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LOWER ROMAINE RIVER AREA, SAGUENAY COUNTY

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PROVINCE OF QUEBEC, CANADA

Department of Mines

Honourable W. HAMEL, *Acting Minister*

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DIVISION OF GEOLOGICAL SURVEYS

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GEOLOGICAL REPORT 19

LOWER ROMAINE RIVER AREA

SAGUENAY COUNTY

by

J. A. Retty.



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1944

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LOWER ROMAINE RIVER AREA

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INTRODUCTION

General Statement

The rocks occurring along the lower portion of the gulf of St-Lawrence have been examined at various times by officers of the Geological Survey of Canada and the Quebec Bureau of Mines. These investigations have been confined almost entirely to the country adjacent to the gulf. Very little is known of the geology of that vast section of the Province which extends far to the north of the gulf.

In order to explore part of this region and to locate, if possible, favourable ground for prospecting, the writer undertook, during the field season of 1941, a reconnaissance survey of the geology of the Lower Romaine River basin. This report presents the results of the work.

Acknowledgments

Messrs. Simard and Baillargeon, Quebec Land Surveyors, gave the writer information on the routes of the area which was invaluable in the execution of the work.

The Department of Lands and Forests, Quebec, furnished the plans that were used in the compilation of the base map.

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The writer was ably assisted in the field by Jacques Claveau. The canoeemen, Jean Giasson and Lauréat Arsenault, of Seven Islands, Que., deserve special mention and grateful recognition for their loyal, efficient, and untiring efforts on the swift and treacherous waters of Romaine river. Alphonse and Albert Lebrun, of Havre-St-Pierre, acted as guides, and the latter also served as cook.

Previous Work

Prior to the investigation of the writer, no geological work had been done in the Lower Romaine River area.

The upper part of the river was explored by A.P. Low in 1894 (1), and as early as 1856 the Mingan islands, off the coast at its mouth, were examined by James Richardson (2). Reference to investigation along the St-Lawrence coast in the vicinity, carried out at various times between the years 1883 and 1889 by J. Obalski and H. de Puyjalon, appears in the reports of the Commissioner of Crown Lands, Quebec, for those years.

GENERAL FEATURES OF THE AREA

Location, Access, and Settlement

The Lower Romaine River area is in Saguenay county, on the north shore of the gulf of St-Lawrence, about 400 miles below Quebec city. The western part of the island of Anticosti lies directly south of the area.

The meridian of west longitude 63°00' crosses the eastern part of the area, and the parallel of north latitude 51°00' crosses the northern part.

The territory examined is of irregular outline, its boundaries being controlled, in great part, by the possibility of travel along watercourses. The Romaine valley was examined to a point sixty miles north of the gulf of St-Lawrence. The lower portions of the rivers Romaine-Est and Romaine Nord-Est were also examined, together with the group of lakes west of the lower part of Romaine river. This area of irregular outline comprises approximately 1,000 square miles.

During the navigation season, Havre-St-Pierre, nine miles east of the mouth of Romaine river, is a port of call for a weekly boat service of the Clarke Steamship Company, Limited, from Montreal. In winter, a boat makes periodic trips in the lower part of the gulf of St-Lawrence; also, a mail and passenger service is operated under government contract by Quebec Airways, Limited, from Rimouski to Blanc Sablon which is about 320 miles down the St-Lawrence from Havre St-Pierre.

An improved road has been constructed from Havre-St-Pierre to a point six miles west.

A telegraphic service is maintained by the Dominion Government along the north shore of the gulf. There is a telegraph office at Havre-St-Pierre. Formerly there was one also at Betchouane, eighteen miles east of Havre-St-Pierre, but this settlement is now abandoned.

Havre-St-Pierre is the point of departure for the Lower Romaine River area. Within the map-area proper, there is no means of transportation other than by canoe.

Travel on Romaine river below the Bassin des Murailles is comparatively easy. The portages are few and almost all of

(1) Report on Exploration in the Labrador Peninsula; Geol. Surv. Can., Ann. Rept., Vol.VIII, 1895, Part L, pp.167-170, 234-236.

(2) Geol. Surv. Can., Report of Progress, 1853-1856, pp.239-243.

them are short. An outboard motor may be used to advantage on this lower stretch of the river, as also on its tributary, Puyjalon river, and on Puyjalon lake. Above these points, however, travel is difficult and should be attempted only by experienced canoeists, as the river is very swift and treacherous. There are many stretches where poleing is the only practicable method of propelling a canoe. Above the mouth of Romaine Nord-Est river for an undetermined distance beyond the map-area, the river offers exceptional difficulties to travel.

There is no settlement within the map-area. The village of Havre-St-Pierre on the St-Lawrence shore, just south of the area mapped, has a population of about 1,400. It is the seat of a bishopric, and institutional buildings include a hospital, a convent, and a normal school. The population is entirely French Canadian and derives the main part of its livelihood from fishing. There are excellent harbours on the gulf of St-Lawrence at Havre-St-Pierre and at Betchouane.

The southern part of the area is in the 'Seigneurie de Mingan'. This land grant, which dates back to the time when Canada was a French colony, includes the strip of country extending six miles back from the St-Lawrence shore between Goynish (Aguanus) river on the east and just beyond Bouleau river on the west.

Resources

The northern portion of the area examined is densely wooded and contains an abundance of good, merchantable timber, mostly black spruce. There were once fine stands of timber in the southern part of the area, but these were damaged by forest fires during the summer of 1941. Unless salvaged within the next few years, all this timber will be valueless.

Fish are plentiful in the lakes and streams. Spruce partridge are abundant, but larger game was not observed. Fur-bearing animals were driven from the area by the forest fires of 1941.

Extensive flat areas extend eastward from the mouth of Romaine river to Havre-St-Pierre and beyond, and also up the valley of Puyjalon river and northward along Romaine river to the Bassin des Murailles. Rapid examination indicates that the soil in these areas is fine sand underlain by clay. The surface is swampy in many places but could probably be drained without much difficulty. Whether or not the soil and the climate would be favourable to agriculture could be determined only by experts on such matters.

The numerous falls and rapids along Romaine river and its tributaries afford many sites for the development of hydro-electric power. Thus far, none of the sites has been harnessed. Many are situated close to the gulf of St-Lawrence and constitute a large reserve of hydro-electric energy.

The following data concerning the water-power sites along the lower portion of the river are given in List of Water Powers in the Province of Quebec (1).

(1) Cooperatively prepared by Dominion Water Power and Reclamation Service, Department of the Interior, Ottawa, The Quebec Streams Commission, and The Hydraulic Service, Department of Lands and Forests, Quebec, 1928.

<u>River and Power Site</u>	<u>Undeveloped Site No.</u>	<u>Head (Feet)</u>	<u>Drainage Area (Square miles)</u>	<u>Est. Capacity in H.P. at 80% Efficiency</u>	
				<u>At Ordinary Medium Flow</u>	<u>At Ordinary Six Months' Flow</u>
Romaine River:					
36 miles from mouth	2 VC ₁₄	100	7,120	22,650	42,000
30 miles from mouth	2 VC ₁₅	108	7,150	24,500	45,600
9 miles from mouth	2 VC ₂₄	13	7,260	3,000	5,580
At mouth	2 VC ₂₅	10	7,700	2,450	4,550
Romaine Nord-Est River: (Trib. to Romaine)					
15 miles from mouth	2 VC ₂₇	108	540	1,856	3,450
9 miles from mouth	2 VC ₂₀	387	738	9,077	16,890
Romaine Est River (Trib. to Romaine) Foot of Cimon lake	2 VC ₁₆	150	61	286	545
18 miles from mouth	2 VC ₁₇	366	116	1,330	2,495
12 miles from mouth	2 VC ₁₈	80	165	422	780
At mouth	2 VC ₁₉	67	227	480	900

Additional to the above, the writer, in the course of his rapid survey, observed a number of other possible water-power sites along the Romaine and its tributaries, Puyjalon and Allard rivers. Three of those on Romaine river are as follows:

- 20 miles from mouth - Chute-à-Charlie, 15-ft. drop
- 33 miles " " - Two chutes, 50-ft. drop
- 50 " " " - Les Murailles (at least 3 chutes), 150-ft. drop in four miles

The writer estimates that there is at least 100,000 horse-power of hydro-electric energy available on that part of the river up to a point 28 miles north of Betchouane.

PHYSICAL FEATURES OF THE AREA

Topography

From the viewpoint of topography, the area may be divided into two parts: the lowlands and the uplands.

