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MATAPEDIA LAKE AREA, PART OF THE COUNTIES OF MATANE, MATAPEDIA AND RIMOUSKI

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DIVISION OF GEOLOGICAL SURVEYS

I. W. JONES, Chief

GEOLOGICAL REPORT No. 9

MATAPÉDIA LAKE AREA

PARTS OF THE COUNTIES OF MATANE, MATAPÉDIA AND RIMOUSKI

by

E. Aubert de la Rüe

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PARTS OF THE COUNTIES OF MATANE, MATAPÉDIA, AND RIMOUSKI

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PARTS OF THE COUNTIES OF MATANE, MATAPÉDIA, AND RIMOUSKI

by E. Aubert de la Rüe

INTRODUCTION

Location and Area

During the summer of 1938, the writer made a geological study of a triangular area adjacent to the south shore of the Saint-Lawrence, extending along the river from Father Point on the southwest to Sainte-Félicité on the northeast, a distance of 60 miles, and having its southeast corner in the vicinity of Val-Brillant, on the south shore of Matapédia lake, about 24 miles south of Sainte-Félicité. The map-area embraces the whole of Matane, Macnider, and Cabot townships and of Métis and Matane seigniories, and parts of Fleuriault, Awantjish, Langis, Tessier, Saint-Denis, Massé, Nemtayé, and Cherbourg townships and Lessard, Lepage-Thibierge, and Matapédia Lake seigniories. The area thus outlined lies between 48°20′ and 48°50′ north latitude and 67°20′ and 68°30′ west longitude, and has an area of about 700 square miles.

Means of Access

The main Quebec-Halifax line of the Canadian National railway, following the shore of the Saint-Lawrence, continues in the map-area as far northward as Mont-Joli and there turns eastward, passing through Val-Brillant and close to the south shore of Matapédia lake and so out of the area. From Mont-Joli, also, a branch line of the railway extends northward along the Saint-Lawrence to Matane.

By automobile, the area is easily reached over the Quebec-Gaspé highway, which, like the railway, here closely parallels the Saint-Lawrence. By this route, Matane is 250 miles from Quebec city. Branching inland from this highway are several secondary roads, the principal of which, from west to east within the map-area, are as follows: Sainte-Luce to Saint-Donat; Priceville or Metis through Saint-Moïse to Sayabec; Baie-des-Sables through Saint-Damase to Sayabec; and Matane through the valley of the Matane river and Saint-Vianney to Amqui, at the eastern end of Matapédia lake. In addition to these, a well developed network of country roads covers the area, so that almost all parts of it may be reached easily by automobile. Some sections, however, are heavily forested, particularly the hilly country around Awantjish in the extreme south, the district north of Matapédia lake, and that between Saint-Damase and Saint-Léandre, and travel in such sections is difficult, even on foot.

(*) Translated from the French.

Matane is a regular port of call for vessels of the Compagnie de Navigation du Bas Saint-Laurent; and at most of the villages along the Saint-Lawrence there are wharves at which the smaller river boats can pick up and discharge cargo and passengers.

Method of Work and Acknowledgments

Three months, from July to October, were spent in the field, and during that time traverses totalling close to 400 miles were made. All important outcrops were examined and mapped, and visits were paid to all localities reported by residents in the area to contain mineral deposits.

Plans, on a scale of one mile equals two inches, prepared by the Provincial Department of Lands and Forests from aerial photographs, were used in the field; also the regional map at three miles to one inch published by the same Department. The geology was mapped on a base of three miles to one inch.

Thanks are due to Dr. J. L. P. Landry of Mont-Joli, Mr. P. Plante of Sainte-Angèle, and Messrs. Peter Forbes and E. Marquis of Matane, who kindly guided the writer to various localities and also supplied much useful information concerning the area.

Louis de Gonzague Deschênes, of Saint-Joseph-de-Lepage, acted as assistant during these investigations.

Previous Work and Bibliography

The earliest geological work within the map-area was that of Alexander Murray, in 1845. In the years that followed, many distinguished geologists visited the area, either to make a special study of some particular feature of the geology or in the course of reconnaissance surveys of more extensive regions. Thus Logan, Bell, Ells, Low, Harrington, Dawson (Sir William), Bailey, and McInnes all made important contributions to our knowledge of the geology. In more recent times, numerous reports have been published dealing with restricted sections of the area, as the vicinity of Matapédia lake, or with wider regions of which it forms a part, many of them concerned with some particular topic or phase of the geology, as physiography, palæontology, structure, or glaciation. Up to the present, however, there has been no detailed study of the geology of the map-area as a whole.

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DESCRIPTION OF AREA

Topography

The Saint-Lawrence, bounding the map-area on the west, has an almost straight shore-line, trending northeast, broken by only one or two small bays or inlets. Except near Métis-sur-Mer, where there are a few escarpments of minor importance, the shore is relatively low and is bordered by a series of terraces, the highest of which extends two to three miles inland. The shore is a rocky one for most of its length, and sandy or pebbly beaches, such as are seen near Sainte-Luce and a short distance above Matane, are not very extensive.

The area presents a certain amount of relief, but altitudes in general are moderate. Inland from the Saint-Lawrence, the elevation rises progressively in a series of low, northeasterly trending hills to between 500 and 1,000 feet above the river level. In Awantjish township to the south, Mount Saint-Pierre, forming part of the Notre-Dame mountains, rises to a height of 3,200 feet; and eastward from Matapédia lake, beyond the limits of the map-sheet, the Shickshock mountains (the prolongation of the Notre-Dame mountains) that form the dividing ridge of Gaspé peninsula, attain elevations of about 3,000 feet in the vicinity of Matane lake.

For the most part, these low hills or ridges, paralleling the Saint-Lawrence shore-line and many of them almost identical in form, have not been given distinguishing names, or are known locally by the names of farmers who own land nearby, as for example Mount Chamberland, south of Sainte-Jeanne-d'Arc, and Mount Michel Nadaud, to the east of Sainte-Angèle. An exception is the Shickshock-de-la-Rivière-Blanche, a hill with steep northern slope which extends for some miles to the southeast of Saint-Damase, in Macnider township.

In contrast to the general smooth and rolling topography are the butte-like escarpments, formed of resistant rock, notably quartzite, that are seen to the west of Saint-Léandre.

Rivers and Lakes

There are numerous rivers in the map-area, but for the most part they are comparatively short streams, with frequent rapids and sharp bends along their course, so that they are useless for purposes of navigation. Most of them empty into the Saint-Lawrence, but those draining the basin of Matapédia lake flow southeastward through the Matapédia river to Chaleurs bay. The divide between the two systems passes close to Saint-Cléophas, Sayabec, and Sainte-Paula and there turns sharply northward to Portage lake, only ten miles from the Saint-Lawrence.

The rivers have their sources in the numerous lakes of the area, and generally they flow through narrow, steep-sided valleys. Since the hills, as already mentioned, generally have a northeasterly trend, paralleling the Saint-Lawrence shore-line, the northward-flowing rivers are forced to

make frequent sharp turns, or detours, in their passage to the sea. Some of them, as the Neigette and the Tartigou, parallel the Saint-Lawrence for a part of their course.

From west to east across the area, the principal north-flowing rivers are: the Métis, coming from Métis lake, and having as its chief tributary the Neigette, which enters on its west bank; the Tartigou, whose source is in the vicinity of Saint-Moïse and which, for part of its course, flows through a valley whose walls rise to a height of several hundred feet; the Blanche, fed by numerous small lakes that dot the country about Saint-Léandre and Saint-Damase and with picturesque rapids some miles from its mouth; and, lastly, the Matane, the most important river in the area, which rises in the Shickshock mountains. The principal tributaries of this river are, on the east, the Petite Rivière Matane and Gagnon brook, and on the west, the à-la-Truite, Tamagodi, and Petchédec.

There are more than one hundred lakes in the map-area. Matapédia lake, at the south boundary, has a length, southeasterly, of 16 miles and is 3 miles wide. It is the largest lake in Gaspé peninsula. None of the other lakes exceed 2 miles in length. Chief among them are: du-Gros-Ruisseau, to the west of Mont-Joli; Bernier, or Inconnu, near Sainte-Jeanne-d'Arc; Blanc at Saint-Damase; Portage, not far from Sainte-Paula; and à-la-Truite, or Grand Lac Petchédec, to the south of Saint-Léandre. Some of the lakes, as for example Matapédia and à-la-Truite, appear to be of tectonic origin, connected with faults; others are, in the main at least, of glacial origin.

Settlement

The area mapped has a population of about 30,000, or one-half of the total population of Matane, Matapédia, and Rimouski counties. In a general way, villages are larger and more numerous adjacent to the Saint-Lawrence than farther inland, but there are a number of settlements along the main highway leading to the Matapédia valley. Matane, with a population of 4,000, is the largest town and most important centre of the region; Mont-Joli, about two miles south of the Saint-Lawrence, is the second place of importance. Totally uninhabited areas are of limited extent and usually are confined to the still thickly wooded districts, such as the northern part of the seigniory of Lac Matapédia, or to the hilly districts, as in the southern part of Awantjish township.

Resources

Over about one-half of the area, the land has been cleared of forest, and the major portion of the population is engaged in farming and cattle raising. Wheat, rye, oats, hay, apples, and various vegetables are grown for local consumption, and potatoes are shipped as far as Montreal and Quebec city. Cattle, hogs, and fowl are also shipped to Montreal and Quebec, and a well developed dairy industry furnishes these centres with butter and cheese.

In the forested sections of the area, the lumber industry is still important, though less so than in the past. Both pulp-wood and lumber for construction are produced. Mills are operated by Price Brothers and Company, Limited, at Matane and Priceville, by the Compagnie de Bois de Luceville at Luceville, and by the John Fenderson Company at Sayabec and Val-Brillant, and each of these companies has extensive forest reserves in the area. In addition, there are a number of small saw-mills operated by individuals, who supply lumber, shingles, etc., for local needs and also sell a part of their output to the larger companies. The principal trees of the forests are spruce, fir, pine, cedar, red birch, white birch, maple, and poplar. White birch for many years was shipped to England, where it was in demand as spool-wood. In some districts, the maple trees are tapped in the spring for maple syrup.

There is only one hydro-electric power plant in the area, on the Métis river, at Priceville. This plant supplies current for power and lighting not only to the region neighbouring Priceville but also to places a considerable distance away. Along certain other rivers, the 'head' appears sufficient for a moderate water-power development, as, for example, on the Blanche river a short distance west of Matane.

There are a number of popular summer resorts along the Saint-Lawrence, and the area attracts numerous tourists.

GENERAL GEOLOGY

The map-area is at the northwest extremity of the 'Appalachian region', and, apart from unconsolidated Quaternary deposits, it is underlain throughout by Palæozoic rocks, of Ordovician and Silurian age. Sillery (Lower Ordovician) beds are the oldest and the most widespread, and, although no fossils have been found in them, they are easily recognized by their lithological character. The Middle (?) Ordovician Pohénégamook formation has limited surface outcrop, in beds that are readily identified by certain rare graptolites found in them. The Silurian (Niagara) strata also are highly fossiliferous in some localities.

Although the several formations are seldom seen in actual contact, outcrops are sufficiently plentiful to make it possible to delimit their boundaries and map them with a fair degree of accuracy. They are best exposed along and near the shore of the Saint-Lawrence and in the more hilly country inland, but outcrops are frequently seen also as rocky points and ledges in the forested and cleared sections of the area and, where these are at all prominent, they are referred to locally by such terms as 'crans' (knotches) and 'caps'.

