CANADA
DEPARTMENT OF MINES
HON. T. A. CRERAR, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

BUREAU OF ECONOMIC GEOLOGY
GEOLOGICAL SURVEY

MEMOIR 201

Geology and Mineral Deposits of Ville-Marie and Guillet (Mud) Lake Map-areas, Quebec

BY
J. F. Henderson

OTTAWA
J. O. PATENAUDE, I.S.O.
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
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CHAPTER I

INTRODUCTION

The following report describes a district in Quebec adjoining the east side of lake Timiskaming. Interest in this district as a possible source of mineral deposits was first aroused in 1903 when rich silver ores were discovered near Cobalt, only 10 miles to the west. However, little or no success rewarded the prospector's search for silver-bearing veins within the area. In recent years the prospector's attention has been directed to the finding of gold, particularly in districts underlain by Keewatin greenstones and sediments. Detailed mapping of a part of the western or Ville-Marie area by M. E. Wilson during 1906 and 1907 first indicated the presence of these formations and in 1930 J. A. Retty of the Quebec Bureau of Mines traced a belt of these rocks to the east through Gaboury and Blondeau townships to Lac aux Sables. The recovery of several promising gold-bearing veins in Guillet township in 1933 aroused a considerable amount of interest in the mineral possibilities of the whole district. Detailed mapping of an area extending from the shores of lake Timiskaming easterly to Soufflot lake was undertaken during the field season of 1935 and this report with accompanying maps gives the results of the work.

LOCATION AND MEANS OF ACCESS

The area described forms a rectangle 17 miles in width extending easterly from the shores of lake Timiskaming some 47 miles to Soufflot lake; to be more precise it lies between longitudes 78°30′ and 79°30′ and latitudes 47°15′ and 47°30′. All of this territory lies in Quebec with the exception of about 6 square miles west of lake Timiskaming which is in Ontario.

The greater part of the western half of the area is settled, much of the land is cleared and under cultivation, and good roads make all points easily accessible by motor car. Ville-Marie, the largest town in the area, may be reached by the Mattawa-Angliers branch of the Canadian Pacific railway or by a road that runs south from the Ferguson highway a few miles east of New Liskeard.

In contrast with the easily accessible western area the country to the east is unsettled bush-land over which travel is limited to canoe or airplane. The best route to the Guillet-Soufflot Lake section of the country is by way of Latulipe and Ottawa river. Latulipe is a small village east of Gillies bay which may be easily reached by motor car over a good road from Ville-Marie. From Latulipe the route is by boat down Fraser river to

Gillies bay and thence up Ottawa river by lac des Quinze to Klock bay at the south end of lake Simard. A good wagon road, about 4 miles long, has been built from Klock bay to Devlin lake over which much of the heavy freight for the mining properties is brought in during the summer months. Good roads lead from Thibault lake, which adjoins Devlin lake to the south, to the McIntyre Porcupine Mines gold property and to Guillet lake. Guillet lake may be reached by canoe from Devlin lake by way of Guillet creek.

An alternative route from Latulipe to Guillet lake is up Fraser river to rivière des Bois, up this stream to lac des Bois, and thence easterly through Blondeau township by way of Lett and Kelly lakes to lake Allard. From lake Allard two routes lead to Lac aux Sables. The easier is by Sand creek except when the water is low, when it is preferable to go up Girard creek about one mile and then travel east by lakes Morin and Froid to Lac aux Sables. Guillet lake is reached from lac aux Sables by a 30-chain portage from Sand creek. This route necessitates many long portages and unless travelling with a light load the route by way of lac des Quinze and lake Simard is much to be preferred.

A winter road has been built from Latulipe to the McIntyre property north of Guillet lake, over which most of the freight for the mines is brought in during the winter months. It makes a good trail during the summer and it is possible to walk from Latulipe to the property in one day.

Blondeau and Guillet townships may also be reached from Kipawa on the Mattawa-Angliers branch of the Canadian Pacific railway. The route is by way of Kipawa and Turtle lakes to Hunter point and thence through lakes Ostaboning and Lavoie to lake Allard.

The numerous lakes and streams in the eastern area provide water routes that allow one to approach within a mile or two of any given locality. The portages on the majority of these routes are kept in excellent condition by the Ottawa River Forest Protective Association.