The lowlands parallel the shore of the gulf and extend northward along the river valleys. They have the form of broad, comparatively flat, marine terraces, known locally as 'the plains', composed of sand underlain by clay.

The valley of Puyjalon river is occupied by terraces to a point one mile south of Puyjalon lake. Terraces also extend up Romaine river to the Bassin des Murailles and occupy the territory bounded by the mouth of Romaine river on the west, the old settlement of Betchouane on the east, Romaine river on the north, and the gulf of St-Lawrence on the south.

Along the St-Lawrence gulf, and northward to the westward-flowing part of Romaine river, the plains are in great part open muskeg, dotted with ponds and almost devoid of trees. North of this, trees become more abundant. On approaching the uplands, occasional monadnocks rise above the general level of the plains.

Beyond these lowlands, the land surface rises very abruptly to form the more rugged country known as the uplands. By far the greater part of the map-area consists of uplands, where bedrock is well exposed or is covered only with a thin veneer of boulders and sand.

The surface of the uplands has been deeply incised by turbulent streams, which have cut V-shaped valleys. Where the underlying rock is gneissoid, the orientation of the hills is usually north-south, which is the direction of the foliation. The topography presents a closely corrugated surface with precipitous slopes, which renders travel slow and arduous.

Areas underlain by anorthosite, on the other hand, are generally characterized by topography of a different aspect. The anorthosite masses have the form of round-topped, steep-sided domes which have resulted in part from the massive and jointed character of the rock and in part from its uniformity in composition.

Elevations in the northern part of the area are estimated to be as much as 800 feet above the level of the surrounding country, or approximately 1,500 feet above sea-level. Elevations gradually increase westward until, 130 miles away, or 50 miles north of Seven Islands, the uplands are as much as 3,200 feet above the sea.

Despite the irregularities of the surface in detail, a general uniformity of relief prevails. There are no outstanding peaks. This general concordance of summit levels probably indicates an ancient peneplain. The surface presents the appearance of a dissected plateau, with the rivers strongly entrenched in deep valleys.

Drainage

The area is drained by the Romaine River system. The river rises some 175 miles north of Havre-St-Pierre and flows in

a general southerly direction to the gulf of St-Lawrence.

The tributaries of Romaine river, in the upper part of the area examined, are river Romaine-Est and river Romaine Nord-Est. In the lower part, the main tributary is Puyjalon river.

Romaine river above the Bassin des Murailles, and its upper tributaries, river Romaine-Est and river Romaine Nord-Est, are very turbulent and swift-running streams. They are flanked by high ridges having local elevations of 600 to 800 feet. The course of the streams is controlled in the main by the foliation of the country rock. Numerous falls and rapids make travel by canoe very difficult. The Indians do not use this upper part of Romaine river for travel. Beyond the northern limit of the present survey, approximately 85 miles from the mouth of the river, there is a continuous rapid for at least four miles.

Directly above the Bassin des Murailles there is a particularly turbulent five-mile stretch of river, with many rapids and several large falls. It is known as 'Les Murailles' and is reputed by local people to be impassable. If portages were cut, however, it is the opinion of the writer that this stretch of the river would offer a much easier route for travel than that usually followed over the very rugged hills north of Puyjalon lake.

Below the Bassin des Murailles, the river cuts through marine terraces, and long, broad, placid stretches are common, broken only here and there by swift rapids and falls.

Puyjalon river also meanders through marine terraces and is a comparatively placid stream, but its tributary, Allard river, which enters it at the junction of the lowlands and the uplands, is very swift, with numerous rapids and waterfalls along its course.

Buit and Forget lakes, the largest bodies of water in the northern part of the area, are surrounded by hills having a local elevation of about 300 feet. They are near the divide between the rivers Romaine-Est and Romaine-Nord-Est.

In the area west of Romaine river drained by its tributary, Puyjalon river, there are several lakes, some of which, as for example Puyjalon and Allard, are long and narrow. These two lakes have a north-northeast trend, paralleling what appears, from incomplete mapping, to be the direction of the major axis of the 'main' anorthosite mass. Cliffs that rise almost perpendicularly from the water's edge to local elevations of as much as 300 feet are a striking feature of these lakes, and particularly of Puyjalon lake. They appear to owe their origin to jointing of the surrounding rock. In the case of Puyjalon lake, however, they may, in part at least, be the result of faulting. The presence of a fault along this lake is suggested by the apparent displacement of the granite and the anorthosite at the north end of the lake.

Possibilities for Railway Construction

Inasmuch as the area lies south of the iron ore fields of Labrador and New Quebec, general observations were made with a view to determining the suitability of the terrain for railway construction.

Across the lowlands, as far north as the Bassin des Murailles, twenty-five miles from the gulf of St-Lawrence, railway construction would be easy and inexpensive. In the uplands region north of the Bassin des Murailles, railway construction, though more difficult, would still be quite feasible. The valley narrows considerably, but the river is fringed by terrace deposits at frequent intervals. The writer estimates that, in this upper stretch, as far as the northern limit of the map-area, 60 per cent of the roadbed would be on river terraces, and 30 per cent on boulder slopes. The remaining 10 per cent would require rock cuts.

Were such a railway constructed, the most suitable terminus on the gulf of St-Lawrence would probably be Betchouane, which not only has an excellent harbour but is almost in direct line with the south-trending, upper Romaine valley.

GENERAL GEOLOGY

The Precambrian rocks of North America occupy a great shield-shaped area surrounding Hudson bay. The southeastern portion of the shield forms the peninsula of Ungava. The Lower Romaine River area lies at the south margin of Ungava peninsula, in close proximity to the boundary of the Precambrian with the Palaeozoic strata. The broad, flat, marine terraces directly south of the long, east-west stretch of Romaine river are probably underlain by Palaeozoic rocks.

The area examined is underlain by rocks of Precambrian age. The two great subdivisions of the Precambrian are represented:

(1) The Archaean, consisting of a series of metamorphosed sedimentary rocks, now represented by quartzites and paragneisses, intruded by masses of anorthosite, gabbro, and meta-gabbro. The anorthosite is cut by granite which outcrops over a large part of the area.

(2) The Proterozoic, represented by diabase dykes that are probably of Keweenawan age.

The area is remarkable in that the various rock types occur generally as distinct lithological units which may be easily delineated in field mapping.

Table of Formations

Pleistocene and Recent	Clay, sand, gravel		
Precambrian	Proterozoic	Keweenawan ?	Diabase
	Archaean		Biotite-quartz diorite
			Granitic rocks: porphyritic granite, hornblende-biotite granite, pegmatite, aplite
			Gabbro
			Meta-gabbro
		Morin Series	Anorthosite dykes
			Anorthosite, anorthositic gabbro, ilmenite-rich anorthosite
		Grenville Series	Injection gneiss and migmatite (comprises altered Grenville sedimentary rocks abundantly intruded by gneissic facies of later granitic rocks)
			Quartzite, quartz-biotite gneiss, quartz-hornblende gneiss, garnetiferous gneiss, amphibolite, garnetiferous graphite schist, greywacke

Grenville Series

In travelling northward from the gulf, rocks of the Grenville series are first met with at the east end of the westward-flowing part of Romaine river. They then outcrop intermittently, in some places over long stretches, along the main river to just above the mouth of the river Romaine-Nord-Est and along the river Romaine-Est to the northern limit of the map-area. Small patches were also observed on the river Romaine-Nord-Est at the farthest points reached along it during this investigation.

Along the lower part of the main river, as far north as one mile north of the Bassin des Murailles, these Grenville rocks are highly granitized and are represented by injection gneisses and migmatites. A small patch of similar rocks occurs on the river just above the mouth of the river Romaine Nord-Est. Elsewhere, the Grenville rocks are mainly quartzites and para-

gneisses. Except across the southern two miles of the first band on Romaine river above the Murailles, these rocks show remarkably little granitization, even in the near vicinity of their contacts with intrusive rocks.

Quartzite

Quartzites are common in the Grenville of this map-area. They are particularly well developed to the east of the river Romaine-Est, east of Forget lake, where they are exposed almost continuously for a distance of at least two miles, forming high, corrugated ridges in monotonous succession.

The quartzites are usually fine-grained, white and vitreous. They generally contain a small percentage of biotite and a little magnetite, and, locally, grains of garnet are scattered through the rock. The quartzite in the vicinity of the granite mass on Sanson lake contains up to 20 per cent of epidote, as a consequence of which the rock has a greenish-yellow hue. At some places, the bedding has been well preserved, but at others it has been completely obliterated.

