.....	4	29.05	17.92	80.54	0.023
Block L					
76.....	4.5	30.47	34.35	62.43	0.027
77.....	2.5	42.72	36.48	61.47	0.027
78.....	2	31.25	44.80	47.81	0.022
79.....	1	18.65	18.59	80.06	0.070
80.....	2	18.77	10.56	88.75	0.136
81.....	4	39.53	47.62	49.02	0.041
82.....	1.5	31.57	6.29	92.36	0.178
83.....	1	35.88	26.47	72.28	0.038
84.....	1	41.34	22.86	75.81	0.038
85.....	3	14.16	20.14	78.50	0.020
86.....	1	18.05	19.52	77.82	0.013
87.....	4	18.26	23.32	75.90	0.016
88.....	2	22.18	31.43	68.77	0.021

Drill Site	Thickness (feet)	Organic Matter	SiO ₂	Fe ₂ O ₃	Mn
BLOCK L (cont'd.)					
89.....	1.5	29.49	11.12	87.58	0.068
90.....	1.5	22.07	33.47	63.77	0.466
91.....	2.5	18.98	9.32	90.04	0.117
92.....	4	19.33	24.06	74.19	0.043
93.....	2	34.69	11.56	87.65	0.034
94.....	2	21.71	10.68	88.24	0.179
95.....	1	22.72	17.51	80.71	0.152
96.....	2	5.52	67.08	30.04	0.024
97.....	1	20.14	16.23	82.60	0.043
98.....	3	43.73	7.87	91.20	0.011
99.....	2	14.33	21.89	76.63	0.022
100.....	1.5	14.13	24.74	74.16	0.036
100,1.....	4	20.36	22.81	75.91	0.016
101.....	4	13.09	31.67	66.08	0.021
102.....	1	19.37	17.97	80.82	0.040
103.....	1	17.47	17.89	79.96	0.038
104.....	4	15.15	27.01	71.54	0.052
105.....	1.5	19.58	30.81	68.47	0.043
107.....	1.5	19.86	23.42	72.85	0.071
108.....	1	18.29	20.12	76.82	0.055
109.....	3	20.26	53.10	40.65	0.017
110.....	2.5	20.54	37.79	58.17	0.011
111.....	2.5	23.01	13.56	84.41	0.397
112.....	1	24.59	42.38	51.32	0.027
113.....	0.5	14.01	9.68	89.73	0.067
114.....	3.5	43.71	20.64	67.38	0.024
115.....	2	21.56	21.79	74.51	0.028

PAINT BAY OCHRE DEPOSITS:

Paint bay (Anse à la Peinture) is situated between Manicouagan point and Paradis point, in the Manicouagan peninsula. Ochre occurrences here have been known for many years. The first letters-patent covering them were granted on three lots at Paint bay to one McDole, probably in 1866. Later, in 1886, three other lots were granted to two partners named Bossé and Michaud, two lots being on the west and one on the east of the McDole lots. The locality is commonly known as the 'Six Mining Lots'.

According to J. Obalski^①, an American fishing company became established here about 1886 and bought the ochre deposits with the object of working them. It does not appear, however, that they ever made any serious attempt to do so.

^① Que. Bur. Mines, Ann. Rept., 1889-90, pp. 33, 35, 36.

Obalksi estimated the ochre field to have an area of 300 acres and a maximum thickness of five to six feet. According to our investigations, it consists of a large number of small deposits which are not connected with one another. They are situated along the bases of small escarpments, perhaps ten feet high, which occur between the St. Lawrence and the interior of the peninsula, at intervals of about 200 feet, separated by swamps. The ochre occurs only at the foot of the scarps; notwithstanding careful drilling, none was found in the intervening swamps. It therefore appears to me that the extent of the Paint Bay ochre field was greatly over-estimated by Obalksi. At a maximum, it is not more than 3,000 feet long by 420 feet wide. It extends along the St. Lawrence at an average distance of 300 feet from the shore and crosses mining lots 3, 4, 5 and 6 (see map, Figure 2). But even within the limits so defined, the ochre in nowise forms a continuous and uniform deposit; it is often interrupted by considerable areas of barren swamp.

The principal deposit is situated along a little brook which runs into the sea on mining lot No. 5. The maximum thickness of ochre here is six feet, as was noted by Obalski, but the average of fifty-one soundings is only two feet four inches.

The ochre is nearly always red and it commonly carries a high percentage of manganese. The average of sixty-one analyses is as follows:

Organic matter.....	26.44	Fe ₂ O ₃	79.04
SiO ₂	15.46	Mn.....	0.152

This deposit is four and a half miles from the hamlet of Lebel Point. The nearest wharf is at Outardes Point, ten miles distant. Navigation along the intervening shore-line is difficult owing to the large sand banks.