ACKNOWLEDGMENTS

During the season of 1935 efficient assistance in the field work was given by S. H. Ross, N. H. Fraser, P. H. Riordon, D. F. Hatfield, L. E. Robert, F. Read, and J. W. Colley. Mr. Ross and Mr. Fraser were in charge of sub-parties under the writer's supervision during the greater part of the summer. Mr. Ross mapped the northwest part of Blondeau, all of Latulipe, and the eastern half of Baby townships; Mr. Fraser mapped the southern part of Blondeau, all of Gaboury, and the southwest corner of Guillet township.

It is a pleasure to record the interest and co-operation in the work by the residents about Ville-Marie. To the managers of the mining properties within the area the writer wishes to express his thanks for the many courtesies received during the summer. The McIntyre, Noranda, Nipissing, Prospector's Airways, Coniagas, and O'Brien mining companies furnished the writer with detailed geological plans of the properties controlled by them in the area, thus contributing much information that would otherwise not have been obtained.

PREVIOUS WORK

The earliest geological traverse of the area was made by Sir William Logan in 1842, who, in a general description of Ottawa river, describes the geology along the shores of lake Timiskaming.[1] A more detailed description of the geology along the shores of the lake is given by A. E. Barlow in a report published in 1897 on the geology and natural resources of an area included in the Nipissing and Timiskaming map sheets.[2] A report on the silver deposits of Timiskaming by Professor Miller, which was published in 1905, contains several references to the geology of the east shore of lake Timiskaming and includes a description of the argentiferous galena deposit known as the Wright mine.[3] In 1910 M. E. Wilson reported in detail on an area adjoining the east side of lake Timiskaming.[4] This map includes an area extending about 23 miles from the shore of the lake, which is covered by the Ville-Marie sheet accompanying this report.

The report of the Quebec Bureau of Mines for 1931 contains a geological map and report by J. A. Retty on portions of Gaboury and Blondeau townships, with a description of the mineral deposits occurring therein. In 1934 J. A. Retty made a preliminary geological survey of the northern part of Guillet township and his map and report have been published in the Quebec Bureau of Mines report for 1935.

[1] Geol. Surv., Canada, Rept. of Prog. 1845-6, pp. 69-70.
[2] Geol. Surv., Canada, Ann. Rept. 1897, vol. X, pp. 193-202 (1899).
[3] Ont. Bureau of Mines, Ann. Rept. 1905, pt. 2.
[4] Geol. Surv., Canada, Pub. 1064 (1910).

CHAPTER II

GENERAL CHARACTER OF THE DISTRICT

PHYSICAL FEATURES

The entire area, with the exception of a few isolated localities at and near the shore of lake Timiskaming, is underlain by crystalline Precambrian rocks and presents the topography characteristic of the Canadian Shield. The bedrock topography of an area extending east for about 20 miles from lake Timiskaming has been modified by a deposit of lacustrine clay. The clays, which were deposited in a large post-glacial lake, have filled the depressions in the original uneven rocky surface and form plain-like, gently rolling areas. Since the recession of the waters of the glacial lake the streams and rivers have begun to dissect the clay flats and have carved deep gulleys and meandering river channels with steep clay banks.

Projecting through the clay blanket are knolls, hills, and ridges which were once islands in the glacial lake. Some of the smaller elevations are eskers, kames, and other unconsolidated morainal accumulations which were formed during the retreat of the glacial ice-sheet. Most of the hills, however, are composed of rock, and vary in size from small, low outcrops projecting only a few feet above the clay to upland areas of precipitous, rocky hills that rise from 300 to 350 feet above the general level of the country. The majority of these upland areas are bare rock covered only in part by morainal sands and gravels.

East from the shore of lake Timiskaming the rocky upland areas increase in number and size, until in Blondeau township the eastern limit of the glacial lake is approached and deposits of clay are no longer to be found. The greater part of the country from here to the eastern boundary of the area consists of hills 100 to 250 feet in height composed of solid rock which is in part mantled by a few inches or feet of sand and gravel. Between the rocky hills the lower ground is swamp, muskeg, or sand and boulder plain. In some localities sand or boulder plains cover large tracts of country, as in the northeast quarter of Guillet township and in Blondeau township east of lac des Bois. Many of the depressions between the hills are occupied by lakes with which the country is dotted. The numerous lakes in the eastern area are in contrast with the clay-covered country to the west which contains no lakes except within the rocky uplands that project through the clay flats.

The topography is not greatly influenced by changes in the character of the bedrock. Areas underlain by schistose phases of the Keewatin volcanics are usually low and swampy, but the more massive Keewatin rocks form as prominent hills, as do intrusive rocks such as granite, diorite, and gabbro. The mica schists of sedimentary origin do not form prominent hills, and outcrops of these rocks are scarce. The sedimentary gneisses on the other hand form high hills and the greater the amount of granitic material they contain the more rugged the country tends to become. The shore-lines of the larger lakes usually conform to the strike of the gneisses or schists in which they lie.