In three localities, basic volcanics are interstratified with Ordovician strata, and basic intrusive rocks of Devonian or later age form a band cutting the Silurian in Awantjish township.

TABLE OF FORMATIONS

QUATERNARY	Marine (Champlain).....	Sand, gravel
	Glacial, lacustrine, and fluviatile.....	Gravel, boulder clay
	Long period of erosion	
DEVONIAN (?)	Intrusive rocks	Peridotite, gabbro, serpentine Aplite dykes
	Intrusive contact	
SILURIAN	Niagara: Saint-Léon formation.....	Sandstone, shale, limestone, conglomerate
	Sayabec formation.....	Argillaceous sandstone, limestone
	Val-Brillant formation.....	Quartzite
	Unconformity	
MIDDLE (?) ORDOVICIAN	Pohénégamook	Graphitic shale, slaty shale, limestone, sandstone, limestone-conglomerate Basalt
	Unconformity (?)	
LOWER ORDOVICIAN	Sillery	Arkose, shale, sandstone, quartzite, limestone-conglomerate Basalt and diabase

LOWER ORDOVICIAN

Sillery Formation

Lower Ordovician (Sillery) beds occupy the northern part of the map-area. They form a continuous band along the Saint-Lawrence, about six miles wide at Father Point, in the extreme southwest, but widening progressively northeastward until finally they underlie the entire width of the area and continue eastward beyond it. To the southeast they are succeeded by Silurian strata. The contact between the two formations is everywhere concealed beneath vegetation and overburden, but between Matapédia lake and Métis river, its position can be established fairly closely.

The Sillery beds present a variety of types, similar to those that characterize the formation elsewhere in the Province, and, since fossils are extremely rare, it is by their lithological character that they are recog-

nized as Sillery. They are dominantly slaty shales, grey, red, greenish, and sometimes black in colour, and highly fissile, with very steep to vertical dip (Plate I-B). In places, the stratification is made particularly evident by thin intercalated beds of sandstone, quartzite, or limestone. Generally, but not invariably, the cleavage follows the bedding planes. The shales frequently enclose small nodules of pyrite and are traversed by quartz or calcite veins, particularly where the beds are much folded.

Limestone is rare in the Sillery of the map-area. The rock is compact and grey, and some of the beds seen are lenticular. The sandstones and quartzites interbedded with the predominantly shaly series are usually light to dark grey, but some are greenish or nearly black. Minute flakes of muscovite are sometimes seen in the sandstone. In general, these beds of sandstone, quartzite, and limestone are numerous and relatively thin, from an inch to one foot thick. They, in turn, in some places contain narrow bands of shale. In other places, as well illustrated at Métis point, there is a very regular alternation of shale and sandstone bands.

Outcrops of the shales are numerous and frequently of large extent, particularly along the shore of the Saint-Lawrence in the zone between high and low tides. Inland, these rocks, generally dark grey, are widespread between Luceville, Saint-Donat, and the Métis river, and also between Sainte-Angèle, Saint-Octave, Saint-Antoine-de-Padoue, and farther east in the vicinity of Saint-Léandre. Green and red schists, so typical of the Sillery, in addition to being exposed at places along the Saint-Lawrence shore, are also to be seen near Sainte-Jeanne-d'Arc, Saint-Moïse, Sainte-Paula, between Sayabec and Saint-Damase (Plate I-A), and in many places along Matane river for about 24 miles from its mouth.

In addition to the narrow bands of sandstone interbedded with the shales, the Sillery formation also contains some thick zones of sandstones. These sandstones, usually quartzose and of a greenish-grey colour, often contain rounded fragments of black shale and of feldspar, but not in sufficient amount for them to be classed as arkose. The grain-size of these sandstones is very variable, occasionally quite fine but with coarse types predominating, and in places the rocks grade into quartz-conglomerates. These conglomeratic phases are usually strongly developed in the middle of the massive sandstone zones, from which they differ only in grain-size. Fracturing of the beds in these massive zones is a common feature, and, like the shales, the sandstones are often traversed by quartz or calcite veins. The bedding as a rule is not very clear.

It is difficult to determine the exact stratigraphic position or positions of these massive sandstone zones within the Sillery. They probably represent originally extensive deposits of more or less lenticular form that now find their expression as outcroppings in northeast-trending bands of various width. They probably were sediments that were deposited under near-shore conditions during the time that the main bulk of the Sillery sediments were being deposited in waters of greater depth.

These massive zones of greenish-grey sandstones are best developed in a band, about one mile wide, which is adjacent and about parallel to the shore of the Saint-Lawrence and is particularly well exposed in the neighbourhood of Métis-sur-Mer, between Métis bay and Les Boules. At some

distance southeast of this, or farther inland, is another, parallel band about one-third of a mile wide which can be followed in almost continuous exposures for a distance of more than twenty-miles northeast from Gros Ruisseau lake, just west of Mont-Joli, to the boundary between Macnider and Matane townships at a point a little south of Tartigou river. The rock is distinctly coarser grained than in the band described above that lies near the Saint-Lawrence shore, and in places there are intercalated bands of quartz conglomerate. This more southern band is particularly well exposed at Mont Chamberland (between Ste-Jeanne-d'Arc and La Rédemption); at a point two miles south of Saint-Joseph-de-Lepage; at Grand Remous, at a point three miles south of Priceville, on both sides of Métis river (Plate II-B); immediately south of Saint-Octave, along the road leading to Padoue; along the road from Métis-sur-Mer to Saint-Moïse; in the valley of Tartigou river at the crossing of the road from Métis-sur-Mer to Saint-Moïse; and, finally, in the immediate vicinity of Saint-Damase. A third important band of the sandstones occurs along the shore of the Saint-Lawrence between Petite-Matane and Sainte-Félicité, whence it continues northeastward toward Grosses Roches. Its width at Saint-Félicité is about two miles. Another band outcrops a short distance southwest of Saint-Luc, around the shores of Fortin and Bernier lakes.

Quartz-conglomerate, interbedded with these sandstones, is well exposed in a quarry at Grand Remous, three miles up the Métis river from Priceville (Plate II-B). In this locality, the conglomerate has a thickness of fifty feet and is made up of pebbles and fragments of white quartz and black shale, with some of white feldspar, in a siliceous cement, through which is distributed some chlorite and pyrite. The fragments are mostly one-third to one-half an inch in diameter, but they range up to two inches. The colour of the rock is from pale to dark, depending on the abundance of quartz or shale. Similar conglomerate occurs to the southeast of Saint-Octave and at several points on both sides of Tartigou river.

Beds of quartzite, with associated limestone-conglomerate, occur within the Sillery at a number of places. They form relatively narrow bands trending east-northeast, parallel to the Saint-Lawrence shore-line. Lithologically, these rocks are similar to those occurring farther west, at Bic, described by Bailey and McInnes, and to those which, at Kamouraska, Dresser has designated the 'Kamouraska formation'. This term is applied here by the writer to the quartzite and limestone-conglomerate occurring in the present map-area, but it should be emphasized that these rocks are not a distinct formation, but merely a facies, fairly common, of the Sillery. Proof of this is well seen in rock-cuttings along the railway between Saint-Moïse and Saucier, to the north of Malfait lake, where the Kamouraska-type quartzites and conglomerates are intercalated between Sillery shales and are conformable with them (Plate VI-B). Like the sandstones already described, it would appear that they are not confined to one particular horizon within the Sillery, but that there are several distinct bands of these Kamouraska-type beds. They are lenticular, but extensive, and their thickness varies considerably.

As a result of folding and faulting, the Kamouraska-type sediments often outcrop in a succession of parallel bands, and from band to band the beds exposed may be of very diverse type. Thus, one band may be

composed entirely of quartzite, grey on fresh surface but weathering almost white (Plate II-A), with poorly marked stratification, and traversed in all directions by veinlets of milky quartz. Limestone-conglomerate is found in some places, but rarely, in the midst of a quartzite band. In other places, the conglomerate predominates and contains only, here and there, some thin layers of quartzite. Generally, however, the quartzite and conglomerate appear as alternating beds, from one foot to several tens of feet thick, with more or less numerous intercalated beds of shale. The transition from quartzite to conglomerate may be sharp or gradual, with the quartzite, in the latter case, containing more and more pebbles of limestone as the conglomerate is approached.

The conglomerate is a grey rock composed essentially of limestone, with fewer sandstone, pebbles which, in different outcrops and even in a single outcrop, have a wide range in size, from quite small fragments up to boulders two feet across. Generally, however, they are from one inch to two or three inches in diameter, and they often have a platy form. The majority of them are limestone, grey, very fine to compact, sometimes arenaceous, and almost devoid of fossils, although some fragments of coral were found in limestone pebbles in the conglomerate in Langis township. The limestone formation that furnished the pebbles has not been observed within the map-area, nor, indeed, in the surrounding region. However, in limestone pebbles of the similar conglomerate that occurs between Bic and Trois-Pistoles, Bailey and McInnes found fossils that indicate a Cambrian age for the limestone.

Pebbles of very fine grained, brownish-grey sandstone, pebbles of quartz, and fragments of black shale, also occur in the conglomerate, but they are far less numerous than the limestone pebbles. It is noteworthy that no pebbles of granite, or of 'Laurentian' gneiss, have ever been observed in the rock.

The conglomerate has a siliceous matrix and on weathered surfaces of the rock this material stands out in ridges, owing to the more rapid weathering of the soft limestone pebbles. The folding movements to which the area has been subjected have given to the conglomerate a weakly developed schistose structure. On account of their superior hardness and durability, outcrops of the quartzite and conglomerate generally have sharp relief, forming buttes and long ridges, well-rounded and striated by glacial erosion, and as often as not completely bare.

Except between Father Point and Mont-Joli, where the Sillery beds consist almost entirely of shales, quartzite and limestone-conglomerate of the Kamouraska type are widespread through that portion of the map-area underlain by the Sillery formation. Only the more important occurrences are shown on the map accompanying this report. As may be seen, they are particularly numerous between Baie-des-Sables and Saint-Damase, between Sainte-Jeanne-d'Arc and Saint-Moïse (Plate III-B), and in Matane township. There is a remarkable alignment of some of the bands of these rocks, particularly between Sainte-Jeanne-d'Arc and Matane valley, over a distance of more than thirty miles.

A type of conglomerate somewhat different from that described above, and unaccompanied by quartzite, occurs in several localities as bands within the Sillery shales. It is composed of limestone pebbles,

similar to those of the Kamouraska conglomerate, but they are in a shaly matrix. The bands have a thickness of some tens of feet but they are not sharply defined, grading on either side into the adjoining shale. Several such conglomerate bands may be seen within the shales along the road from Saint-Moïse to Sayabec, and also in outcrops a little southeast of Sainte-Paula.

Along the north shore of Matapédia lake, the Sillery shales are overlain conformably by a thick series of arkose beds, which form a band having a width of about six miles. Although underlying but a small section of the present map-area, these arkose beds are known to extend far to the east. They were observed, during the present investigation, along the road between Amqui and Saint-Vianny and along Matane river in Cuoq township, above the mouth of Jean river. Beyond the map-area, they attain an important development in the Shickshock mountains. Ells regarded these beds as Precambrian, but Alcock, in his more recent studies, showed that they are resting upon Sillery shales. There seems no good reason for regarding them as a distinct series, and, for the purposes of this report, we shall regard the arkose beds in the present map-area as the upper part of the Sillery formation.