Quartz-Hornblende Gneiss and Quartz-Biotite Gneiss

Quartz-hornblende gneiss and quartz-biotite gneiss are abundant throughout the Grenville of the area. They are well banded rocks, the banding being due to a slight alternating variation in composition or in grain. They are usually dark in colour, but light coloured, highly feldspathic types occur in some places.

These rocks consist principally of quartz, hornblende, biotite, orthoclase, and albite. Different assemblages of these minerals, probably due to original variation in composition of the sedimentary beds from which they were derived, produce different types of rock. In some occurrences, quartz and biotite predominate; in others, quartz and hornblende. Feldspar is usually subordinate to quartz, but in one thin section of a light-coloured gneiss, quartz and albite were found to be present in about equal amount. A thin section of the gneiss occurring along Romaine river directly west of the north end of Boucher lake, and probably representing a type scarce in this map-area, contained 5 per cent of sillimanite and 20 per cent of cordierite in addition to the usual quartz and biotite.

Accessory minerals in these gneisses include apatite, zircon, magnetite, and graphite.

Garnetiferous Gneiss

Much of the Grenville gneiss of the area is garnetiferous. Typically, it is a hornblende-rich variety, containing besides quartz, from 15 to 20 per cent of garnet, with minor amounts of albite, graphite, and biotite.

Garnetiferous Graphite Schist

Garnetiferous graphite schist was observed in a northerly trending band, 170 feet wide, about a mile and a quarter east of a point midway along the east shore of Forget lake. The rock is fine-grained, black, and graphitic. Minute grains of garnet, about two millimeters in diameter, are visible on the crests of the slightly undulated surface which is characteristic

of the exposure. Examined in thin section, the rock is seen to be composed essentially of graphite and quartz in about equal amount with occasional grains of garnet, and very few small scales of what is probably sericite.

Greywacke

Greywacke occurs at the head of, and along, the high fall at the outlet of Cimon lake. It is a greenish rock consisting of fine-grained chloritic material alternating with narrow bands of siliceous material.

Altered plagioclase forms 40 per cent of the rock; quartz 30 per cent. Small amounts of amphibole, chlorite, and biotite are also present.

Amphibolite

Amphibolite occurs on the bay at the outlet of Sanson lake. It forms a band about 1,000 feet wide striking northwest across the bay. The rock is dark green in colour, medium-grained and massive. Examined in thin section it was found to be composed mainly of actinolite with a small amount of plagioclase ($Ab_{51}An_{49}$). Accessory magnetite and apatite are present, and epidote veinlets cut across the section.

Injection Gneisses and Migmatites

Injection gneisses and migmatites extend northward intermittently from the major bend in Romaine river, close to the St-Lawrence, to one mile north of the Bassin des Murailles. They are also to be seen along the river a short distance above the mouth of river Romaine Nord-Est. These rocks are of very distinctive type and are marked by a well developed foliation and banding.

Heterogeneity is the outstanding characteristic of these rocks. They are paragneisses that have been invaded along their bedding planes by granite. The degree of granitization varies from point to point, thus resulting in many gradations of texture, structure, and composition. At some places, the outcrops are marked by typical lit-par-lit injection; at others, where the granitic rocks invaded the gneisses in haphazard fashion, the intruded and intruding rocks appear as irregular masses of non-descript shape. At some points, there is a sharp boundary between the paragneiss and the intruding granite; at others, hybrid types - typical migmatites - are developed.

Within the areas that are mapped as 'granite' along the Romaine-Est river and Romaine river below the Bassin des Murailles, there are patches of paragneiss not sufficient in size to be indicated separately on the map. These remnants of paragneiss are easily identified because of their richness in biotite.

Morin Series

One of the most important lithological units within the map-area is anorthosite, with its related rock-types. Although anorthosite forms but a small proportion of the igneous rock of the earth's crust, it is relatively abundant in eastern Canada, occurring intermittently along a northeasterly trending zone from near Hull, north of the Ottawa river, along the north shore of the gulf of St-Lawrence, to the coast of Labrador. The anor-

thosites and related intrusive rocks are known as the Morin series, being so named from the type locality originally described by F.D. Adams (1).

Two large masses of anorthosite occur in the area examined. One is in the northern part of the area and will be referred to as the 'northern mass'; the other, in the southwest, will be referred to as the 'main mass'. They are twenty miles apart, and the country between them has not been geologically mapped. Hence it is not known whether or not they are parts of a single mass. Some twenty-five miles west, a mass of anorthosite has been mapped by Low (2) extending for a distance of 62 miles along St-John river. The anorthosite mapped by the present writer in the Lower Romaine River area is possibly the eastern extension of that mapped by Low.

There is also a mass of anorthosite at the mouth of Romaine river. Time did not permit of its exact delineation, but from work done to the north it appears that this is a relatively small body, probably surrounded by granite.

The 'northern' mass of anorthosite extends for five and a half miles along Romaine river in the northern part of the area examined and continues farther north for an unknown distance. From his observation of the southeastern margin of the mass, the writer is of opinion that its northeasterly trend represents the 'strike' of the mass. It is known to extend in this direction for at least two miles.

The mapped portion of the 'main' mass of anorthosite is elliptical in outline, elongated in a north-northeast direction with dimensions approximately 26 miles by 9 miles.

The mass at the mouth of Romaine river appears to be very limited in extent. It has an outcrop width of only 700 feet. Its probable western extension was not determined.

The areas underlain by the two large anorthosite masses are quite rugged. In fact, the most rugged portion of the map-area is that underlain by the northern mass. The hills, rising to heights of 300 to 500 feet above the surrounding country, have steep slopes and, at many places, they form sheer cliffs close to the river. They have the form of roughly rounded domes rather than continuous ridges and thus give rise to a distinctive topography which is an aid to identification of the anorthosite masses.

Within the map-area there is no evidence as to the relative age of the anorthosite and the paragneisses. At other points along the north shore where geological mapping has been

(1) Geology of a Portion of the Laurentian Area lying North of the Island of Montreal; Geol. Surv. Can., Ann. Rept., Vol. VIII, 1895, Part J, pp.85-116.

(2) Geol. Surv. Can., Ann. Rept., Vol.VIII, 1895, Part L, pp.236-237; Map 586, Labrador Peninsula, Southeast Sheet.

carried out, the anorthosite has been found to be the younger (1), and in the absence of evidence to the contrary it is assumed to be younger in the present area.

The several facies of the anorthosite are described below.

Anorthosite

The anorthosite proper is variable in appearance, due mainly to its wide range in colour, which may be white, light grey, dark grey, pink, or mauve. Light grey is the most common colour.

On the weathered surface, the white variety is usually yellowish; other varieties are generally dark grey. No matter what the true colour of the rock, surfaces freshly exposed by removing overlying earth were invariably found to be snow-white, probably due to the action of humic acid.

A peculiar effect of weathering is seen in the rock at many localities, where rudely circular tube- or cup-shaped depressions, as much as three inches deep and four inches across, are irregularly distributed over the surface of the outcrops. The writer has given the name of 'tubular' weathering to this feature. The depressions are probably the result of rapid disintegration of the rock about grains of pyrite or ilmenite.

Anorthosite rich in disseminated ilmenite and biotite also disintegrates very rapidly, with production of a coarse, sand-like coating on the surface of the outcrop. Where this occurs on steep slopes, it gives rise to minor landslides. A good example of this may be seen along the shore of Allard lake, directly north of Rouge point.

Despite the usually very massive appearance of the rock, where exposed along the shores of lakes it commonly exhibits a pronounced vertical jointing, which gives rise to almost vertical cliffs. This type of jointing is particularly well developed along the Shore of Puyjalon lake and the northern half of Allard lake. In the northern anorthosite mass, along Romaine river, the jointing is so closely spaced that it resembles jointing of the columnar type.

In the 'main' anorthosite mass, the selvage of the joint faces, at some localities, appears to be different in composition from the central part of the joint block. It is pink and contrasts strikingly with the surrounding dark anorthosite. This material, examined in thin section, exhibits great alteration.

(1) MAWDSLEY, J.B., St-Urbain Area, Charlevoix District, Quebec;
Geol. Surv. Can., Mem.152, 1927.

FAESSLER, C., Geological Exploration on the North Shore, Manicouagan to Godbout; Que. Bur. Mines, Ann. Rept., 1933
Pt. D, pp.149-165.