The Huronian sediments, which are confined to the western or Ville-Marie area, outcrop as hills that rise precipitously from the clay flats to heights of 350 feet or more. Many of the tops of these rocky hills are almost flat or table-like, conforming with the practically flat dip of the sedimentary beds. There is a tendency for the gently inclined Huronian strata to form asymmetrical ridges, the gentle slopes of which are determined by the dip of the beds, but this tendency is not pronounced.

FARMING

The greater number of the clay-filled valleys of the townships of Guigues, Duhamel, Baby, Fabre, and western Laverlochère have been cleared and now support a prosperous farming community. The clay lands of the townships of Latulipe, Gaboury, and eastern Laverlochère have not yet been entirely cleared, but settlement is proceeding rapidly. The farmers in the newer sections cannot as yet earn their livelihood entirely from their farms and are forced to supplement their earnings by employment such as lumbering and trapping during the winter months.

In addition to dairy farming, hay, root, and grain crops are raised with success. Head lettuce is an important and remunerative crop as it matures some weeks after the crops in southern Ontario and Quebec.

The problem of finding nearby markets for the farm produce is being rapidly solved as new mining centres develop. The discovery and development of each mining property means increased prosperity for the settlers in the vicinity.

LUMBERING

The greater part of the timber within the area has been destroyed by fire. Practically the whole of Blondeau, much of Gaboury, and large areas in the southern part of Guillet townships have been swept by fire at one time or another within the last thirty years. Good stands of timber are still to be found in Guillet township and in a few isolated areas in Blondeau township.

Spruce, white, red, banksian pine or jackpine, and balsam are the most valuable woods in the area. Cedar, birch, poplar, and maple are plentiful, but are not at present of much commercial value. There are relatively few stands of white pine, although at one time they covered large tracts of the country. The best trees were cut for square timber about thirty to forty years ago and many of those fallen were left lying on the ground when found to contain some minor defect. These logs are still in an excellent state of preservation. The remaining white pines are now found mainly as isolated trees towering above a jungle of spruce, balsam, birch, and maple. Second growth stands of this valuable tree are extremely rare. Red or Norway pine is much more plentiful and some excellent stands of young trees are to be found in Guillet township—particularly the central part.

The second growth on the burned over areas is almost entirely poplar and birch with few or no coniferous trees, although the original forest cover was of the latter type.

CHAPTER III

GENERAL GEOLOGY

OUTLINE

The rock formations of the area fall naturally into three groups, separated from each other by two major unconformities. These three groups are, from the oldest to the youngest, as follows:

(1) The pre-Huronian floor or basement on which the other rocks rest.
(2) The Huronian sediments.
(3) Palæozoic sandstone.

The pre-Huronian basement is composed of the Keewatin volcanics and an overlying series of sediments. The Keewatin is an assemblage of lava flows that range in composition from basalt to rhyolite. Minor amounts of tuffs and tuffaceous sediments are interbedded with the flows. The pre-Huronian sediments overlie the Keewatin with apparently conformable relations. They are mainly greywackes and arkoses and have been altered to gneisses over large areas. Sills, dykes, and irregular bodies of basic rocks that vary in composition from quartz diorite to peridotite intrude the Keewatin. Some of the more basic phases are altered to serpentine. Dykes of albite and quartz-albite porphyry intrude the Keewatin and the overlying sediments.

The Keewatin volcanic rocks and pre-Huronian sediments are steeply folded and have been intruded by large granite batholiths. A period of erosion of such duration followed the folding and granitic intrusion that the cover of Keewatin lavas and later sediments was worn away, exposing the granite batholiths over wide areas.

The Huronian sediments, which comprise the second group, rest in profound unconformity on the old pre-Huronian erosion surface. They are a practically horizontal, comparatively unmetamorphosed series of sediments composed of the Gowganda and the overlying Lorrain formations. An erosional unconformity separates the Gowganda from the Lorrain. This unconformity represents an erosion interval of considerable duration, but is not comparable in magnitude with the angular unconformity between the Huronian and pre-Huronian. Diabase dykes intrude the pre-Huronian, and probably the Huronian rocks; they are believed to be Keweenawan in age.