The arkose is a hard rock, greenish-grey or reddish in colour, and faintly schistose. Frequently it contains rounded fragments of red shale identical with that of the lower Sillery beds. On a small island in Matapédia lake, near the north shore and opposite Val-Brillant, the arkose is in sharp but normal contact with green Sillery shale. Not far from here, at a point on the north shore of the lake, a little east of Matane island, thick beds of Kamouraska-type conglomerate are interbedded with the arkose, and all along the lake shore here, basaltic flows are interstratified with the arkose. Arkose appears also on some of the islands in Matapédia lake eastward from Val-Brillant (Plate IV-B), but is entirely absent on the south shore of the lake, which probably coincides with a major fault.

Middle (?) Ordovician

Pohénégamook Formation

Associated with the Lower Ordovician in certain parts of the map-area are beds of a younger formation, comparable in lithological character to that which, in the counties of Montmagny, l'Islet, and Kamouraska, to the west of the present map-area, Dresser has designated the *Pohénégamook* formation. He regarded it as Lower Trenton, a series placed by some authorities in the Upper Ordovician and by others, including Schuchert, in the Middle Ordovician. The present writer favours the latter view. This correlation is supported by fossils found in black shales of this younger formation at a point 2¼ miles south of Matane, notably *Climacograptus parvus* Hall, which, in the Ordovician, characterizes the *Dicellograptus* zone. The writer is indebted to l'Abbé J. W. Laverdière for determination of the fossils.

No actual contacts between the Pohénégamook and the underlying Sillery were seen, but it is believed an unconformity separates the two formations. The scattered patches of the former undoubtedly owe their preservation to faulting. Neither the boundaries nor the extent of the

formation within the area can be mapped with precision, one reason for this being that the grey or black shales of which it is largely composed are difficult to distinguish from some similar shales of the Sillery formation. Its principal development is between the Blanche and Matane rivers, but, for the reason just mentioned, it may be more extensive than is shown on the accompanying map.

The Pohénégamook formation consists of shales, limestones, and sandstones, and often there is a gradation from one type to another. In some outcrops, there is a repetition of beds of identical type. This might be the result of faulting or folding, or merely of a recurrence of deposition of similar sediments. In general, the beds of any one type of rock are not very thick—averaging about ten feet—but some shale bands are thicker than this. Taken as a whole, the formation is highly folded, but not severely metamorphosed—less so than the Sillery. Locally, the shales are intensely crumpled as well as folded.

The formation consists predominantly of shales. These are highly fissile rocks, for the most part slate-grey or greenish-grey, but including also black and somewhat graphitic types. In places, they are pyritiferous. Intercalated beds, up to a few feet thick, of sandstone and grey limestone are fairly common, as also are veins of quartz and white calcite, particularly the latter.

The limestones of the Pohénégamook formation include beds of very diverse character and appearance. Some are grey, compact, well stratified rocks, in beds from six inches to one foot thick; others are almost black and somewhat shaly. The black colour of the latter is due to their content of anthraxolite, a carbonaceous substance, to which further reference is made in the section on *Economic Geology* (p. 30). In another type, the limestone is arenaceous, and this may grade into sandstone with calcareous cement. Most common, however, are brecciated or conglomeratic limestones. In these, the matrix is usually calcareous, but it may be siliceous or shaly. No fossils have been found in these limestones.

Sandstone is rare in this formation. Where it occurs, it is associated with the limestones as intercalated beds. As already noted, however, beds of arenaceous limestone in places grade into calcareous sandstone.

The Pohénégamook formation has its greatest development in the area as a band, roughly paralleling the Saint-Lawrence shore-line, which extends from Blanche river to Saint-Adelme, a distance of about 17 miles, and which is nearly 5 miles wide in its eastern part. This band is well exposed a short distance south of the village of Rivière-Blanche, in range III, Saint-Ulric parish, and again on both sides of Matane river, particularly along the east side of the valley, between two and three miles south of Matane. A number of fossils were collected from beds in the latter locality, notably *Climacograptus parvus* Hall and a lingula. For some distance eastward from here, the formation is generally concealed beneath quaternary alluvial deposits, but extensive outcrops of the shales and limestones again make their appearance between Saint-Luc and Saint-Adelme, in Matane seigniory and Saint-Denis township. A band of shaly sandstone, several feet thick, exposed along the road leading from Petite-Matane to Saint-Denis township, at the boundary of ranges II and III, Matane seigniory, is extremely rich in graptolites, but, unfortunately, they are poorly preserved.

A narrow strip of Pohénégamook formation is exposed at the point known as Bécatron hill, about 21 miles from Matane along the road that follows the east side of the Matane River valley. Here, slaty and graphitic shales, intensely folded and crumpled, are succeeded on the east, opposite the bridge on the Matane-Amqui road, by a band of conglomerate some tens of feet thick, composed of small pebbles of grey limestone in a greyish-white quartzite matrix.

A narrow band of grey shales, limestones, and calcareous sandstones exposed along the road leading from Métis-sur-Mer to Saint-Moïse, at a point three miles from the Saint-Lawrence, is also assigned to the Pohénégamook, though with some reservation. This band, striking east-northeast, is about 600 feet wide. The beds resemble somewhat closely the Ordovician beds in the vicinity of Matane.

Silurian

Niagara Formation

Silurian beds occupy the southern part of the map-area, including Awantjish township and that portion of the seigniory of Lake Matapédia to the east of it. The eastern limit of this belt of Silurian rocks lies at the southern shore of Matapédia lake, which apparently marks a fault, since Lower Ordovician beds are exposed along the northern shore of the lake. To the west and to the south, this Silurian belt extends beyond the boundaries of the map-area.

The contact between the Lower Ordovician and the Silurian has a general east-northeast trend, about parallel to the Saint-Lawrence shore and some 15 miles inland from it, passing a little south of Sainte-Jeanne-d'Arc and Saint-Moïse and through Sayabec.

The Silurian deposits adjacent to Matapédia lake, between Sayabec and Val-Brillant, and farther south toward Saint-Léon, have been described by Bailey and McInnes, Alcock, and, in greater detail, by Crickmay. The last named estimated that the Middle Silurian (Niagara) in this area has a thickness of at least 3,000 feet, and he subdivided it into three formations, designated, from top to bottom, as follows:

(1) *Saint-Léon formation*, consisting of sandstones, shales, limestones, and conglomerates.

(2) *Sayabec formation*, 300 to 500 feet thick; mainly argillaceous sandstones and limestones.

(3) *Val-Brillant formation*, about 200 feet thick; white quartzites.

Descriptions of these three formations have been given by Crickmay ① and Alcock ②

From Val-Brillant westward along the south shore of Matapédia lake, and beyond as far as Sayabec, there are intermittent exposures of well stratified quartzites (Plate IV-A), in places nearly horizontal, and of

① *Op. cit.*, *see* Bibliography No. 11.
② *Op. cit.*, *see* Bibliography No. 14.

grey limestones, belonging respectively to the Val-Brillant and Sayabec formations, but in the heavily wooded Awantjish township, outcrops are seen but rarely. It would take a much longer time than was available during the present investigation to search them out, to examine them all in detail, and to assign each outcrop to its particular formation: the more so as there are beds of very similar type common to all three formations. Thus, the Val-Brillant formation as exposed in a quarry one mile west of Val-Brillant (Plate V-A) includes in its upper part alternations of sandstone and limestone beds, the latter closely resembling those of the Sayabec formation. Similarly, the Saint-Léon formation includes grey quartzite beds which are difficult to distinguish from the Val-Brillant quartzites at the base of the Silurian.

The Saint-Léon formation, which is the most widespread of the three, consists mainly of black, fissile, highly argillaceous limestones which in some beds grade into calcareous shales of the same colour. On weathered surface they are grey or buff. The graptolite *Monograptus* is common in these beds. The Notre-Dame mountains in the southern part of Awantjish township are composed mainly of beds of this formation, usually with very steep to vertical dip, and similar beds are exposed between Saint-Cléophas and Val-Brillant at the foot of the north slope of the mountains.

Between La Rédemption and a point a little east of Val-Brillant, the limestones and shales of the Saint-Léon formation are succeeded on the north by a band of grey quartzite, about 200 feet wide, striking east-northeast; and two miles east of La Rédemption the quartzite is succeeded to the north in turn by a narrow band of greyish-green argillaceous shales, with, in places, intercalated beds of arkose. Locally, the shales contain *Atrypa reticularis*, as well as corals, in abundance. All this assemblage of rocks very probably belongs to the Val-Brillant formation.

One mile west of Val-Brillant, a quarry between the national highway and Matapédia lake (Plate V-A) exposes beds of the Val-Brillant quartzite overlain by well stratified, nearly horizontal beds of black limestone which contain few or no fossils. These beds belong to the Sayabec formation, to which also must apparently be assigned the much coarser and often nodular limestones exposed at numerous points in the vicinity of Sayabec and La Rédemption, in ranges I, II, and III, Awantjish township. These coarse limestones are very rich in fossils, principally corals, crinoid stems and brachiopods They also exhibit striking solution phenomena. The Ruisseau Sec—a branch of the Ruisseau Rouge, which empties into the Métis river—flows underground within the limestone for a part of its course. Also, in lot 5, range III of the township, a cave, known locally as the *Grotte à la Fée* (Fairy Grotto), 300 feet long and 80 feet deep, has been carved in the limestone by subterranean waters.

These limestones are often accompanied by sandstones, which have a great development in the basin between the Sillery escarpment on the north and the Notre-Dame mountains on the south, principally in the parish of Saint-Cléophas. They extend from a point a little east of Sayabec to within the neighbourhood of Matapédia lake. These sandstones, in places argillaceous, are very fine grained. They are often somewhat micaceous, grading into 'psammites', or micaceous sandstones. Typically, they are bluish-grey, weathering grey. The sandstones split readily into

thick slabs, and in some of these, on lot 58, range VII, Awantjish township, the graptolite, *Monograptus*, is to be found in great abundance. Because of the thick mantle of glacial deposits in this part of the map-area, the sandstone does not form conspicuous outcrops, but the surface is strewn with numerous loose blocks of the rock, some of which have been transported by the local (Notre-Dame) glaciers far to the north of their original location.

Shales do not form an important part of the Silurian formations of the map-area. The principal occurrences have been noted in the above paragraphs, as, for example, the narrow band two miles east of La Rédemption. A little south of that place, in the Notre-Dame mountains, there are outcrops of non-fossiliferous shales that have been locally metamorphosed by a basic intrusive. Shales, associated with sandstones and thin interbedded limestones, all steeply dipping, may be observed in the long railway cutting two miles east of Val-Brillant.

Silurian conglomerate has very limited distribution. Generally, the rock is a limestone composed of coral fragments and it belongs presumably to the Sayabec formation. The best exposures seen are near Sayabec, in the seigniory of Lac Matapédia: one in range II, just east of the road leading from Sayabec to Saint-Cléophas; another in range III, southwest of Val-Brillant. At the latter locality, the calcareous conglomerate grades laterally to a conglomerate of somewhat different type, characterized by shale pebbles embedded in a fine sandy matrix which contains also a little mica. Some graptolites and small brachiopods were seen in this rock.