Sept-Iles Area, North Shore of St-Lawrence, Saguenay County; Que. Bur. Mines, Geol. Rept. No.II, 1942.

GREIG, E.W., Advance Report on Matamec Lake Area, Saguenay County; Que. Bur. Mines, P.R. 155, 1940.

In places, the rock has a foliated structure, made evident by the distribution of biotite, hypersthene, and ilmenite. In the 'main' mass, the trend of foliation is usually parallel to the major axis of the body. Close to the granite-anorthosite contact, the foliation is quite pronounced. In the rock at two localities, the hypersthene was observed in the form of knots, discontinuous bands, and fine 'schlieren' having a width up to three inches.

Most commonly, the anorthosite is medium grained, with crystals of plagioclase from 5 to 8 mm. in diameter. In places, however, it is much coarser than this. Porphyritic texture was observed at several localities, the phenocrysts of plagioclase being up to 6 cm. across.

The typical anorthosite of the area is a rock composed essentially of plagioclase feldspar, and examination of thin sections shows that this ranges in composition from acid andesine, through basic andesine, to acid labradorite. The actual type present cannot be determined by mere inspection of hand specimens of the rock, colour alone affording no clue. However the typical, dark grey, coarse labradorite may usually be identified by the well developed twin striae cleavage surfaces. Only at one locality, near the south end of Allard lake, was the labradorite or basic andesine observed to display the play of colours which characterized this mineral in some of its occurrences elsewhere.

Many specimens of the anorthosite were collected, but only the representative types were examined in thin section under the microscope. The results of this work reveal that there are two general facies of the rock which, depending on the variety of plagioclase they contain, may be named labradorite anorthosite and andesine anorthosite, respectively. The two types occur in intimate association and, being almost or quite identical in appearance, they are distinguishable only in thin section. They weather somewhat differently, and in some places, on the weathered surface, one type seems to cut across the other; but on breaking the rock, no distinction by eye can be made between the two. It would require detailed petrographic study to determine whether a cross-cutting relationship really exists or is merely apparent.

Andesine anorthosite, as here defined, includes those facies of the rock containing plagioclase of composition $Ab_{65}An_{35}$ to $Ab_{51}An_{49}$. It is far more abundant than the more basic labradorite anorthosite, and also contains a higher percentage of feldspar - in rare cases, as much as 98 per cent. Ferromagnesian minerals, in many of the thin sections examined, are almost entirely absent. They are of the same kind as in the labradorite-rich rocks, described below.

Labradorite anorthosite occupies but a small proportion of the area underlain by anorthosite. In this type, the feldspar is acid labradorite, of composition $Ab_{50}An_{50}$ to $Ab_{44}An_{56}$, and typical specimens of the rock contain almost 90 per cent of this mineral. The other essential constituents are hypersthene, augite, biotite, and ilmenite, the last sometimes exhibiting alteration to leucoxene. Some quartz is usually present, both in micropegmatitic intergrowth with the feldspar and as blebs and vermicular shapes within that mineral (myrmekite structure). In some of the thin sections examined, the hypersthene has been altered entirely to amphibole; in others, amphibole forms a reaction

rim around the hypersthene. Pyrite and apatite are present as accessory minerals.

Ilmenite-Rich Anorthosite

This rock occurs in a zone about one mile wide, crossing Bat-le-Diable lake in an east-west direction and including part of the north shore and the peninsula which extends south in the main part of the lake. It also outcrops over a distance of two miles on the east side of Allard lake, from Rouge point northward to aux Orphelins point and thence northeastward to the northern tip of Froide bay. Again, it is to be seen along two stretches on the northwest shore of Puyjalon lake: one near the northern end of the lake, extending from the granite-anorthosite contact southwest for a distance of half a mile, the other extending from the high fall at the mouth of Octave river to a point one and a half miles southwest. A comparatively small exposure, striking northeast, was seen on the east side of Puyjalon lake about two miles northeast of the outlet of the lake, and smaller masses at several other localities.

The ilmenite-rich anorthosite has a pronounced granular structure and weathers to a rust-coloured, sand-like material. Usually it is impossible to secure a fresh specimen of convenient size because of the manner in which the rock has disintegrated.

The fresh rock is characteristically mottled in green and black and consists of greenish feldspar, ilmenite, pyroxene, and biotite, in grains and crystals three to five millimeters in length. In thin section, typical specimens are seen to be composed of basic andesine or acid labradorite (60 per cent), ilmenite (up to 25 per cent), hypersthene (10 per cent), and biotite (5 per cent). In some varieties, the proportion of ilmenite exceeds 25 per cent. Some quartz is usually present, included in the feldspar (myrmekite structure). Accessory minerals are apatite and pyrite. The rock thus has the same mineral composition as the normal anorthosite, but its appearance is quite distinctive owing to the unusual proportions in which these minerals are present and to the contrasting association of dark coloured ilmenite and biotite with light coloured feldspar.

The rock is too poor in ilmenite to make ore, yet too rich in this mineral to be classed as true anorthosite.

Although diligent search was made in the field, the writer was unable to secure any evidence as to the age of this ilmenite-rich anorthosite relative to the other types. In his opinion, all are probably contemporaneous or nearly so.

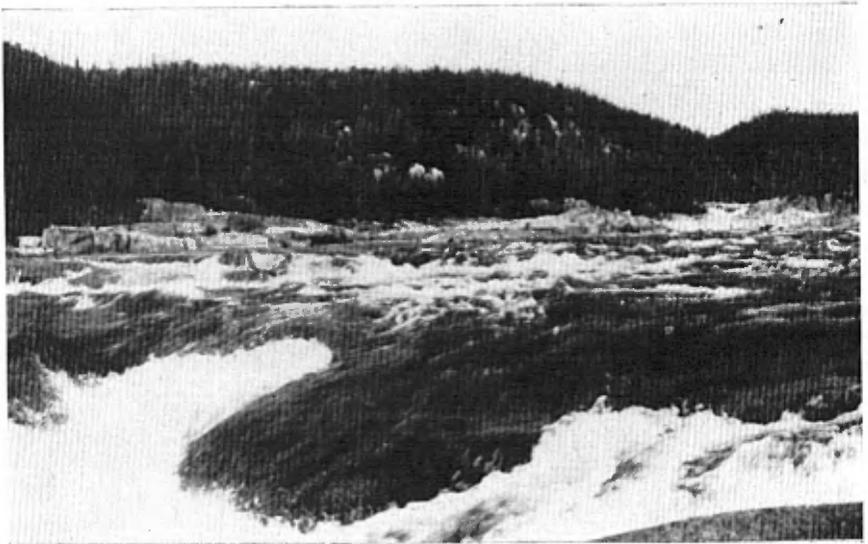
Anorthositic Gabbro

Gabbroic rocks are closely associated with the anorthosite. They occur as a narrow marginal facies along the eastern edge of the 'main' anorthosite mass, close to the granite contact, more especially in the northern portion of the mass.

The mineral association is the same as in the normal anorthosite, but ferromagnesian minerals are present in greater amount. The rock is more properly a norite than a true gabbro, as it contains hypersthene. A noteworthy feature of the rock is that it contains about 5 per cent of quartz. It might thus be classed as a quartz-gabbro or quartz-norite, but its occur-



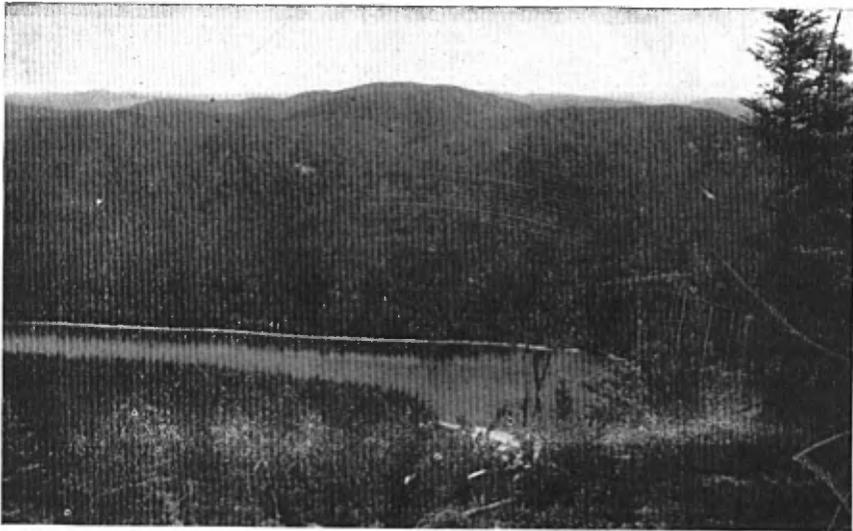
A.—Looking north up Romaine river from one mile north of Grande Chute. Note flat character of topography.