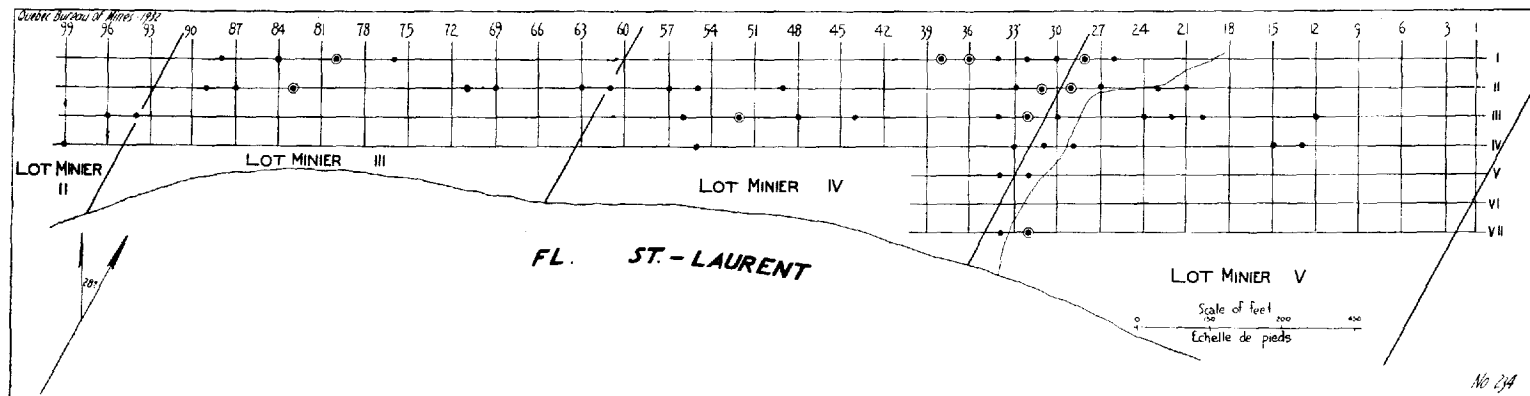


FIGURE 2.—Paint Bay (Anse à la Peinture) ochre deposit, Manicouagan township.

LEGEND.—Black dot: Thickness of ochre, 1 to 4 feet, one sample taken.

Black dot in circle: Thickness of ochre 4 feet and over, two samples taken.

DETAILS OF DRILLING AND ANALYSES OF OCHRE,
PAINT BAY DEPOSIT

NOTE.—Holes were drilled and samples taken at the intersections of lines numbered in Roman and Arabic figures on the accompanying sketch map (Figure 2).

Where the ochre bed is more than four feet thick, two samples were taken and the analyses averaged.

Organic matter in samples dried at 105°C; other constituents in calcined material.

Drill Site	Thickness (feet)	Organic Matter	SiO ₂	Fe ₂ O ₃	Mn
I....26.....	1	28.31	6.93	92.26	0.033
28.....	6	32.00	48.31	46.01	0.007
30.....	2	27.21	8.52	89.82	0.006
32.....	3	19.10	9.43	90.66	0.007
34.....	2	19.25	13.97	84.70	0.007
36.....	4	25.24	13.62	83.89	0.011
38.....	6	37.28	22.66	74.09	0.013
76.....	3.5	25.37	15.49	81.29	0.020
80.....	5	16.89	16.17	80.24	0.014
84.....	3	17.77	13.48	84.03	0.305
88.....	1	20.30	8.40	91.56	0.019
II....21.....	1	29.12	11.48	87.12	0.028
23.....	1	26.34	7.43	91.72	0.257
27.....	1	17.03	34.35	61.10	0.029
29.....	4	24.92	11.87	80.54	0.019
31.....	4	19.70	10.74	85.78	0.219
33.....	1	22.99	7.07	89.62	0.217
49.....	1	25.80	8.13	87.81	0.076
55.....	1	21.86	9.95	87.59	0.062
57.....	1	33.62	18.70	80.12	0.146
61.....	1	26.48	5.18	91.08	0.029
63.....	3.5	27.44	23.57	70.96	0.032
69.....	1	32.13	22.74	70.17	0.030
71.....	1	29.12	8.12	88.04	0.241
83.....	5	22.91	11.32	85.80	0.038
87.....	2	21.60	14.91	80.46	0.011
89.....	3	27.79	20.19	74.58	0.061
III....12.....	1	29.76	7.85	86.27	0.005
20.....	1	27.12	9.65	85.23	0.075
22.....	2	29.23	9.36	84.77	0.041
24.....	1	27.04	11.40	83.02	0.065
30.....	1	27.25	11.25	83.23	0.109
32.....	4	17.44	14.26	80.65	0.188
34.....	3	30.98	10.47	84.66	0.341
44.....	1	26.09	5.18	91.15	0.245
48.....	1	31.65	15.16	80.83	0.394
52.....	4	29.51	9.50	83.66	0.366
56.....	3	30.10	10.53	89.01	0.404
94.....	1	32.37	5.68	91.17	0.350
96.....	1	28.64	9.01	85.43	0.313