Igneous Rocks

Both volcanic and intrusive igneous rocks occur in the map-area, but they play a very limited role. The volcanics occur as flows interstratified with sediments of the Sillery and Pohénégamook formations and hence are of Ordovician age; the intrusives are seen cutting Silurian strata and are of Devonian or later age.

Ordovician Volcanic Series

The Ordovician lavas are generally much altered, but originally they were of basaltic composition. They are dark green, sometimes brown, rocks, usually massive but in places faintly schistose, and they include both compact and vesicular types. The green colour is due to uralitization of the original pyroxene constituent and to the presence of secondary chlorite and epidote. Vesicles, where present, are often filled with quartz, calcite, and chlorite; and pyrite, in disseminated grains, is fairly common in the rock. Frequently, the basalt is traversed by quartz veins, which take all directions. In some places, diabase is associated with the basalt. It does not appear to form dykes, however, but rather to represent the central, more coarsely crystalline, part of very thick flows. The basalt may occur as a series of relatively thin flows alternating with the sedimentary beds, or as a single, thick, massive flow with sediments above and below. In either case, the sediments are not perceptibly altered at the contacts.

The basalts occur in three localities within the map-area. The most important occurrence is in the central part of Cabot township, where a band of basalt, with associated diabase, elliptical in form and flanked by Sillery shales and sandstones, extends in a northeasterly direction from range I to the range northeast of Kempt road, or from the national highway to near Dufaultville station on the Canadian National railway, a total distance of 3½ miles. The width ranges from 1,000 feet to one mile. Because of their superior hardness, the basalt and diabase have suffered less erosion than the adjacent sediments, and, as a consequence, they form a very conspicuous ridge, known locally as Michel Nadaud mountain.

As noted on a previous page, basalt occurs along the northern shore of Matapédia lake as flows interstratified with the arkose beds which here overlie the Sillery shales. The northward extent of the basalt is not known, as the country in that direction is heavily wooded, but ten or more parallel bands of the rock are exposed, some of them several hundreds of feet wide, others only a few tens of feet. The prolongation of some of these bands toward the south is seen on the small islands in Matapédia lake, to the east of Val-Brillant, some of which are formed entirely of basalt.

The third locality in which basaltic flows occur is southwest of Saint-Adelme, in Saint-Denis and Tessier townships. As the country hereabouts is thickly wooded, it was not possible in the time available to determine the exact distribution or boundaries of this basalt. Outcrops occur on both sides of Gagnon brook, and from a study of these it would appear that there are two, or possibly more than two, distinct but closely adjacent bands of the rock interstratified with the arenaceous and shaly Middle Ordovician limestones which here form the main country rock. Both the limestones and the basalt are heavily impregnated with anthraxolite, and they also carry minor amounts of copper minerals. Considered as a unit, the basalt has the form, in outcrop, of an elliptical mass, trending northeast with a length of three miles and a mean width of two-thirds of a mile. Actually, it was possible to trace the basalt from lot 35, range V, Tessier township, to lot 5, range V, Saint-Denis township.

Devonian (?) Intrusive Series

Serpentine and serpentinized ultrabasic rocks are exposed at a number of points in Awantjish township, mainly along a hill known as Petit Mont Saint-Pierre, on the northern slope of the Notre-Dame mountains (Figure 1). Except on certain rocky bluffs and cliffs, the serpentine and associated rocks are almost everywhere concealed amid dense forests, but their presence has been revealed at a number of points as a result of trenching and other prospecting work that has been carried out in recent years in the search for deposits of chromite and asbestos. So far as can be judged, the serpentine forms a narrow band, trending east-northeast, which extends from lot 2, range III, to lot 18, range IV. It is the northeasterly prolongation of the well-known 'serpentine belt' of the Eastern Townships. Efforts to trace its possible extension farther to the northeast failed, but to the southwest—outside of the map-area—the serpentine outcrops again in Massé township.

A.—Area underlain by Sillery shales. At right in the far background, Notre-Dame Mountains. View from a point a little east of Saint-Damase.

B.—Steeply dipping Sillery shales along the St. Lawrence, a little east of Baie-des-Sables.

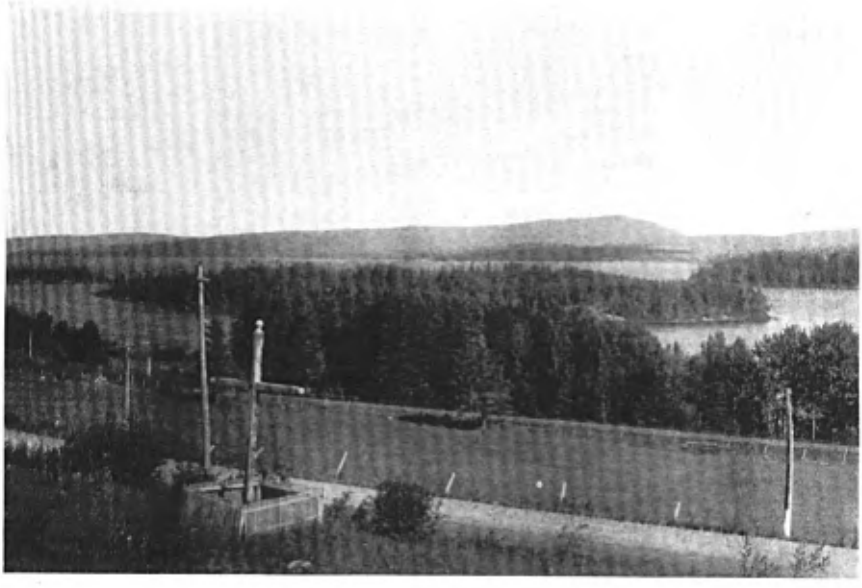
A.—Outcrop of Lower Ordovician quartzite, St-Ulric parish, range III, Matane township. The knolls in the background are also quartzite.

B.—Quarry of Sillery sandstone at Grand Remous, Métis River valley.

A.—Outcrop of calcareous conglomerate of Lower Ordovician, on range X, Tessier township.

B.—Calcareous conglomerate of Lower Ordovician, near Ste-Jeanne-d'Arc, Cabot township.

A.—Beds of quartzite of Val-Brillant formation, along the south shore of Matapédia lake, a mile west of Val-Brillant.



B.—Islands in the southeastern part of Matapédia lake. These islands are formed of Ordovician arkose and basalt.

A.—Quarry of Silurian limestone (Val-Brillant formation) one mile west of Val-Brillant, on the shore of Matapédia lake (Upper quarry).

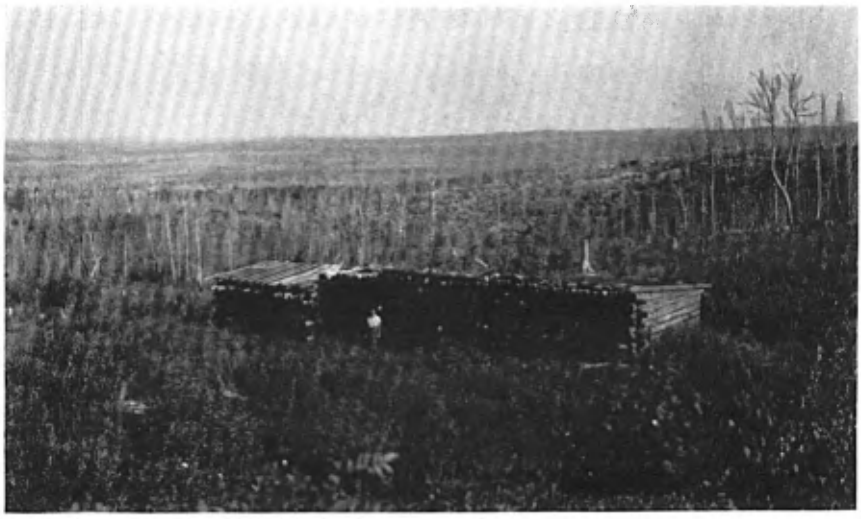
B.—Silurian quartzite interbedded with black limestone (Val-Brillant formation). Quarry one mile west of Val-Brillant (Lower quarry).

A.—Outcrop of Silurian limestone on range II of Awantjish township.

B.—Red shales of Sillery, alternating with thin beds of white quartzite dipping at 90° and polished by glacial erosion; Saucier, Macnider township.

A.—Fournier lake, a little east of Mount Saint-Pierre, Awantjish township. Area underlain by Silurian calcareous shales.

B.—Notre-Dame mountains, in the region of Saint-Cléophas. View from north, showing the extensive depression underlain by Silurian formations of the northern part of Awantjish.



A.—Contact zone between serpentine (camp site) and Silurian quartzite (in middle ground), Awantjish township.

B.—Trench opened in a serpentine outcrop in search for chromite. Lot 11, range IV, Awantjish township.

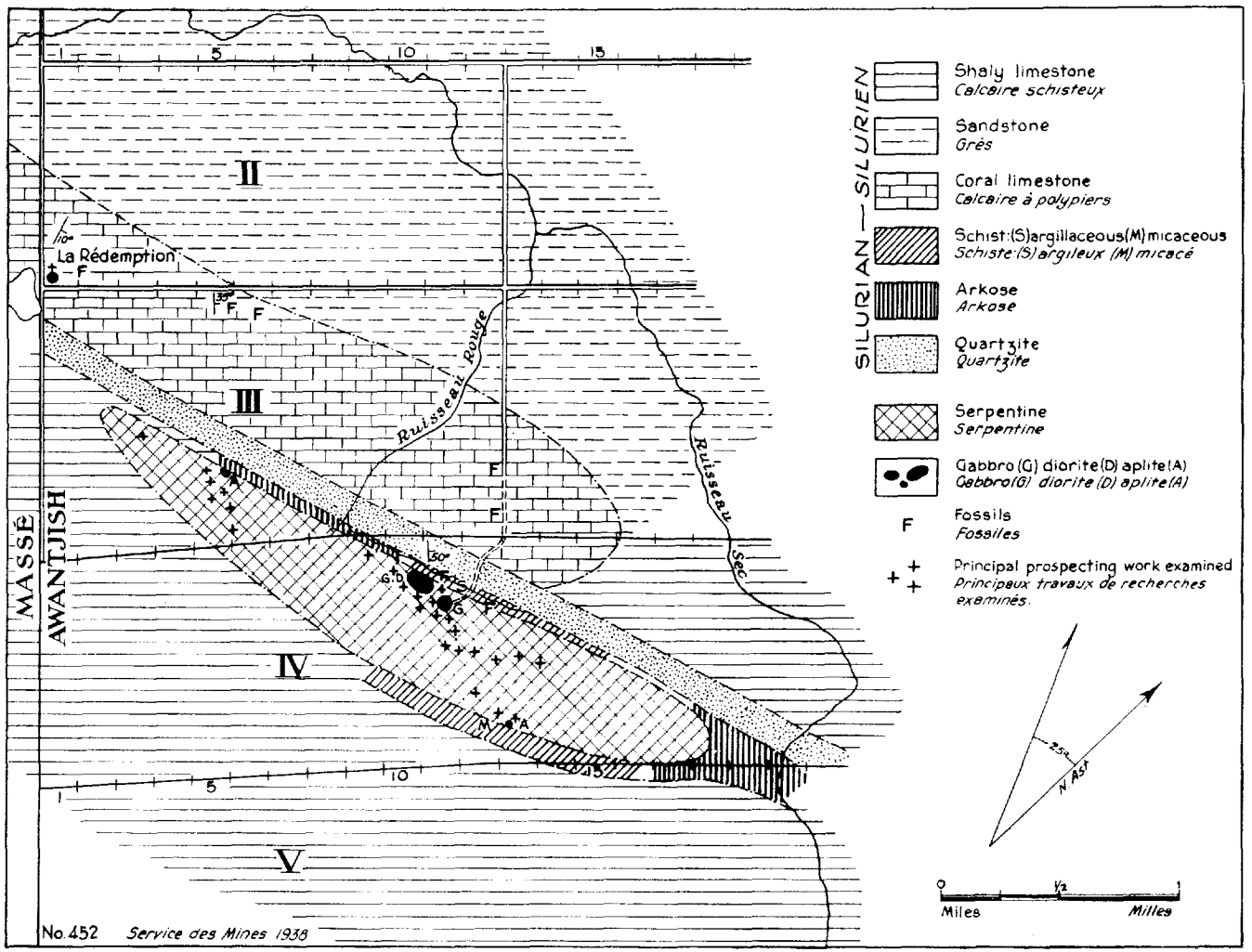


Figure 1.—Serpentine belt of Awantjish township.