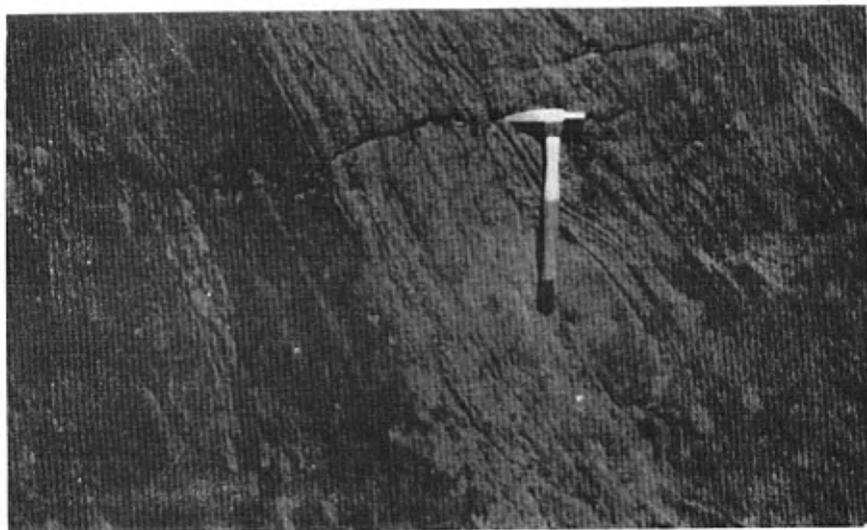
B.—Romaine river along "les Murailles".



A.—Looking north along Romaine river, one mile north of the north end of “les Murailles”.



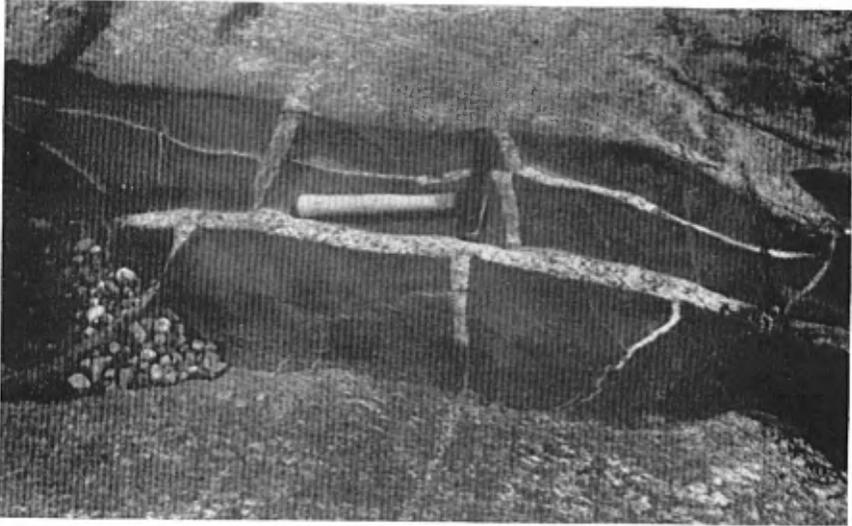
B.—Looking northeast across Romaine river from ridge west of mouth of Romaine-Nord-Est river.



A.—Injection gneisses, Romaine river, 1½ miles northwest of Romaine-Nord-Est river.



B.—Cliffs of anorthosite, east side of Puyjalon lake. Note strong jointing.



A.—Inclusion of quartz-hornblende gneiss in porphyritic granite, both cut by narrow pegmatite dykes.



B.—Band of ilmenite (dark) in anorthosite, east side of Allard lake northeast of Ste-Hélène island.



A.—Contorted ilmenite-rich anorthosite, east side of Allard lake. Note ilmenite-rich bands and lighter anorthosite bands.



B.—Lens of ilmenite in anorthosite, 500 feet north of Rouge point, east side of Allard lake.



rence close to the granite suggests that it is more probably a contact hybrid rock.

Anorthosite Dykes

Three dykes of anorthosite were found cutting the 'main' anorthosite mass. They have the same general mineral composition as the latter except that they contain no biotite. Two of these dykes - one 10 inches wide (striking northeast), the other one foot wide (striking northwest) - are respectively 600 feet and 300 feet south of aux Orphelins point, on the east side of Allard lake. Both are 'andesine anorthosite', containing 80 per cent basic andesine. The third dyke (striking northwest) is on the west side of Puyjalon lake, 1,600 feet southwest of the granite-anorthosite contact or two and three-quarter miles from the northeast end of the lake. This dyke, which is four feet wide, is a 'labradorite anorthosite' containing 80 per cent acid labradorite. In the anorthosite adjacent to the dyke there are ovoid phenocrysts of labradorite as much as two inches in length. These are apparently the result of recrystallization of the original feldspar of the rock.

While it is evident that these dykes are younger than the main mass of anorthosite, they are probably related to it genetically and belong to the same cycle of intrusion.

Meta-Gabbro

A mass of meta-gabbro occurs along Romaine-Est river, extending up-stream for a distance of two and a half miles from a point half a mile north of the mouth of Metivier river. It forms a very prominent topographic feature, the stretch of Romaine-Est river it borders having steeper and higher banks and a much narrower valley than elsewhere.

The greater part of the mass is a massive, coarse, greenish rock composed of crystals of actinolite up to one inch across distributed through light-coloured material that is too highly altered to be determined in hand specimen. Bordering this is a medium-grained rock resembling ordinary gabbro. Along the bed of the stream, in the vicinity of a probable fault, the rock is an actinolite schist.

In thin section, the coarse facies is seen to be considerably altered. It consists mainly of actinolite, together with gedrite, some chlorite, and a little epidote. Magnetite is present as an accessory. The border, gabbroic facies consists of actinolite and plagioclase in about equal amount. The plagioclase is too highly altered to permit determination of its composition. The schistose type contains actinolite and gedrite (4 per cent), chlorite (30 per cent), and plagioclase (30 per cent).

The heterogeneous character of this mass, and the degree of alteration, are the reasons for classing the rock as a meta-gabbro.

The meta-gabbro is intrusive into paragneiss, which underlies the surrounding country. There is no direct evidence as to its age relative to the other rocks of the area, but it is probably older than the granitic rocks that are to be described below and, judging by its highly altered condition, it may also be older than the anorthosite.

Gabbro

Gabbro occurs in the area east of Romaine-Est river, beyond Forget lake. There are several bands of the rock, apparently dykes, which range in width from 200 feet to 2,000 feet and strike approximately northwest or north-northwest.

The rock is massive, medium-grained, and dark. Examination of a thin section reveals that it is highly altered and composed now of plagioclase ($Ab_{51}An_{49}$) and actinolite. A small amount of biotite is also present.

Apart from the fact that it cuts paragneiss, there is no evidence as to the age of the gabbro. It is probably older than the granite.

Granitic Rocks

The distribution of the granitic rocks is shown on the accompanying map. Because of lithological differences, they have been divided, for purpose of description, into two units: the southern and the northern granitic rocks.

Southern Granitic Rocks

The southern granitic rocks include those which outcrop abundantly along Romaine river from its mouth to a point about ten miles up-stream from Les Murailles, and, in fact, all the granitic rocks that have been mapped in that part of the map-area lying between the St-Lawrence shore and Sauvage and Metivier lakes. The outstanding feature of these rocks is their coarsely porphyritic character.

They range from light-coloured types, containing abundant quartz and feldspar, to moderately dark varieties rich in hornblende and biotite or their alteration products. The light-coloured types are by far the more abundant.

Typically, the rock is massive. However, the band on Romaine river, eight miles above Les Murailles, exhibits a slight foliation, and gneissoid structure is pronounced in the granite below the Bassin des Murailles, which contains many narrow remnants of paragneiss; but in both these occurrences, the porphyritic character of the rock is distinctly recognizable.

In places, jointing is well developed, and several points below the Bassin des Murailles on Romaine river, horizontal jointing was observed.

The grain is generally coarse. In places, it is exceptionally coarse, as along the travel-route north from Puyjalon lake to Romaine river, where the phenocrysts of orthoclase are up to one and a half inches across. Another noticeable feature of these rocks is that the quartz is usually opalescent. The dark constituents, hornblende and biotite, are also conspicuous in the hand specimen.