The third group of rocks consists of Palæozoic sediments that lie almost horizontally on the Huronian and pre-Huronian rocks. The unconformity between the Precambrian and the Palæozoic is comparable in magnitude with that beneath the Huronian.

Unconsolidated morainal sand and gravel, and stratified lake clays rest on the eroded surface of the Precambrian and Palæozoic rocks. They were deposited in Pleistocene time during the retreat of the continental ice-sheet.

The geological succession is given in the following table:

Table of Formations

Modern	Post-Glacial	Stratified clay, silt, and sand
	Glacial	Gravel, sand, and boulder clay
Palæozoic	Ordovician	Conglomerate, sandstone
Proterozoic (Late Precambrian)	Keweenawan (?)	Diabase dykes
	Huronian	Lorrain formation: quartzite
		Gowganda formation: conglomerate, greywacke, arkose
Archæan (Early Precambrian)		Lamprophyre dykes
		Granite, granodiorite, and allied rocks
		Albite porphyry, quartz-albite porphyry
		Quartz diorite, diorite, gabbro, peridotite
	Keewatin (?)	Greywacke and arkose, largely converted to mica schist and biotite-hornblende gneiss
	Keewatin	Basalt, andesite, dacite, rhyolite, tuff, agglomerate, iron formation

KEEWATIN

The rocks classed as Keewatin include a wide variety of types. Basic lava flows of andesitic and basaltic composition predominate, but light grey to white lavas that range in composition from dacite to rhyolite are plentiful—particularly in the western or Ville-Marie area. Tuffs, agglomerates, and associated sediments occur interbedded with the volcanic flows.

A wide belt of Keewatin rocks, striking east to southeast, occurs in Duhamel, Fabre, and Laverlochère townships, but the greater part is covered by the Huronian sediments in these townships and consequently the outcrops of Keewatin are confined to small areas where the Huronian has been removed by erosion.

A second belt of Keewatin outcrops in Baby township west of Gillies bay. The northwestern part of this area of Keewatin is composed almost entirely of porphyritic dacite; to the south and east the flows are mainly andesites.

A third belt of Keewatin extends from Honorat lake, near the eastern boundary of Gaboury township, easterly through Blondeau township to lake Allard. This belt, which strikes in a general east-west direction, has a maximum width of 3 miles. A fourth greenstone area extends from Girard lake, near the eastern boundary of Gaboury township, east through Guillet township to Soufflot lake. There the belt swings to the north and continues beyond the northern limit of the map-area. This belt attains a maximum width of more than 7 miles in Guillet township. The Gaboury-Blondeau and Guillet belts are composed mainly of andesites and basalts with interbedded tuffs. A considerable thickness of rhyolite and associated tuffs and agglomerates occurs in central Guillet township northwest of Caribou lake.

Andesites and Basalts. Andesites and basalts make up the bulk of the Keewatin volcanics of the area. The two types are intergradational and it is difficult if not impossible to differentiate between them in the field. Both are dark green, fine-grained rocks, although, as a rule, the andesites are lighter in colour than the basalts due to a higher content of feldspar. They are usually equigranular, but occasionally are porphyritic—particularly the andesites which may contain many small crystals of white weathering feldspar.

The basic lavas are thoroughly altered to a mat or mesh of secondary minerals and microscopic study yields little information as to their original character. Chlorite and hornblende predominate with abundant epidote and zoisite; carbonate and kaolin are usually present and occasionally small grains of a fresh, secondary acid plagioclase may be recognized. More of the original character of these rocks may be determined from a study of a clean, weathered rock surface than from microscopic study of thin sections, as original textures are preserved on the weathered surface that cannot be recognized under the microscope.

Dacites. The dacites include the "grey" lavas intermediate in composition between the andesites and the rhyolites. They are largely confined to the western or Ville-Marie area where they are almost as plentiful as the more basic andesites and basalts. The largest area underlain

by dacite flows is in the northwestern part of Baby township and in the adjoining township of Guigues. Small outcrops also occur along the shores and on the islands of lake Timiskaming, along the western edge of the large outcrop of Huronian rocks southwest of Lorrainville, and at the south end of range III, Duhamel township.