Drill Site	Thickness (feet)	Organic Matter	SiO ₂	Fe ₂ O ₃	Mn
IV....13.....	2	27.87	21.89	75.26	0.468
15.....	2	39.40	11.01	82.85	0.435
29.....	2	21.62	22.13	76.19	0.171
31.....	2	36.73	5.06	92.32	0.446
33.....	3	11.27	54.49	40.73	0.142
55.....	2	38.51	47.20	48.97	0.153
99.....	1	26.20	14.60	81.29	0.426
V....32.....	2	37.97	11.68	81.76	0.287
34.....	1	32.53	8.83	87.06	0.266
VII...32.....	4	23.58	21.61	75.36	0.210
34.....	2	23.01	12.42	83.76	0.376

MINERAL WATER

As mentioned on a previous page, there are three springs of salt water in the valley of the Manicouagan. One of these is below the first chute from the mouth of the river, about 1,000 feet from the portage, on Block *M*. The result of an analysis of the water of this spring is given in the Annual Report of the Geological Survey of Canada for the year 1895 (Part *R*, p. 55). Two other springs of the same character occur on the banks of the Manicouagan at the foot of Montagne Salée; they are probably covered by the water of the river at time of high flood. The first of these two is 1,200 feet from the mouth of the Blanche river and the other is a hundred feet farther upstream. J. H. Valiquette^①, in 1908, was the first to report officially on these springs, but their existence must have been known a long time previously. The Indians of the region have some notable legends about them.

The source of these springs is doubtful; but as there are no Palæozoic formations in the region, it is probable that they originate in some salt-bearing bed near the base of the Champlain sediments. The general correspondence in composition of the water from the two localities, as shown in the analyses below, suggests that all the springs have a common origin.

^① Loc. cit., pp. 33, 34.

ANALYSES OF MINERAL WATER FROM VALLEY OF MANICOUAGAN
(IN PARTS PER MILLION)

	Foot of Mt. Salée	First Chute
Total solids.....	8,088.0	8,763.0
Total.....	9,555.0	.....
SiO ₂	37.0	5.0
Fe ₂ O ₃	4.3	trace
Al ₂ O ₃	11.7	.....
CaO.....	101.0	174.0
MgO.....	286.0	261.0
SO ₃	223.0	519.0
Cl.....	4,333.9	4,533.0
Na ₂ O.....	3,529.8	3,877.0
K ₂ O.....	134.8	100.0
CO ₂	144.8	315.0
Organic and volatile matter.....	224.8	tr. org. mtr.

The acids and bases can reasonably be assumed to be present in the combinations indicated in the table below. Carbonates are calculated as mono-carbonates and all the salts as anhydrous.

	FOOT OF MT. SALÉE		FIRST CHUTE	
	Parts per million	Grains per Imp. gallon	Parts per million	Grains per Imp. gallon
NaCl.....	6,657.2	388.31	6,669.0	470.09
KCl.....	213.4	12.44	158.0	11.13
CaCl ₂	199.8	11.75	.....	.....
MgCl ₂	168.4	9.82	550.0	38.76
MgSO ₄	335.1	19.54	.....	.....
MgCO ₃	234.4	13.67	63.0	3.89
FeCO ₃	6.2	0.36	trace	trace
Al ₂ O ₃	11.7	0.68	.....	.....
SiO ₂	37.0	2.15	5.0	0.35
CaCO ₃.....	.....	.....	218.0	13.60
CaSO ₄.....	.....	.....	128.0	9.02
Na ₂ SO ₄.....	.....	.....	786.0	55.40
Organic matter.....	224.8	13.10	trace	trace

The physical characters of the water from Montagne Salée are as follows:

Density at 22°C	1.0051	
pH.....	7.5	
Turbidity.....	5-10	} U. S. Geol. Surv. Standard
Colour.....	5-10	
Odour, cold.....	0	} A. P. H. A. Standard
" warm.....	1	

The samples not being fresh at the time they were analysed, no quantitative determination was made of NH₃, NO₂ or NO₃; but a determination made one month after they were collected gave:

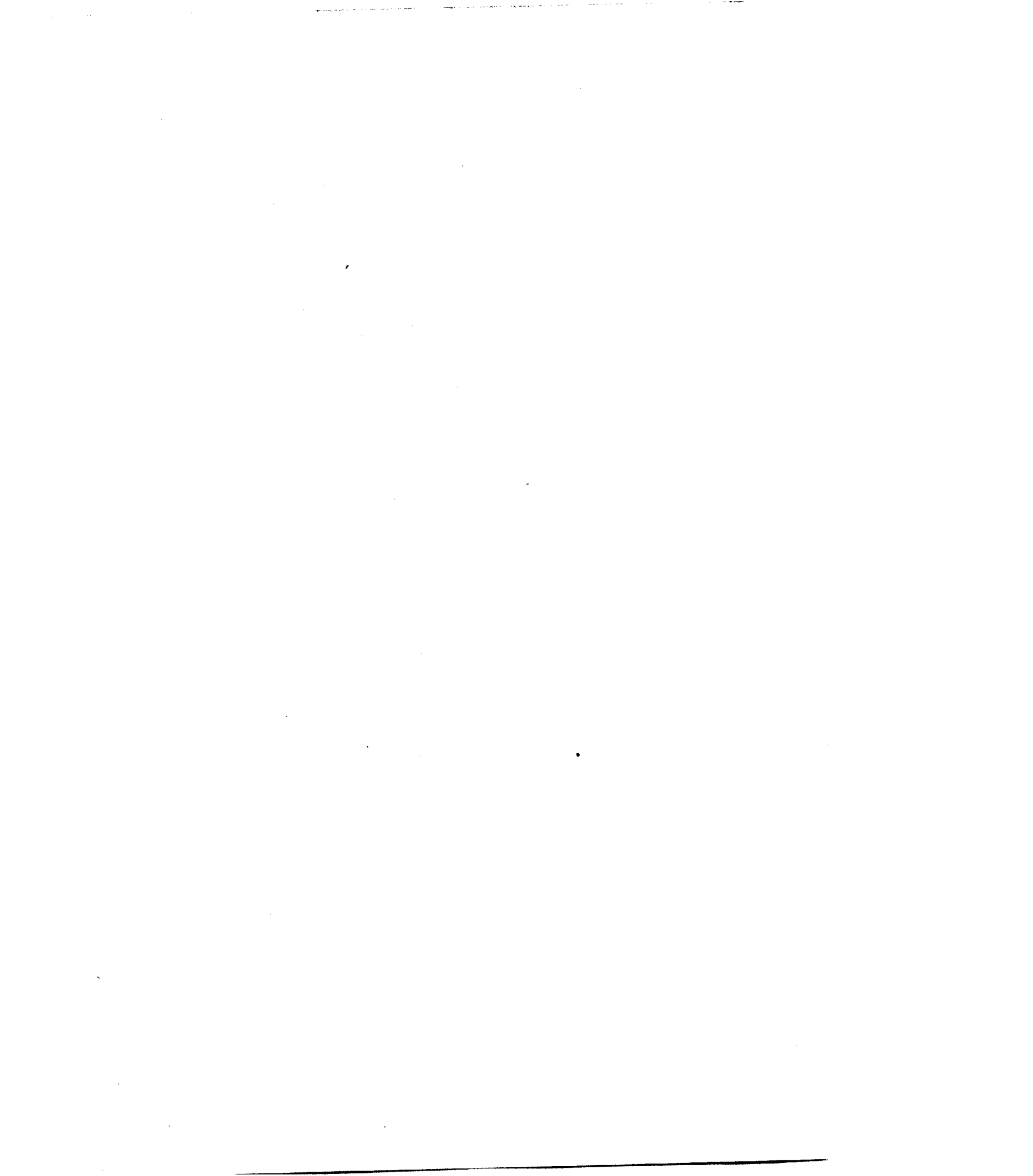
NH ₃	less than 5 parts per million
NO ₂	trace
NO ₃	trace

ANALYSES

The analyses of quartz containing pyrite from Ile de la Mine, referred to on page 128, were made at the provincial laboratory in École Polytechnique, Montreal, Adhémar Mailhiot, Director.

The analysis of mineral water from the first chute of the Manicouagan was made in 1895 by F. G. Wait, of the Geological Survey of Canada.

All the other analyses given in this report were made in the Mineralogical Laboratory of École Supérieure de Chimie, Laval University, Quebec, by Alfred Potvin.





A.—Betsiamites village (Bersimis), at mouth of River Betsiamites, in
Papinachois Indian Reserve.



B.—Family of Indians at Betsiamites (Bersimis).





A.—Betsiamites (Bersimis) river, from top of Montagne Carrée.



B.—Lac à l'Ours, Nipi River, showing glacial topography.





A.—Glacial grooves, Papinachois river.



B.—Manicouagan river, above first fall.

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