Although this band of rock is composed mainly of serpentine, the original peridotite and pyroxenite from which the serpentine has been derived are still recognizable in places. Gabbro was seen only in lots 10 and 11, range IV, and locally its alteration has given rise to fairly considerable masses of grey talc. The gabbro contains some biotite and often exhibits a pegmatitic texture. A dioritic type of rock with large amphibole crystals, seen in some exposures, appears to be an altered gabbro. Two aplite dykes were observed, both at the margin of the band. One of these, only a few feet wide, is in the south part of lot 13, range IV; the other, of greater width, is at the boundary between lots 5 and 6, range III. Masses of white compact-fibrous pectolite are common within the serpentine, particularly in lot 5, range III, and lots 11 and 12, range IV. This mineral has resulted from the metamorphism of fragments or blocks of the sedimentary rock that were caught up in the basic magma at the time of its intrusion.

The rocks of the serpentine band are intrusive into Silurian strata, and the latter are fairly well exposed in the northern part of lots 11 and 12, range IV, on the northern side of the band, largely as the result of trenching and other work by prospectors. A section across the strata, northward from the serpentine band, shows the following succession of beds:

	Outcrop Width
Black shales, hardened and somewhat metamorphosed	30 feet
Red and green shales, containing thin intercalations of dark, pyritic, arkosic sandstone	100 "
Arkosic sandstone, with some beds of slightly bituminous, fossiliferous limestone	200 "
Fossiliferous shales, containing *Atrypa reticularis*	150 "
Grey quartzite (traced along strike for several miles)	500 "
Limestone, containing corals	

On its south side, the serpentine band is flanked by shales and black shaly limestones which have been altered near the contact to micaceous schists and hornfels.

Quaternary

Glaciation and Glacial Deposits

Most of the rock outcrops seen in the area bear the obvious marks of glacial erosion. Outcrops of even the softest rocks, as the shales, with their vertical dip, have the characteristic *moutonnée* form and are marked by glacial striæ. There is evidence that ice sheets from two different centres passed over the area. One, the Labrador glacier, advanced from the north; the other, a more local sheet, moved northward from the Notre-Dame mountains.

Coleman has shown that a lobe of the Labrador glacier advanced as far as the depression now occupied by Matapédia lake and valley. During the present investigation, evidence of this was found in the occurrence, not far southeast of Saint-Cléophas, of erratics of 'Laurentian' rock, granite and gabbro, at an elevation of at least 1,000 feet. More difficult to account

for is a rounded boulder of granite—a rock entirely foreign to the area—which we observed at an elevation of 2,500 feet on the northern flank of Mont Saint-Pierre, a ridge of the Notre-Dame mountains.

Apart from these boulders, the Labrador glacier has left little evidence of its presence in the area, except in the vicinity of the Saint-Lawrence where, along the shore and for a distance inland not exceeding three miles, there are extensive deposits of glacial gravel composed of 'Laurentian' material, as well as numerous erratics up to several feet in diameter.

The Notre-Dame glaciers, descending from the south, advanced as far as the coast and, on their retreat, left a widespread mantle of morainic material whose thickness, however, seldom exceeds fifty feet. These deposits include gravel, boulder clay, and loose boulders, the latter often of considerable size—larger than any of the 'Laurentian' erratics seen along the Saint-Lawrence shore. Some blocks of Silurian limestone no less than thirty-five feet long were observed resting on Sillery strata—one such may be seen just east of the national highway at a point three miles southeast of Sainte-Angèle. The moraines left by this local glacier are composed entirely of material derived from rocks of the immediate region. They consist for the most part of fragments of Silurian sandstone, quartzite, and limestone, and Lower Ordovician quartzite, sandstone, and limestone-conglomerate.

Marine and Fluviatile Deposits

Marine deposits, laid down in the sea that covered the coastal area following the retreat of the Labrador glacier, occupy a zone along the Saint-Lawrence and extending inland from two to five miles. They form a series of more or less well defined terraces, varying in number but usually five or six, which mark successive stages of elevation of the land surface as it emerged from the post-Glacial sea. The highest terrace is 300 feet above the level of the Saint-Lawrence river. These terraces are built up of sandy clay, loam, and gravel, and in places they contain an abundance of marine shells (*Mytilus edulis, Saxicava rugosa,* etc.). Their material was derived for the most part from pre-existing glacial moraines.

Somewhat similar terraces, but of fluviatile origin, occur along the valleys of the principal rivers, notably the Métis and Matane. In some places along the Matane there are as many as five successive terraces, the highest about 120 feet above the river level. These terraces also are formed for the most part of material derived from glacial moraines.

STRUCTURAL GEOLOGY

The Palæozoic rocks of the area are much folded and faulted. The axes of the principal folds have a northeasterly trend, parallel to the major fault which here determines the direction of the Saint-Lawrence river. The dominant northeast-southwest structural direction is expressed very clearly in the topography of the whole map-area.

Folding took place at two periods, first toward the close of Ordovician time—the so-called Taconic folding—and again during or after Devonian. The Ordovician strata, having been subjected to both of these folding

movements, are much more disturbed and dislocated than the Silurian. They have been thrown into a succession of folds which appear to have been overturned toward the north, since the dips observed are generally toward the south. The dips are almost invariably steep and in many localities are vertical, especially in the Sillery. The beds have been displaced by a multitude of minor faults along many of which there has been horizontal movement, as may be seen particularly well where the beds are hard, as for example quartzites and conglomerates.

The basic volcanics interstratified with the Ordovician sediments have suffered similar deformation, as is shown by the schistosity they sometimes, though feebly, display.

The Silurian formations are much more gently and broadly folded than the Ordovician, and in many localities, as along the south shore of Matapédia lake, between Val-Brillant and Sayabec, the beds are nearly horizontal. Contrasted with this is the highly tilted and frequently vertical attitute of the Silurian strata in the Notre-Dame mountains.

The most important fault in the area appears to be that which, trending west-northwest, marks the southern shore of Matapédia lake.

ECONOMIC GEOLOGY

There are no mining operations within the map-area, but a certain amount of limestone is quarried and used mainly for road maintenance and for making lime. In past years there has been some production of building stone also. Gravel deposits are fairly widespread, and these are drawn upon as necessary for surfacing and repairing highways. Copper mineralization has been observed at several points, particularly in the district southwest of Saint-Adelme, and on one property a shaft was sunk and lateral work carried on underground; but work on this and other prospects failed to reveal the presence of ore in commercial quantity.

The economic possibilities of the area are summarized in the pages that follow under the appropriate headings of metallics, non-metallics, and building materials.

Metallics

Chromite

In 1927, Pantaléon Plante, of Sainte-Angèle-de-Mérici, discovered chromite in the serpentinized peridotite and gabbro mass a short distance east of La Rédemption. This body of ultrabasic rock, lying within Silurian sediments, has been described on an earlier page. It extends over the northern slope of Saint-Pierre mountain in an east-northeast direction for a length of about three miles, from lot 2, range III, to lot 18, range IV, Awantjish township, and has a maximum width of 2,000 feet. A number of claims have been staked, and some fifty or more shallow trenches have been dug in the search for deposits of chromite or asbestos. The excavations, for the most part, have been made on lot 5, range III, and on lots 10, 11, and 12, range IV. The serpentinized rock in many places carries disseminated grains of chromite, with here and there small pockets of massive ore. The

best showing is on the Plante claim, on lot 11, range IV, where the trenching has exposed a small lens of chromite in the serpentine striking S.37°E. for a length of 15 feet and a width of 10 inches. Accompanying the chromite is a minor amount of talc, and in places fissures in the rock contain a bright green mineral, apparently the chrome garnet, uvarovite. Analysis of a sample of the chromite, collected by the writer, gave 37.16 per cent Cr_2O_3, or 25.43 per cent Cr. The occurrence was examined by B.-T. Denis in 1931 (1). The following analysis of the chromite, reproduced from his report, was made in the Provincial Assay Laboratory:

Cr_2O_3	36.75 per cent
SiO_2	9.90 "
Al_2O_3	12.30 "
MgO	15.57 "
Fe	13.20 "
Corresponding to Fe_2O_3	18.86 "

Copper

As early as 1892, the report of the Commissioner of Crown Lands for the Province of Quebec drew attention to the occurrence in Matane county of erratic blocks of 'trap rock', some of them weighing more than one ton, through which were scattered specks or grains of native copper, and whose source was evidently the Shickshock mountains to the south. In the following year, copper was found 'in place' on lots 2 and 3, range V, Saint-Denis township. In 1900 and succeeding years, the finding in their fields of loose lumps of almost solid native copper, some of them weighing several pounds, was reported by owners of farms in several localities in the district, all the way from range IV, Saint-Denis, northward to ranges II, III, and IV of Matane seigniory. One such mass, found about twenty-five years ago by F. Côté on his farm in Petite-Matane parish (range II), weighed twelve and a half pounds. It is believed that these erratics are of local origin, derived from the copper-bearing basalt of Saint-Denis township and transported to their present positions by the local Quaternary glaciers as they moved northward. It should be stated, however, that large masses of copper such as these have never yet been found in the basaltic rock in place. These various discoveries led to considerable prospecting and to the staking of numerous claims in Saint-Denis and the adjoining Tessier township.

As noted earlier in this report, basaltic volcanic rocks are exposed here along and in the vicinity of Gagnon brook, forming two bands, at least, in a zone nearly one mile wide and extending northeastward for about three miles to within one mile of Saint-Adelme. Interbedded with these volcanics and also forming an extensive belt around them are rocks of sedimentary origin—grey, sometimes arenaceous, limestone, limestone-conglomerate, sandstone, and black graphitic shales—which may belong to the Pohénégamook (Middle Ordovician) formation. The basalts are, in many places, cut by veinlets of quartz and calcite, rarely more than two inches wide, and they as well as the neighbouring sedimentary rocks

(1) Que. Bur. Mines, Ann. Rept. Part *D*, 1931, p. 101.

contain considerable anthraxolite. Copper-bearing minerals have been found particularly along a zone extending over lots 1 to 5, range V, Saint-Denis, and lots 36 to 40, range V, Tessier township. These minerals are of several kinds and they have been found both in the volcanic and in the adjacent sedimentary rocks.