The typical dacite of the district is a quartz-feldspar porphyry. The colour is variable, but commonly is white to light grey on the weathered surface and dark grey to green on a fresh fracture. Locally, as in the vicinity of Baby lake in Baby township, the rock has a pinkish cast both on the weathered and fresh surfaces. The more basic phases, which predominate along the shores of lake Timiskaming, weather a light to rather dark green and are dark green on a fresh fracture. An almost constant characteristic of the porphyry, whatever its colour, is the presence of phenocrysts of quartz and feldspar that stand out prominently on the weathered surface. The quartz phenocrysts, which are not usually as numerous as the feldspar phenocrysts, average 2 to 3 mm. in diameter, although grains as large as 5 mm. are not uncommon; they are opalescent in colour. The feldspar phenocrysts are grey to white and occur as blocky individuals with perfect crystal outline. They average 2 to 3 mm. in length, but not infrequently attain dimensions of 6 mm. A feature of the rock is the large proportion of phenocrysts to the groundmass; in many localities the phenocrysts of quartz and feldspar make up more than 50 per cent of the rock.

When examined under the microscope the rock is seen to be composed of idiomorphic phenocrysts of basic oligoclase (Ab_{70}) and quartz in a fine-grained groundmass of quartz, feldspar, and chlorite. Epidote, zoisite, and carbonate are abundant as small grains in the groundmass and as well-defined veinlets that cut across both groundmass and phenocrysts. The oligoclase phenocrysts are considerably altered to sericite. No orthoclase was recognized in any of the sections examined.

In addition to the quartz-feldspar porphyry described above, there are finer grained, grey to light green flow rocks with very small if any feldspar phenocrysts. They occur interbedded with the typical porphyritic dacite in Baby township and in Duhamel township southwest of Lorrainville. Some dacite of this type is also associated with the rhyolite on the shore of lake Allard south of the portage leading to Kelly lake.

Microscopic study shows the fine-grained dacites to be composed mainly of acid plagioclase with subordinate amounts of chlorite, pale uralite, sericite, and commonly a little quartz. Phenocrysts of feldspar, when present, are generally albite (Ab_{90-95}); the feldspar of the groundmass is also an acid plagioclase probably of about the same composition. Epidote and zoisite are abundant as small grains and as veinlets. No potash feldspar was observed in the thin sections that were studied.

Rhyolites. The rocks classed as rhyolite include siliceous lavas containing free quartz, which is commonly visible to the unaided eye. Rhyolite flows outcrop in Blondeau township east of and on the shores of Lett lake, and between Lett, Kelly, and Allard lakes. The outcrops tend to be in alinement and probably form two or more bands of rhyolite flows interbedded with the andesites and basalts.

The largest area underlain by rhyolite is in the central part of Guillet township northwest of Caribou lake. There the flows occur near the contact with the overlying sediments and apparently the extrusion of the rhyolite marked the close of Keewatin vulcanism in this locality. A great variety of fragmental volcanic rocks such as tuffs, agglomerates, and breccias are associated with the rhyolite flows.

The rhyolite of Blondeau township is a flinty, fine-grained, porphyritic rock with phenocrysts of bluish quartz up to 3 mm. in diameter. The rock weathers a light grey, with a rough, nodular surface caused by the projection of the resistant quartz phenocrysts; dark green almost black varieties also occur. The rhyolite of Guillet township is similar to that in Blondeau, but weathers a lighter yellowish grey and contains larger quartz phenocrysts of a pronounced opalescent blue, which attain dimensions of 5 mm. or more. Much of the rock is schistose and in places has been converted to yellowish sericite schist in which the blue quartz eyes may be still readily distinguished. Finely disseminated pyrite is present in much of the rhyolite.

Tuffs, Agglomerates, and Associated Sediments. Tuffs and agglomerates are most abundant in association with the dacite flows of Baby township. Good exposures of these rocks may be observed on the large point on the south shore of Baby lake. The agglomeratic beds consist of angular fragments of dacite varying from 2 to 15 inches in diameter in a matrix of smaller fragments averaging 2 mm. in diameter. Associated with the agglomerate are flow breccias and fine-grained, bedded tuffs. Tuffs, agglomerates, and related sediments are also well exposed on the south side of a railroad cut on the Canadian Pacific railway south of lac Douze; the majority of the outcrops of dacite along the shore of lake Timiskaming are at least in part fragmental in character.

Agglomerates and tuffs are common associates of the rhyolite flows in Blondeau and Guillet townships. They are particularly abundant interbedded with the rhyolite northwest of Caribou lake. The common type is composed of fragments of rhyolite 5 inches or more in diameter in a fine, fragmental matrix, but there is much fine-grained, siliceous, bedded material in addition to the agglomeratic varieties.