In thin section, much of the quartz and feldspar is seen to be in micrographic or myrmekitic intergrowth. The feldspar is clouded with alteration products, and in a thin section of the rock occurring at Boucher lake the hornblende is completely altered to chlorite. Apatite, zircon, and magnetite are usually present as accessories.

In many places these granites are poor in quartz and could be termed more properly quartz-syenites. A band of this type of rock is exposed along Romaine river from a point two miles west to a point seven miles east of the mouth of Puyjalon river.

Alaskitic types (that is, rocks composed essentially of quartz and alkali feldspar) were observed along the route northward from Puyjalon lake to Romaine river. At one point along the same route, the rock has the composition of quartz monzonite. Pegmatite is of common occurrence. It is granitic in composition. Aplite is less common.

A zone of hybrid rock has been developed between the granite and the anorthosite on the west shore of Puyjalon lake, near its northeastern end, where, close to Octave river, the anorthosite is cut by a tongue of granite. Within this zone, the rock shows all gradations from anorthosite to granite.

Along Romaine river, at several points below the Bassin des Murailles, the granite which has invaded the paragneiss and thereby produced injection gneiss is a fine-grained variety. The porphyritic granite cuts this fine grained type at several places, notably at Les Trois Chutes, at Chute-à-Charlie, and on the first lake at the head of Au Foin river. Also, inclusions of a fine-grained, pink granite were observed in the porphyritic granite on Sauvage lake. In thin section, these show extreme alteration, probably produced by the intrusion of the porphyritic granite.

These observations, in the opinion of the writer, establish the fact that there are granitic rocks of at least two ages in the area. The more markedly gneissic character of the older ones suggests an appreciable lapse of time between the periods of their intrusion.

Northern Granitic Rocks

In the northern part of the area, granites occur in the vicinity of Romaine-Nord-Est river and in the adjoining area to the east. Coarse grained, porphyritic types, so prevalent in the south, were not found anywhere in the north, and a further point of difference is that the granites there are for the most part somewhat gneissic. However, the northern granites have essentially the same mineral composition as those in the south. Muscovite granite occurs on Pauline lake.

The granitic rocks on Pauline lake and on Albert and Sanson lakes are a nondescript mixture of pegmatite, granite gneiss, and paragneiss, with pegmatite, both as dykes and segregations, forming about 50 per cent of the rock, biotite and hornblende granite 30 per cent, and inclusions of paragneiss the remaining 20 per cent.

The paragneiss at the southern end of Sanson lake has been invaded by numerous sheets of granite.

Farther east, the granite is of normal type, but at contacts with the paragneiss there is considerable pegmatite.

The relative ages of the northern and southern granites are not known.

Relation of Granite to Anorthosite

The immediate contact area of the anorthosite with the granite is a foliated zone. This zone appears to parallel the contact.

Many pegmatite dykes cut the anorthosite in all parts of the area, and at three localities, all in the northern part of the area, dykes of granite were found cutting the anorthosite.

One of these dykes is on the west bank of Romaine river, two and a half miles in a straight line south-southeast from the northern boundary of the map-area. It is 15 inches wide and strikes north-south. The rock is a fine-grained, pinkish granite composed of quartz, hornblende, and microcline.

The other two dykes are on the east side of Romaine river at the foot of the first rapid, just north of the contact of the northern anorthosite mass with the granite. One is three feet wide and, like that mentioned above, it strikes north-south. The rock is pinkish and medium-grained, but with a segregation of pegmatite along the central part of the dyke. Ovoid crystals of plagioclase, up to four inches across, occur in the anorthosite nearby. The other dyke, 200 feet northwest of this, is two feet wide and strikes N.20°E. It is porphyritic, with phenocrysts of orthoclase up to one inch across.

A tongue of porphyritic granite projects into the anorthosite on Puyjalon lake. It outcrops 2,000 feet northeast of the high fall at the mouth of Octave river.

From the above, it is evident that the granite is younger than the anorthosite.

Biotite-Quartz Diorite

An occurrence of biotite-quartz diorite was noted on the east side of Romaine-Est river, half a mile north of the chute east of the portage from Forget lake. The mass has a north-westerly trend and is surrounded by paragneiss.

The rock is greyish and slightly porphyritic, a feature best seen on the weathered surface. The only minerals recognizable in hand specimen are greyish feldspar and brownish biotite, the latter uniformly scattered through the feldspar. In thin section, it is seen that the feldspar is plagioclase and that, in addition to feldspar and biotite, the rock contains muscovite and quartz. Accessory magnetite is also present.

Diabase (Keweenawan ?)

Intruding the injection gneisses five miles below the Bassin des Murailles is a sill of fresh-looking diabase, striking northeast which is exposed along the east side of Romaine river for a distance of slightly over a mile and a width of about twenty feet.

The rock is dark green and fine-grained (1 to 2 mm.). On weathered surfaces, the ophitic texture is quite apparent. In hand specimen, fresh surfaces of the rock show minute laths of glassy feldspar distributed through a groundmass which is mainly dark green but mottled with paler shades.

In thin section, the rock is seen to consist essentially of plagioclase, augite, and bronzite. The plagioclase is highly altered.

In places, the sill contains up to 10 per cent pyrite; also, throughout its length, there are many inclusions of porphyritic granite.

Similar diabase occurs on the south side of Sauvage lake, cutting porphyritic granite. It is exposed for a length (N.65°W.) of fifteen feet, with a width of three feet.

Pleistocene and Recent

In the southern part of the area, the effects of glaciation are slight. Few erratics and few glacial striae were observed. There are no moraines and no thick glacial deposits. Loose boulders in the area underlain by anorthosite were found, without exception, to be anorthosite.

In the northern part of the area, some effects of glaciation are to be seen, but they are not marked. The present relief is probably due to erosion prior to Pleistocene time; there is no reason for postulating any very appreciable erosion by ice, and the present topography probably resembles that of pre-Pleistocene time.

The most outstanding glacial feature observed in this northern part of the area is the valley occupied, in part, by Romaine-Nord-Est river and extending southwest along Bernard river. It is an excellent example of a U-shaped valley. Whereas most of the valleys are narrow and V-shaped, that along Romaine-Nord-Est river is broad and follows regular, sweeping curves. It is as much as one mile across and the river cuts through deposits of sand and gravel, presumably of glacial origin. There are similar deposits at the mouth of Romaine-Nord-Est river.

Undoubtedly, the valleys of Romaine river and of Romaine-Est river have also been modified and rounded off by glacial erosion, but nowhere is the evidence of ice action so marked as along Romaine-Nord-Est river.

Glacial striae indicate that the ice movement along Forget lake was north-south. Along Romaine-Nord-Est and Bernard rivers it was southwest. The fact that the valley of Romaine-Nord-Est river is broad whereas that of Romaine river is narrow suggests that there may have been stream piracy, i.e., that Romaine river originally occupied the broad valley through which Romaine-Nord-Est river now flows. If such be true, there is a possibility that the broad, U-shaped character of the Romaine-Nord-Est river and Bernard valleys is not entirely due to glacial action. Glacial striae observed on the east-west flowing stretch of Romaine river, in the southern part of the area, have a south-westerly direction.

Bedrock is generally covered with a thin veneer of ground moraine, but it is evident that glacial deposition in this area was very scant. The numerous valleys of the dissected plateau are conclusive evidence of this. Had it been otherwise, they would have been completely obliterated. However, the deposits of sand and gravel along Romaine-Est river to a distance of two and a half miles above Boucher lake are probably of glacial origin.

Glacial effects in the lowlands have undoubtedly been effaced or masked by the invasion of the Champlain sea. Marine terraces, consisting of sand underlain by clay, are almost continuous fronting that part of the gulf of St-Lawrence within the area mapped, and similar sands and clays probably mantle the low-lying plain between the shore and the long, westward-flowing part of Romaine river. Much of this stretch is muskeg and scattered over it are many small ponds. The marine terraces extend up Romaine river to the Bassin des Murailles, and up Puyjalon river to within one mile of Puyjalon lake. They were not examined in detail other than along lower Romaine river. Their marine character is presumed, because of the similarity of the beds throughout, the relationship everywhere being clay overlain by sand.