At various points in lot 1, range V, Saint-Denis—where the better-appearing showings have been observed—attempts have been made to develop a productive mine. During the years 1901-04, the Matane Gold-Copper Mining Company ① sank two shafts on the Saucier claim, near the left bank of Gagnon brook, one 30 feet deep and the other nearly 200 feet (180 or 192 feet according to differing reports), and a certain amount of lateral work was carried out from the deeper shaft at the 100-foot level (or 114-foot, according to one report). Both shafts have caved in and are partly filled. The rock exposed near the shafts is black shale containing nodules up to twenty inches in diameter of black limestone. Judging by material on the dump, the shaft passed through beds of limestone, breccia, and limestone-conglomerate, strongly impregnated with anthraxolite and cut by numerous veins of white calcite. No basalt was seen on the dump. Mineralization is sparse and consists of chalcopyrite and, more rarely, bornite, which occur as specks and stringers both in the country rock and in the calcite veins. The property was visited in 1902 and 1903 by J. Obalski, at that time Inspector of Mines for the Province, and his annual reports for those years contain a description of the ore occurrence and of mining development. Samples he collected in the workings on the 114-foot level gave assays of 2.86, 3.85, and 4.97 per cent copper, and one sample gave an assay result of $1.20 in gold per ton. He also states that the Company reported high gold values in core from two diamond-drill holes. These holes, drilled in the same claims on the north side of Gagnon brook, passed through basaltic rock only and reached depths of 640 feet (at an inclination of 64 degrees) and 445 feet. Apparently, however, the mineralization in all these workings was found to be very 'spotty', and operations at the mine were suspended in 1904. The mine is variously referred to as the Saucier or Matane mine, or, locally, as the 'Vieille' (Old) mine. The present writer, in 1938, collected from the dump a sample of grey, veined calcite containing veins of chalcopyrite. An assay of this material gave 3.19 per cent copper and 0.018 oz. gold per ton.

In 1916, some prospecting was carried out on lots 1 and 2, range IV, Saint-Denis township, by Pierre Tétreault, of Montreal. Two shafts were sunk near the right bank of Gagnon brook and about half a mile from the Saucier shaft. One was about 30 feet deep, and the other about 50 feet ②. They are now filled-in and inaccessible. Several tons of high-grade ore were shipped from here to a mill in Ontario for treatment, and some of the ore may still be seen on the dump nearby. It consists of basalt, stained with malachite and lesser azurite, and containing grains of cuprite and native copper, which occur also in veins of calcite, and more rarely of quartz and

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① In 1903 this Company was amalgamated with the Duplex Gold and Copper Mining Company of Matane and was reorganized as the Matane Mining and Smelting Company.

② Alcock, F. J., *Copper Prospects of Gaspé Peninsula, Que.*; Geol. Surv. Can., Summ. Rept., 1925, Part C.11, p. 5.

barite, that traverse the rock. These workings are known locally as the Tétreault, or Dubé, mine. A sample from a two-inch vein of calcite impregnated with native copper, taken by the writer from the main pit, assayed 3.10 per cent copper and 0.015 oz. gold per ton.

Since that time there has been sporadic prospecting in the district, mainly by local people and for the most part superficial. In 1930, J. Desrosiers, of Matane, sank several pits in the limestone at a number of points along the right bank of Gagnon brook, above the Saucier mine. The main excavation was a pit 25 feet deep on lot 2, range V, about 80 feet from the brook, in limestone-conglomerate containing narrow veinlets of chalcopyrite. It is said that chalcocite has been found here also, but none was observed at this place during the present investigation. Mr. Desrosiers also did some prospecting on lot 40, range V, in the adjoining township of Tessier. The rock outcropping here is basalt, in many places stained green with malachite and here and there traversed by veinlets of quartz sparingly mineralized with cuprite and native copper. A little chalcopyrite is said to have been found in a pit six feet deep but now filled with water. As is the case elsewhere in the district, anthraxolite is very common, filling fissures in the basalt. About the same time, a Mr. A. Campbell is reported to have found a little chalcopyrite farther west, in lot 36. It was not possible, however, to locate his workings during the present investigation and no mineralization was observed west of lot 40.

During the summer and autumn of 1937, E. Marquis, of Matane, did some work on two claims in lot 1, range V, Saint-Denis township. Trenches were opened on both sides of Gagnon brook, none of them over six feet deep and most of them in basaltic rock. The most interesting mineralization was exposed in a trench about 100 feet southwest of the Tétreault mine, where numerous fractures in the basalt contain native copper, which also occurs in veinlets of quartz and calcite that traverse the rock. Chalcopyrite, bornite, and rarely covellite, are also present as sparsely disseminated grains in the basalt, which in places is heavily coated with their oxidation products, malachite and, in smaller amount, azurite.

In a trench near the left bank of the brook, in Saint-Denis township not far from the Tessier-Saint-Denis township-line, specks of chalcocite were seen in calcite veins traversing basalt. This is the only occurrence of chalcocite observed in the district during this investigation. At some falls, several hundred feet downstream from this point, outcrops of well-bedded limestones, conglomerates, and sandstones contain a little chalcopyrite and malachite.

Although exploration to date has failed to reveal copper deposits of commercial size associated with the basaltic and adjacent sedimentary rocks in Saint-Denis and Tessier townships, it has shown that mineralization is common over an area about one mile square that includes lots 1 and 2, range V, Saint-Denis and lot 40, range V, Tessier. This mineralization, however, is not continuous as, between some copper-bearing outcrops, the rock is barren. The best showings so far found are in the basalt. Mineralization generally is less strong in the adjacent sedimentary rocks and it appears to die out rapidly away from the contact. There is no reason to assume that a greater concentration of copper mineralization would be found at depth, particularly as this is not the common experience with occurrences of copper in basaltic flows. Diamond drilling, however,

is suggested as being the most convenient means of testing the possibilities at depth. Preferably, such drilling should be done at some selected point or points along the presumed contact between the basalt and the sedimentary rocks.

At several points within the map-area, the Sillery shales are sparsely mineralized with chalcopyrite, or more rarely bornite, accompanied by green malachite staining. In such places, the shales are more sheared, and perhaps more highly metamorphosed, than elsewhere, and are traversed by numerous narrow veins of white quartz, but in most instances there are no intrusive rocks exposed in the vicinity, to which the copper mineralization might owe its origin. Where it does occur, the mineralization extends over a width varying from a foot or so up to about ten feet. Some of the principal occurrences are noted below.

On Rocher Smith, a small promontory at the west end of Matapédia lake, a mile and a half north of Sayabec along the road leading to Sainte-Paula, the shales are much shattered and traversed by a swarm of quartz veins, from one inch to six inches wide. Chalcopyrite occurs both in the veins and in the shale. A trench, 30 feet long and trending perpendicular to the shore of the lake, was dug here some years ago, mainly in the search for gold, but mineralization was found to be far below commercial grade.

During the summer of 1938, similar copper mineralization was exposed at Sainte-Paula, at the south boundary of lot 42, range XI, Matane township, in the course of widening the road referred to above. Specks and veinlets of chalcopyrite and a little bornite, accompanying chlorite, are visible across a zone a few feet wide on the south side of the road, in green and red Sillery shales and in veinlets of quartz. Assay of a sample taken by the writer gave only 0.38 per cent copper, with 0.008 oz. gold per ton. Some nine miles northeast of here, about half a mile south of Canton-Tessier, the Sillery shales near the east bank of Matane river contain a little chalcopyrite and are stained with malachite.

There are minor amounts of copper-bearing minerals in the rocks along and near the national highway in lot 78, range S.W. of Matapédia road, Augmentation of Awantjish, about four and a half miles west of Sayabec. The country rocks at this place are green, red, and black shales with thin interbedded layers of quartzite and grey limestone. Several years ago, two pits, one of them ten feet deep, were opened here on the north side of the road, and a trench on the south side. Bornite, as veins and specks, is to be seen, accompanying quartz and a little white, lamellar barite. North of the road, quartz veinlets cutting shales carry a little chalcopyrite and pyrite. The mineralization usually occurs along fractures normal to the cleavage.

Farther west, in the parish of Sainte-Angèle-de-Mérici, Pantaléon Plante has done some work, including the sinking of a pit 12 ft. by 8 ft. by 7 ft. deep, on his claim on lot 23, range II, Cabot township, where specks of chalcopyrite occur in the shale and sandstone as well as in veinlets, often normal to the cleavage, in which it is accompanied by chlorite, calcite, and quartz. Assay of a sample collected by the writer gave only 0.60 per cent copper, with 0.005 oz. gold per ton. Mount Michel Nadaud, composed of basic volcanic rocks (diabase), is about one-third of a mile north of this locality.

Iron

Hematite, in a siliceous gangue resembling red jasper, occurs in veins in basalt that forms La Croix island, in Matapédia lake, a little east of Val-Brillant. Some of the veins outcrop for a length of several feet, but they rarely exceed one inch in width. No veins of this type were seen on neighbouring, much larger, islands which also are formed in large part of diabase and basalt. An iron-content of 55.04 per cent was obtained from the assay of a sample from one of the veins, but the limited extent and the scattered nature of the mineralization are such that no commercial deposit is indicated.

Recently, a number of loose blocks containing magnetite have been found in Saint-Adelme parish, on lot 45, range VIII, Saint-Denis township. The solid bed-rock here is grey shale, and on the surface there are numerous rounded blocks of quartz, diabase, and the magnetite-rich rock. The latter rock, which undoubtedly had its source in the Shickshock mountains to the south, is greenish and very siliceous, grading in places to jasper. The magnetite occurs as minute grains or octahedra, either in veins or small aggregates, associated minerals being chlorite and epidote. It is evidently a product of contact metamorphism.

Gold

Gold has been reported at a number of localities in the area and as many of these places as possible were visited during this investigation. No visible gold was seen, but at many of the prospects the rocks, of Sillery age in nearly every case, were found to be mineralized to some extent with pyrite or chalcopyrite. Several of these occurrences have already been referred to under the heading of 'copper'. Samples were collected at many of the prospects, but upon assay none yielded more than a trace of gold and many gave a negative result, as, for example, did material from Rocher Smith, at the east end of Matapédia lake, where there was prospecting for gold in quartz veins a few years ago.

Pyrite is fairly widely distributed in the Sillery sedimentary formations, in the basalt, and in the Silurian sandstones, of the area. It occurs as disseminated grains, in small aggregates and concretions, and in veinlets, but everywhere in very minor amount. Some of the more notable occurrences are as follows: as concretions, averaging one inch in diameter, in shales at Sainte-Flavie; in limestone-conglomerates that are interbedded with Sillery shales and quartzites in Sainte-Paula parish, on lot 37, range XIII, Matane township; in conglomerates and black shales at Grand Remous, in the Métis River valley; as veins and small pockets in grey limestone interbedded with Sillery shales and quartzites along the railway on a claim in Cabot township, one mile west of Dufaultville; at the place known as 'La Bécatron', on the Louis Martel claim, on lot 29, range northeast of Matane river, Tessier township, as aggregates in a zone ten feet wide in grey limestone interbedded with black shales which are believed to be Middle Ordovician (Pohénégamook). Assay of a sample taken by the writer on this claim gave no trace of gold.

Lead

Galena was seen at very few localities in the area. A vein less than one inch wide was observed cutting Sillery sandstone at a point about 250 feet northeast of the lighthouse at Métis point. Specks of galena were seen in Sillery rocks at two localities in Cabot township along the road leading from Saint-Antoine-de-Padoue to Saint-Moïse: in quartz stringers traversing green shales on lot 32, range southwest of Kempt road; and in fractures in quartzite, three-quarters of a mile west of Saint-Moïse, on lot 43, range northeast of Matapédia road. There are occasional specks of galena in the Silurian sandstone quarried on the south shore of Matapédia lake one mile west of Val-Brillant.

Non-Metallics

Asbestos

Prospecting for asbestos has been carried on from time to time in Awantjish township, in the district immediately east of La Rédemption where, as already noted, a body of serpentinized peridotite and related basic intrusive rocks extends for about three miles from lot 2, range III, to lot 16, range IV. Most frequently, the material found is the fibrous, brittle variety of serpentine known as picrolite, or locally as 'dry asbestos'; it occurs along slip planes in the massive rock. Here and there, but principally in lots 10 and 11, range IV, veins of 'cross-fibre' chrysotile asbestos are found, but none exceeding one-third of an inch in width were seen. The chrysotile is of excellent quality, but, so far as known, it occurs in far too small amount to be of economic interest.

Anthraxolite

Anthraxolite is a black, coal-like substance with a high lustre, closely resembling anthracite in these respects. It contains above 90 per cent carbon, but being very low in hydrocarbons it is difficultly combustible and hence useless as a fuel. It is fairly common in the Ordovician rocks of the area, as small inclusions or filling narrow fissures, often accompanied by calcite or quartz. Since the material is liable to be mistaken for coal, it may be of interest to note here some of the localities in which it is especially abundant.

Its best development was seen in lot 1, range V, Saint-Denis township, where it is closely associated with the copper mineralization described on an earlier page. The sandstones and limestones here are in many places impregnated with anthraxolite, to which they owe their black colour. The material also occurs as veins, up to one inch in width, in these rocks and in the limestone-conglomerate, notably in exposures along the banks of Gagnon brook; and it is by no means rare in the associated basaltic rocks, where it often accompanies mineralized quartz veins.

Some other localities in which anthraxolite is fairly abundant are the following: in small quartz veins cutting grey shale, half a mile west of Mont-Joli, along the road which, between ranges II and III of the Lepage-Thibierge seigniory, leads to the new sanitorium; one mile west of Métis point, along the national highway, in veins of white calcite cutting across

the green sandstones that are quarried for road-material; in Saint-Léandre parish, in fissures in quartzites exposed along the northeastward trending road of range VI, Matane township, a little west of the road leading from Saint-Ulric to Saint-Léandre; about two and a quarter miles south of Matane, in the district known as 'Petites Montagnes', in calcite veinlets in the cliffs of black limestone that border the Matane-Amqui road.

Marl

Marl with a high lime content occurs in ponds at several points within the map-area and is utilized locally by the farmers as a soil corrective. The material is dug out during the winter months following partial draining of the ponds. A very good quality marl, containing 92.5 per cent $CaCO_3$, is obtained from Lac à Foin, lying between Malfait and Pétchédec lakes, in Saint-Léandre parish, Matane township. There is some production also from Paquet lake, two miles north of Matapédia lake and adjacent to the road leading from Sayabec to Sainte-Paula; this locality is in the Lake-Matapédia seigniory.

Petroleum

During the summer of 1938, an 'oil well' was drilled in Saint-Léandre parish, on lot 24, range X, Matane township, at a point 800 feet south of the southwest end of Chaud lake (known also as Lac aux Canards). The drilling was undertaken following a survey by the 'radiétellurie' method, which gave what were claimed to be favourable 'indications' of oil. The district is underlain by Lower Ordovician (Sillery) strata, with alternating beds of pale grey quartzite and limestone-conglomerate forming the surface rocks. The drilling, which was continued to a depth of 400 feet, passed through similar beds, with some thin intercalations of black shale. No indication of oil or gas was encountered. The fractured, squeezed, and contorted character of the sedimentary formations would appear to preclude any likelihood of finding oil in this district.

The Silurian limestones that extend for about fifteen miles across the southern part of the map-area, from Matapédia lake westward to the valley of Métis river, are for the most part sufficiently bituminous to emit the characteristic odour of that substance when struck with a hammer. This feature is especially pronounced in the coral-bearing beds outcropping to the north and east of La Rédemption and in the vicinity of Sayabec. The bitumen content of the rock is, however, very low. Analysis of a sample of brownish-grey limestone from near La Rédemption, which appeared to be particularly rich in bitumen, gave only 0.17 per cent hydrocarbons. Rocks of the same age and nature, however, may have some importance as a possible source-rock for oil deposits that may exist elsewhere, particularly in Gaspé peninsula.

Soapstone and Talc

Talc occurs in association with the serpentinized basic intrusive rocks east of La Rédemption, Awantjish township. In many places, minor amounts of white or greenish translucent talc are found in the serpentine. On lot 10, range IV, there is a fairly large outcrop of rather impure compact grey soapstone, derived from the alteration of gabbro.

Peat

Peat bogs, varying greatly in size, are widespread in the area. Although many of them could be exploited advantageously, there has, up to the present, been no production. The most extensive bogs are in Awantjish township, where they occupy a wide, flat area between Mont-Saint-Pierre and Sayabec.

Building Materials

Slate

Although shales of the several formations are widely distributed within the map-area, they are in general too highly folded and fissured to furnish slabs of slate that would be of marketable size and quality. Possibly some of the green or red Sillery shales, particularly those outcropping one mile west of Sainte-Paula along the road from Sayabec, could be utilized as roofing slate.

Clay

About twelve years ago, a deposit of clay was worked at Grand Remous, not far from the right bank of Métis river, three miles south of Priceville. The material was used locally in the manufacture of brick but its plastic qualities were poor and, after two years' operation, the enterprise failed. The clay is underlain by red Sillery shales, from the disintegration and alteration of which it has been derived.

Near the church in the village of Sayabec there is a deposit, six to seven feet thick, of grey clay that appears to be of good quality. It overlies sand and probably represents what was, at some former time, the bed of Matapédia lake.

Moraine deposits, and alluvial deposits along the Saint-Lawrence, in many places contain clay, generally very impure and mixed with a large proportion of sand and gravel. Such occurrences have no economic interest.

Limestone

Although limestone forms a relatively small proportion of the sedimentary formations that underlie the map-area, outcrops of the rock, some of them extensive, are fairly numerous in certain districts (Figure 2). Quarries have been opened at several points (see map), and some of these are in continuous or intermittent operation. The stone has been used mainly as road metal, for making lime, and as agricultural limestone, and to a minor extent for building and other construction.

As noted in the section dealing with General Geology, limestones of three different ages are represented: Lower Ordovician (Sillery), Middle Ordovician (Pohénégamook), and Silurian. The general character and distribution of each type is summarized below, and where quarries have been opened they are briefly described.

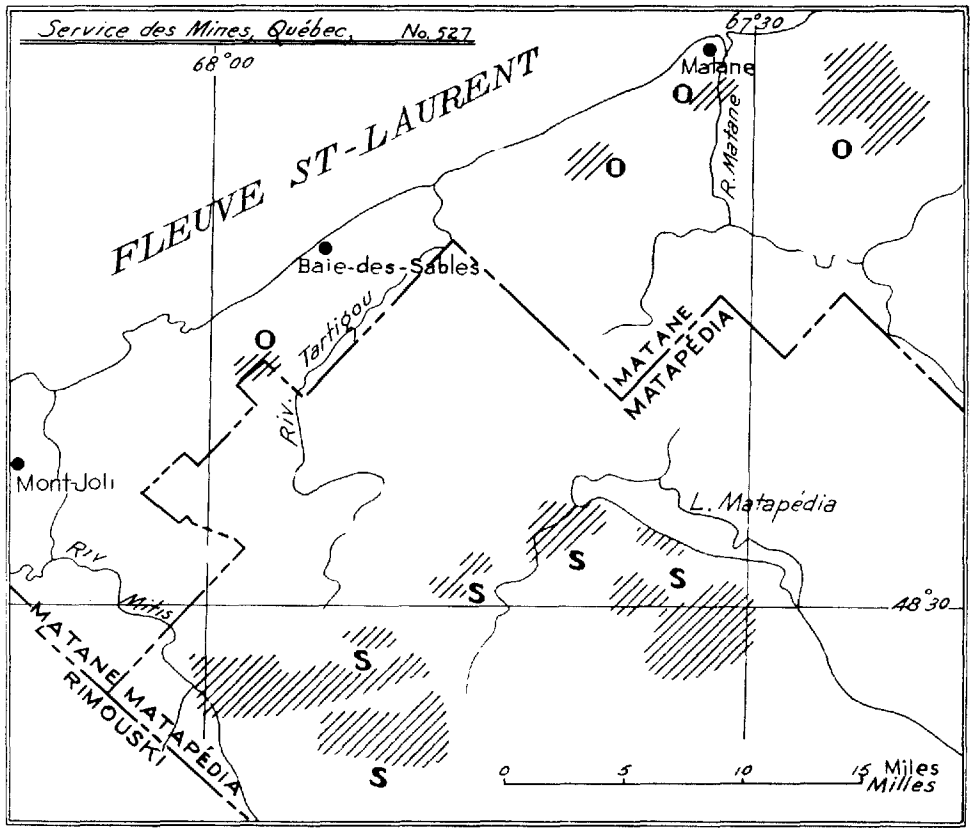

Figure 2.—Principal limestone outcrops. (S) Silurian; (O) Ordovician.

Lower Ordovician (Sillery)

Sillery limestone may be seen in many parts of the area, and particularly along and adjacent to the shore of the Saint-Lawrence, interbedded with the shales of this formation. It is very fine grained to compact, non-fossiliferous, and individual beds are usually only a few inches thick and seldom more than a foot or two. These limestone beds have no economic interest.

Limestone-conglomerate is very common in the Sillery and is well exposed, for example, in and near Sainte-Jean-d'Arc, Saint-Moïse, Saint-Damase, Sainte-Paula, and Saint-Adelme. The beds, commonly tens of feet thick, are interstratified with quartzite and shales. The pebbles are for the most part pale or dark grey limestone, thought to be Cambrian, and some of them exceed one foot in diameter. The matrix is generally siliceous. In many places, the pebbles make up the bulk of the rock. Such material was quarried some thirty years ago on lot 30, range northeast of Kempt road, Cabot township, and the output used for making lime in a kiln near Tartigou station, on the Canadian National railway between Padoue and Saint-Moïse.

Middle Ordovician (Pohénégamook)

The belt extending westward from Saint-Adelme to a point about two miles south of Rivière-Blanche is in large part underlain by rocks of the Pohénégamook formation. The limestones of this formation are grey, non-fossiliferous, non-bituminous rocks, frequently traversed by veins of white calcite. Some types are very fine grained and platy, others contain a high proportion of quartz grains and grade into calcareous sandstones, and others again are brecciated or conglomeratic. In the latter, the pebbles—the great majority limestone, but some sandstone—do not exceed five inches in diameter, and the matrix is argillaceous limestone. The limestone beds are interstratified with shales, or more rarely sandstones, or, conversely, there may be intercalations of shale or sandstone within the limestone. In several outcrops, the limestone has a thickness of but a few feet; in others, of several hundred feet. The rock shows considerable variation in chemical composition, but in most exposures some at least of the beds are suitable for use as agricultural limestone, or for making lime. The extent and importance of the outcrops of these limestones varies in different localities; in some places, particularly east of Saint-Luc, outcrops are numerous but of very limited extent, while a few miles from there, southeast of Petite-Matane, the outcrops of these limestones are relatively extensive.