Fossils collected by the writer from a clay bank on the south side of Romaine river, opposite the mouth of Puyjalon river, were identified by Mr. A. Larocque, of the Geological Survey, Ottawa, as Mya arenaria Linnaeus, Macoma calcarea Gmelin, and Macoma balthica Linnaeus.

STRUCTURAL GEOLOGY

The rocks of the area afford indisputable proof that the region has been subjected to tectonic disturbances on a large scale. The gneisses have the contorted attitudes common in these ancient rocks, but it is possible to work out regional trends and some definite structures within them.

Along Romaine-Est river, the general trend of the bedding and gneissoid banding is north-south, with but minor deviations. On the east side of Forget lake, the paragneisses have been thrown into an asymmetrical anticline with axial plane dipping east. Further east, the structure is a monocline dipping east.

Along Romaine river, below Romaine Nord-Est river, the trend of the paragneisses varies from north-northwest, through east, to southeast, with dips generally to the north and east. The trend of the foliation along Romaine river, below the Romaine-Est river, is generally north-south. The river follows, in great part, the direction of foliation in the gneisses, but at some points it cuts across it.

In the anorthosite, certain trends may be mapped from observation of the biotite-rich zones. They usually parallel the contact. These trends may be due to pressure, but they may also be primary banding. The strongly foliated zone along the granite-anorthosite contact has already been mentioned.

Some contortions and small drag-folds were observed within the ilmenite-rich anorthosite at the northeast tip of Ilmenite bay on the east side of Allard lake (locality No.2 on the map). Similar contortions were noted in ilmenite-rich anorthosite on the east side of Puyjalon lake, two miles northeast of the outlet (locality No.12). These disturbed rocks indicate that the anorthosite mass has been subjected to the tectonic forces which have affected other parts of the area.

The foliation within the granite is generally north-south.

These appears to be a strike-fault, with some horizontal displacement, extending northward along Romaine-Est river from

the mouth of Métivier river. Time was not available to confirm this, but the abrupt change in rock type, the lineal character of the water-course, and the shearing within the gabbro along the stream, all suggest the presence here of a fault.

The apparent displacement of the granite-anorthosite contact on Puyjalon lake suggests the presence of a fault along the lake. The very precipitous sides of the lake have all the appearance of a fault scarp, but there is no definite proof that they are the result of faulting. At other points within the area there are similar steep-faced slopes, and no evidence of faulting has been found.

ECONOMIC GEOLOGY

The work carried out by the writer indicates that the area may have economic possibilities, inasmuch as ilmenite deposits of considerable size and purity were found at many points within the anorthosite. Chalcopyrite mineralization was also observed at six localities in the area, in paragneiss, gabbro, and meta-gabbro.

Ilmenite

The deposits of ilmenite ($\text{FeO} \cdot \text{TiO}_2$) discovered and examined by the writer lie within the 'main' anorthosite mass, at various localities on Bat-le-Diable, Allard, Petit-Pas, and Puyjalon lakes. Further search would probably reveal the presence of other deposits. A description of those discovered is given below.

The dimensions given are for the most part accurate, but in order to avoid return trips to outlying points, the dimensions were estimated in some few cases.

All analyses were made by the laboratory of the Department of Mines, Quebec.

Bat-le-Diable Lake (Locality No.7) (x).--Granular ilmenite occurs ten feet from the water's edge on the south tip of the island in the north arm of Bat-le-Diable lake. This arm is actually a separate lake, as there are rapids along the stream flowing from it into Bat-le-Diable lake proper. The ilmenite outcrops as a tabular body 8 feet thick and 50 feet long. The strike is east-west and the dip 80° south. The steeply-sloping face of the ilmenite is approximately 15 feet high. An analysis of the ilmenite is given in the accompanying table.

Ilmenite is also exposed for a length of 20 feet at the water's edge on the island; as a lens 15 feet long and 18 inches wide on the south side of a point that juts into the lake almost directly west of the island; for a length of five feet on the east side of a point on the lake shore directly south of the island; and higher up on the hillside above this point, where, however, it was not examined in detail.

(x) Locality numbers refer to points so indicated on the accompanying geological map.

Analyses of Ilmenite

(Per cent)

Locality No.*	7	5	1	2	3	4	6
Wt. of Sample	$\frac{1}{2}$ lb.	2 lb.	10 lb.	5 lb.	$8\frac{1}{2}$ lb.	$6\frac{1}{2}$ lb.	1 lb.
Total Iron as Fe	41.06	45.01	41.18	45.08	43.33	43.41	43.64
Total Iron as FeO	52.82	57.91	52.98	58.00	55.75	55.85	56.14
TiO ₂	36.83	32.24	36.00	35.98	35.89	38.14	37.79
SiO ₂	1.50	1.36	2.57	1.78	0.96	0.87	1.42
P	0.01	None	None	None	None	0.05	None
S	0.01	0.14	0.47	0.47	0.16	0.16	0.11
V	0.20	0.02	0.08	0.03	0.03	0.03	0.19

* Locality numbers refer to points so indicated on the accompanying geological map.

Allard Lake, West Side (Locality No.5).-Granular ilmenite occurs in anorthosite on the west side of Allard lake, approximately three miles up the lake from the south end. The ore is exposed for twenty feet along the water's edge over a width of four to five feet, striking northeast. Beneath the water, it is seen to extend for a further twenty feet around the point to the north. Results of analysis of a grab sample of the ore are given in the accompanying table.

About twenty feet up the side of the hill to the southwest there is an irregular zone, 15 feet by 8 feet, which consists predominantly of ilmenite, with 10 per cent inclusions of anorthosite. Smaller lenses of ilmenite were observed to a distance of 100 feet west from the lake at a local elevation of 100 feet. The general strike of this deposit appears to be northeast.

Allard Lake, East Side, Rouge Point (Locality No.1).-Ilmenite-rich anorthosite extends northward along the east side of Allard lake, from Rouge point to the northeast tip of Froide bay. The ilmenite content varies generally from 20 per cent to 80 per cent.

At Rouge point, a concentration of granular ilmenite is exposed along the water's edge. On the south side of the point, extending eastward, there is a zone 68 feet long, the western 12 feet of which is ilmenite with inclusions of anorthosite, followed by 19 feet of anorthosite and then by ilmenite for 37 feet. The true width of ilmenite is not known, as the contacts are concealed by drift. The width exposed along the water's edge varies from one foot at the eastern end of the zone to 15 feet on Rouge point.

The solid ore extends northward along the west side of the point for a distance of forty feet, beyond which for a similar distance there is about 5 per cent admixed anorthosite. The width varies from fifteen feet on the point to one foot along the water's edge at the north end.

The adjoining hill, 100 feet to the northeast, is composed of anorthosite, in which several small lenses of ilmenite were noted.

The accompanying table gives the results of analysis of a grab sample from Rouge point.

Allard Lake, aux Orphelins Point (Locality No.11).- An ilmenite-rich zone on the east side of aux Orphelins point, striking southwest, was traced southeast along Ilmenite bay for a distance of 235 feet. Much of this was originally good ore, but it has been intruded by pegmatite bands and stringers. Moreover, along certain parts of the zone, the percentage of ilmenite in the anorthosite is too low to make 'ore'. There are, however, widths up to five feet of good ore.

The ilmenite-rich zone extends almost continuously to the north tip of Froide bay, with small lenses of good ore in places.

Allard Lake (Locality No.2).-The anorthosite on the point between Ilmenite bay and Froide bay contains numerous irregular lenses of granular ilmenite. They vary in width from one foot to eight feet and have been greatly contorted, but, in the main, they parallel the lake shore. There is also considerable good ore intermingled with ilmenite-rich rock. A grab sample taken from one of these lenses, was analysed, with the result shown in the accompanying table.

Allard Lake, East Side (Locality No.3).-On the east side of Allard lake, directly east of the south tip of Ile Ste-Hélène, massive, dense ilmenite in anorthosite is exposed for a width of eight feet. It appears to strike north-northeast and dips 60° east-southeast. A sample was roughly channeled across the ore. Its analysis gave the results shown in the accompanying table.

There is a selvage of pinkish material along the edge of the ilmenite which appears to be different in composition from the surrounding anorthosite. It is so highly altered that it is impossible to determine the constituent minerals.

Allard Lake, East Side (Locality No.4).-This occurrence is twenty feet north of that just described (No.3). A four-foot width of pure, massive ilmenite is exposed along the water's edge. The ore continues under water for an additional twenty feet northward along the strike of the body and is then exposed on the surface again for a distance of five feet, the material here containing a small amount of feldspar.