A band of the limestone outcrops in the parish of Saint-Ulric, at a point two miles southeast of Rivière-Blanche, where two small quarries have been opened by Octave Gagné on lots 10 and 11, range III, Matane township. The rock is exposed along one side or other of the road that trends northeasterly across this range from lot 12 to lot 6. It shows over a width of seventy feet and can be followed along the strike of the formations for a distance of nearly three-quarters of a mile. Stone from the more westerly of the two quarries is pulverized and used as a soil corrective; that from the other is burned in a kiln of 5-ton capacity, yielding lime of good quality. An analysis of the stone is given in the table on page 36.

Another band is exposed at a point 2¼ miles south of Matane, crossing the Matane river with strike about parallel to the Saint-Lawrence shoreline. A quarry and lime kiln were operating here about twenty years ago. This band has a width of nearly 2,000 feet, but it consists of alternating zones of limestone and shale, with some sandstone, and it is doubtful whether any individual limestone zone has a thickness greater than about ten feet. An analysis of this stone is given in the table on page 36. Westward from the Matane river, the limestone outcrops at intervals for a distance of more than a mile, but eastward the rock is soon concealed beneath quaternary deposits. The Matane-Amqui road crosses this band and gives a good cross-section of the constituent beds.

On lots 1 and 2, range V, Saint-Denis township, Gagnon brook has cut its channel through an extensive band of Pohénégamook limestone, as already mentioned in the description of the copper deposits in that district. These limestones are in many places arenaceous and charged with anthraxolite, and thus are too impure to be utilized. This is not the case, however, farther north, in the prolongation of this band in range IV, Saint-Denis, and ranges IV, III, and II, of the seigniory of Matane. About thirty years ago, the limestone on range III was quarried for manufacture

of lime, and recently a quarry has been opened near the east side of Petite-Matane river, on range II, Matane seigniory, by a Mr. Harrison, who is marketing the pulverized stone under the trade-name 'Calco' for use as a fertilizer.

Limestones believed to belong to the Pohénégamook formation are exposed at a point three miles southeast of Métis-sur-Mer along both sides of the road leading from that village to Saint-Moïse, forming a band with an exposed width of about 600 feet, striking east-northeast. Numerous beds of grey shale and calcareous sandstone are interstratified with the limestone. These rocks outcrop in ranges IV and V, Métis seigniory (parish of Saint-Antoine-de-Padoue) and in range III, Macnider township (parish of Baie-des-Sables). The best beds are found to the west of the main road, along a road which, following the boundary between ranges IV and V of Métis seigniory, leads to Astle lake. An analysis of the stone on range V, Métis seigniory, is given in the table on page 36.

Silurian

There are numerous outcrops of Silurian limestone in the southern part of the map-area, between Matapédia lake and Métis River valley, and particularly in Awantjish township. For the most part they have the form of bands trending northeast, some only a few feet wide, others one-third of a mile and more. A characteristic feature of the stone in most of its outcrops is that it is feebly bituminous. Otherwise, it shows considerable variation in character from place to place. In some exposures, as in the Val-Brillant quarry, it is grey, massive, very fine grained, and well stratified, with individual beds six to ten inches thick; in others, and very commonly, as for example in the vicinity of La Rédemption, it is highly fossiliferous and the bedding is less well marked. In some places, there are associated beds of grey nodular limestone. Also, limestone-conglomerates, containing numerous coral fragments, are seen in various localities, notably along the 'Government' road on range III, seigniory of Lake Matapédia.

The Val-Brillant quarry, referred to above, is one mile northwest of the village, between the highway and the south shore of Matapédia lake (Plate V-A). It was opened in or about 1875, at the time of construction of the Intercolonial (now Canadian National) railway, to furnish ballast for the track and stone for bridges and culverts. Some twenty-five years ago there was a kiln in operation here, but it was found that the stone is not suitable for lime making. In recent years, work at the quarry has been intermittent. Stone from the northern part, where there are interbeds of sandstone, is crushed and sold for use as 'metal' for surfacing roads in the district. The output has ranged from 20,000 tons in 1935 to 6,000 tons in 1938. Analyses of the limestone are given by M. F. Goudge in his report on the limestones of Quebec ①.

Sayabec, in Lake Matapédia seigniory, is in part underlain by Silurian limestone, which is well exposed in the vicinity of the railway station, but in most parts of the village the rock is concealed beneath superficial de-

① Goudge, M. F., *Limestones of Canada: Part III, Quebec*; Mines Branch, Dept. of Mines, Ottawa, Pub. No. 755, 1935.

posits. About thirty years ago a quarry was operated here by Noel Ross, on cadastral lot 464, range I of Lake Matapédia seigniory, a few hundred feet east of the village proper and 600 feet southwest of the national highway. The output was used principally in the construction of Sayabec church. The stone is not suitable for manufacture of lime. There are other outcrops of the limestone about two miles east, and two miles south, of the village, the latter on cadastral lot 506 of range II, Lake Matapédia seigniory, just east of the road leading from Sayabec to Saint-Cléophas.

In the hilly country of Awantjish township, to the south of Val-Brillant and extending westward to Métis river, the limestones are frequently very fine grained, black, argillaceous types, somewhat schistose and in places grading to calcareous shales. Outcrops are rarely seen, owing to the thick bush, but the rock has been exposed in cuttings made for road construction, particularly along the section from Val-Brillant to Sainte-Irène.

There are, however, some very large outcrops in La Rédemption parish, principally in ranges I to III, Awantjish township, between lots 1 and 13. An analysis of the massive grey stone on lot 1, range I, is given in the table below. Outcrops continue farther to the west, in Massé township, and to the north, on lots 53 to 56, range I, Cabot township. A band of the limestone, one-third of a mile wide, traverses ranges I and II, Awantjish township, between lots 18 and 23; and east of here, the rock outcrops again in Saint-Cléophas parish, on lots 42, 52, and 54 along the road between ranges II and III.

Analyses of Limestones

	I	II	III	IV	V	VI
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
SiO_2	8.99	6.30	5.39	2.82	14.26	6.82
Al_2O_3	0.34	2.01	0.55	0.74	3.39	2.23
Fe_2O_3	0.40	0.59	0.58	0.80	0.97	0.23
CaO	49.72	48.31	50.73	52.16	43.99	50.44
MgO	0.82	2.06	1.24	0.86	0.54	0.43
P_2O_5	0.01	0.19	0.05	.....	.....	.....
S	0.04	0.18	0.17	0.33	0.12	0.10
$CaCO_3$	88.71	85.82	90.42	93.02	78.53	90.05
$MgCO_3$	1.71	4.31	2.59	1.80	1.12	0.90
$Ca_3P_2O_8$	0.02	0.41	0.11	0.13	0.02	0.20

I.—Massive grey Silurian limestone, La Rédemption (lot 1, range I, Awantjish township).

II.—Grey Middle Ordovician limestone, Matane River valley, 2¼ miles south of Matane.

III.—Grey Middle Ordovician limestone, range V, Métis seigniory, west of Métis-Saint-Moïse road.

IV.—Middle Ordovician limestone, Octave Gagné quarry, range III, Matane township, 2 miles S.E. of Rivière-Blanche.

V.—Silurian limestone, Val-Brillant, entire face of 15 feet of limestone in old quarry on land of Octave Héon.

VI.—Silurian limestone; better grade stone available in the same quarry as V.

Analyses I, II, III, of samples collected by E. Aubert de la Rüe, analysed at Bureau of Mines, Quebec.

Analyses IV, V, VI, from GOUDGE, M.F., *Limestones of Canada: Part III, Quebec;* Mines Branch, Dept. of Mines, Ottawa, Pub. No. 755, 1935, pp. 263, 264.

As will appear from the foregoing summary, limestones are exposed at numerous points within the map-area. Although such chemical analyses as have been made indicate that much of the stone is not sufficiently pure, or high in calcium carbonate, for certain industrial uses, in some localities, at least, it has proved quite satisfactory for manufacture of lime and for use as agricultural limestone. Moreover, it is probable that more detailed examination of the various occurrences would reveal stone of sufficient purity for use in the pulp industry.

Granite and Gneiss (Erratic Blocks)

Blocks of granite and gneiss, many of them several feet in diameter, are very numerously strewn along the shore of the Saint-Lawrence and for a distance inland averaging two miles. These erratics, derived from the region north of the Saint-Lawrence, afford a very decorative building stone and have been used in the construction of churches in several villages on and near the coast, as in Sainte-Flavie, Mont-Joli, Saint-Octave, Rivière-Blanche, and Matane.

Sandstone and Quartzite

Sillery sandstone is quarried at Grand Remous, in the parish of Saint-Octave-de-Métis, on the east bank of Métis river about midway between Saint-Octave and Sainte-Angèle. The stone is grey-green, very hard and resistant, and somewhat coarse grained, passing to a 'pudding-stone' conglomerate, which forms a band 50 feet thick within the sandstone. The pudding-stone contains rounded fragments of white quartz, black shale, and some of feldspar, in a quartz matrix. It has a rather striking appearance and locally is termed 'granite'. Unfortunately, the stone in this quarry contains rather numerous small specks and veinlets of pyrite. This detracts from its value as a building stone, as the exposed surface soon becomes stained with rust from the oxidation of the iron sulphide. Sandstone and pudding-stone from the Grand Remous quarry were used in

building the church in Sainte-Angèle and also for necessary stone work along the line of the Canadian National railway, notably for the bridge across Métis river. At the present time, the whole of the output is used in the form of crushed stone for road maintenance.

There is an intermittent production of similar, but finer grained, sandstone from a quarry along the national highway one mile west of Métis point. The material, after crushing, is used for road maintenance.

The church at Saint-Moïse is built of grey Sillery quartzite quarried in 1914 on lot 52, range northeast of Matapédia road, Cabot township, at a point less than a mile north of the village. Recently, there was some suggestion of reopening this quarry to supply stone for road work, but, owing to the hardness and toughness of the quartzite, quarrying and crushing costs were found prohibitive.

In the northern part of Awantjish township, and particularly in and around Saint-Cléophas, there are numerous exposures, and also loose blocks, of bluish-grey or greenish-grey Silurian sandstone which splits readily into slabs six to eight inches thick. These slabs, locally known as 'Saint-Cléophas stones', are used by the farmers of the district in making foundations for their barns and for paving pathways around their homes. On lot 18, range I of this township, there are outcrops of rose-coloured, very fine grained sandstone that would furnish excellent stone for construction.

Sand and Gravel

Deposits of gravel suitable for use as concrete aggregate are very widespread. At numerous points within the map-area, such deposits have been drawn upon to furnish gravel for road maintenance.

These gravels occur in marine deposits of the coastal zone, in alluvial deposits along the principal water-courses, and in the morainic and fluvio-glacial deposits which blanket the bed-rock over large sections of the area to a depth of 50 feet and more.

The Saint-Lawrence shore being for the most part rocky, sandy stretches are rare, but there are important accumulations of sand in the alluvial deposits of the Matane river, notably at five miles south of Matane village.

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