The massive ilmenite of the first (southern) exposure was roughly sampled across its width of four feet. An analysis of this sample is given in the accompanying table.

Petit-Pas Lake (Locality No.6).-A body of granular ilmenite occurs at the tip of a point that projects westward from the northeastern shore of Petit-Pas lake. It is exposed for a length of forty-five feet and appears to strike southwest and dip 80° southeast. Only on its southeastern side is the ilmenite seen in contact with the anorthosite country rock; on the north-west side, the contact is drift covered. The ore is strongly jointed. One set of joints is parallel to the strike of the body; the other is at right angles to it, with dip 80° northeast. In places, the ore is somewhat weathered, but generally it is quite massive and fresh. A grab sample was analysed, with the result shown in the accompanying table.

Puyjalon Lake (Locality No.12).--An ilmenite-rich zone occurs in the anorthosite on the east side of Puyjalon lake, on a hook-shaped point about two and a half miles northeast of the outlet of the lake. At the south end of the point, there is a concentration of granular ilmenite fifty feet long, irregularly distributed across eight feet. The zone has been contorted. The degree of admixture of the ilmenite-rich anorthosite with the ilmenite renders this occurrence almost valueless as ore.

Other Localities.--Small lenses of ilmenite were observed on the west side of Allard lake, half a mile from the southwest end; also on the east side of the lake, at the north end of the second expansion, three and a half miles from the south end of the lake.

Description of the Ilmenite Ore

The ilmenite of the area is a black, glistening, usually granular mineral which is somewhat magnetic. It weathers to a rusty brown. The grain size is from 4 mm. to 5 mm.

At localities No.3 and No.4, on the east side of Allard lake, the ilmenite is dense and massive. Analyses show that there is less silica present in this variety than in others.

Pyrite, pyrrhotite, and plagioclase feldspar are associated with the ilmenite in small amount.

Polished sections of ore from several localities were studied. Each section shows that the ilmenite contains discontinuous lamellae of hematite. These form about 16 per cent of the ore. Pyrite is present in every section. A small amount of chalcopyrite was observed in one of the sections. Pyrrhotite is uncommon; it was observed in hand specimen, but not in the polished sections. Sulphides usually form only about one per cent of the ore. Biotite was observed only in a hand specimen from locality No.4.

Origin of the Ilmenite.

The general presence of a small percentage of ilmenite anywhere in the anorthosite, and the occurrence of ilmenite in large amount in some varieties of the rock, indicate that there is a genetic relationship between the anorthosite and the ilmenite. Supporting evidence of this relationship is furnished by the occurrence of the ilmenite in the anorthosite and in the anorthosite only.

There is little, if any, alteration of the anorthosite in the vicinity of the ilmenite bodies, and certainly none of the usual mineralizers (excepting the small amount of biotite and sulphides) that should be expected if the ores had been introduced subsequent to the intrusion of the anorthosite. Although there may be some disagreement as to the mode of emplacement of the bodies of ilmenite, it seems logical to assume that the parent rock is the anorthosite. The writer favours the view that the ilmenite is an original constituent of the anorthosite magma and that, in some places, it has segregated to form masses of appreciable size, and, in others, it has remained scattered through the anorthosite in varying degrees of concentration.

Copper (Chalcopyrite)

Chalcopyrite was observed 'in place' at six localities in the area, and in float at one other locality. These occurrences are either in sedimentary rocks of Grenville age or in the associated gabbro and meta-gabbro.

Sanson Lake (Locality No.9).-At the outlet of Sanson lake, a 1,000-foot band of amphibolite lies within an area that is underlain by alternating patches of granite and paragneiss. Just above the outlet, on the east side of the lake, the amphibolite is traversed by a quartz vein that carries a considerable amount of chalcopyrite. The vein is exposed for a length of 8 feet and is 11 inches wide. It strikes northwest into the lake. Across a width of three inches on its northeast side, the vein consists of massive chalcopyrite. The remaining eight inches is quartz, with pyrite and chalcopyrite in minor amount. A little biotite is associated with the quartz. At the southeast end, the vein pinches out; to the northwest, it continues into the lake. About three feet beyond the water's edge, the vein is cut by a three-foot granitic dyke, but, owing to the depth of the water, it was not possible to determine the actual nature of the dyke or whether the vein continues beyond it. Specks of chalcopyrite were found in the country rock in the vicinity of the vein.

A polished section of the ore reveals the presence of a small amount of magnetite in addition to pyrite, chalcopyrite, and pyrrhotite. Chalcopyrite was the last to crystallize, forming a veinlet cutting across the section. Assay of a general grab sample (3 $\frac{3}{4}$ lb.) of quartz carrying chalcopyrite yielded the following result: copper, 4.21 per cent; silver, 0.175 oz. (\$0.07) per ton; gold, nil.

Romaine River (Locality No.10).-A mineralized zone, 200 feet long, extends along a 15-foot cliff of injection gneiss exposed on the west side of Romaine river in the backwater below the rapid at the outlet of the Bassin des Murailles. There are minor contortions within the gneiss, but the general strike is N.20°W. and the dip is 75° to 80° east.

Quartz has been introduced along the planes of foliation in the gneiss. Pyrrhotite, pyrite and chalcopyrite are associated with the quartz and also occur sparingly in the adjacent gneiss. The zone is somewhat rust coated.

A polished section of the ore substantiates the observations made in the hand specimen. An assay of a general grab sample (7 lb.) yielded the following result: copper 0.50 per cent; silver, 0.038 oz. (\$0.02) per ton; gold, trace.

Romaine River.-Specks of chalcopyrite occur in quartz-hornblende gneiss on the east side of Romaine river, just north of a small creek one mile below the mouth of the stream that flows from Sanson lake.

East of Forget Lake.-Chalcopyrite and pyrrhotite associated with quartz were observed in paragneiss exposed along the portage between Forget lake and Romaine-Est river.

East of Romaine-Est River.-Pyrite and pyrrhotite, with some associated chalcopyrite, occur in gabbro at a point three-quarters of a mile southeast of the mouth of the stream flowing from Cimon lake.

Romaine-Est River.-At the head of the second rapid, about one mile above the mouth of Métivier river, a small amount of pyrite and chalcopyrite occurs in meta-gabbro.

Pauline Lake.-Chalcopyrite in patches up to half an inch across, associated with pyrite, was seen in a large, sub-angular boulder of garnetiferous amphibolite on the north side of, and about a quarter of a mile from, the east end of the long eastward trending arm of Pauline lake, which is about a mile and a half north of the outlet of the lake.

Pyritized Diabase

The diabase which occurs on the east side of Romaine river, five miles south of the Bassin des Murailles, contains up to ten per cent of light-coloured pyrite uniformly scattered through the rock. Assay of a grab sample of this material yielded the following result: copper, trace; silver, 0.033 oz. (\$0.01) per ton; gold, 0.002 oz. (\$0.07) per ton.

CONCLUSIONS

The data presented in this report are of necessity incomplete because of the great extent of the territory covered and the consequent rapidity with which the survey was carried on. The work was of a reconnaissance nature, and many of the features of the area which would ordinarily be studied in detail have been treated but briefly.

From the descriptions given, it will be evident that the anorthosite of the area is favourable to the occurrence of ilmenite. A very rapid examination of the watercourses situated within the anorthosite mass has revealed the presence of ilmenite at many points. It occurs in bodies which, on development, may prove to be of considerable size.

The magnetic character of the ore should be very helpful in the search for new deposits and for the delineation of those covered, in part, by overburden.

The occurrence of chalcopyrite at so many localities within the area also suggests interesting economic possibilities. In itself, the presence of this mineral establishes the fact that metallizing solutions have been introduced into the country rock. It is quite possible that there may be found, within the area, concentrations of chalcopyrite of commercial size and grade.

The fact that copper deposits of commercial grade, such as those of Sherritt Gordon Mines (1) in northern Manitoba, have already been found under similar geological conditions, enhances the possibility that similar deposits may be found in the Lower Romaine basin.

The paragneiss in the northern part of the area appears to be the most favourable host-rock for such metallizing solutions.

(1) BRUCE, E.L., Mineral Deposits of the Canadian Shield, pp. 396-403; The MacMillan Company of Canada, Limited, Toronto, 1933.

These gneisses have not been granitized, they possess favourable structures, and quartz veins are of common occurrence within them.

In brief, the geological criteria are such that the area appears to have excellent possibilities for the discovery of mineral deposits. It merits careful prospecting.

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