Tuffaceous sediments interbedded with ellipsoidal lavas and occasional beds of agglomerate are plentiful to the south of Guillet lake. They are fine- to medium-grained rocks, weather white to light green-grey, and are grey to green on fresh fracture. On the weathered surface the fragmental character of the rock is easily recognized by the presence of grains of feldspar, blue quartz, and small fragments of greenstone. Microscopic examination shows the rock to be composed of angular grains of quartz and feldspar in a fine-grained matrix of quartz, feldspar, carbonate, and chlorite.

One characteristic type of tuff is a very fine-grained, cherty, light grey to white weathering rock. It is thinly bedded and in some cases banded, on account of slight differences in the composition of the beds. The bands are usually narrow, averaging 20 to 30 feet or less, but they are persistent and, as a rule, can be traced for several miles along the strike.

These tuffs are of particular interest because much of the gold-bearing quartz in the area has been found associated with them.

Iron Formation. Thin bands of iron formation interbedded with basic lava flows are fairly common throughout the area. Outcrops of this rock are numerous east of Rousselot lake, at the west end of McKenzie lake, south of lac des Bois, east and west of Lett lake, and south of Kelly lake. The bands are seldom more than 40 feet, and generally less than 20 feet, in width. They weather a rusty red to black and are ribbon-like in appearance. The rock consists of bands of black, cherty quartz, rich in magnetite and up to ½ inch or more in width, which alternate with wider bands of cherty, blue quartz and occasional bands of chlorite or hornblende schist. The iron formation, like the siliceous, fine-grained tuffs, is in many cases well mineralized with pyrite and pyrrhotite.

KEEWATIN (?) SEDIMENTS, GNEISSES, AND SCHISTS

The pre-Huronion sediments and gneisses extend as a more or less continuous east-west band, cut off here and there by masses of granite, through the southern parts of Gaboury, Blondeau, and Guillet townships. On Soufflot lake the general east-west trend changes to north and continues in this direction to the northeast boundary of the area.

Throughout Gaboury, Blondeau, and southern Guillet townships the sediments have been highly altered as a result of the intrusion of many small bodies of granite and pegmatite dykes, and by the intimate lit-par-lit injection of granitic materials. As a consequence the original sediments are now, in large part, quartz-feldspar-biotite-hornblende gneisses and schists.

In central Guillet township and to the northeast along Marécageuse river the sediments contain little or no granitic material. They are, however, considerably metamorphosed: all the beds have been recrystallized and the greywackes and argillaceous varieties converted to mica schists.

Arkose and Greywacke. The ungranitized sediments in central Guillet township are mainly fine-grained greywackes with some impure arkose. The area underlain by the sediments is heavily drift-covered, but outcrops are numerous on Caribou lake and along the north shore of the lake to the south. The sediments are light to dark grey, well bedded, and many of the beds are finely laminated. The grain size varies considerably but in most of the beds is fine. Recrystallization has been complete and most beds have been converted to micaceous schists, although the original bedding is perfectly preserved. They represent silts, fine-grained, impure sands, muds, and probably some tuffaceous material.

As the contact with the volcanic rocks to the north is approached grains of blue opalescent quartz similar to those in the rhyolite and tuffs appear in the beds together with small fragments of fine-grained, volcanic rocks. The general character of these beds, which contain the blue quartz grains, and their similarity to other rocks interbedded with rhyolitic agglomerate to the north suggest that they are in part tuffaceous in origin.

The sediments north of Soufflot lake in Canton 81 are of a somewhat different character from those in central Guillet. Arkosic varieties pre-

dominate, although greywackes and mica schists are also plentiful. The arkosic sediments weather light grey to white and are grey on fresh fracture. The grain size varies from fine to a maximum of 3 to 4 mm. Isolated pebbles of felsitic rocks up to ½ inch in diameter are present in some of the beds. Narrow bands of mica schist representing original argillaceous beds occur interbedded with the massive beds of arkose.

The purer arkose beds are composed of 40 to 60 per cent quartz, 30 to 40 per cent feldspar, and minor amounts of white mica, carbonate, and some epidote and zoisite; the rock is completely recrystallized. All gradations exist between the arkose and the darker coloured, more basic, greywackes rich in biotite, hornblende, and chlorite.

Conglomerate. Near the eastern boundary of the area, north of Soufflot lake, one or more bands of highly sheared conglomerate occur interbedded with the sediments. The conglomerate is composed of a considerable variety of fragments up to 10 inches and averaging 5 inches in diameter, in a matrix of dark grey to green micaceous schist. The fragments have been greatly stretched and elongated. They show considerable variation in colour and grain and stand out conspicuously on the weathered surface. Like the matrix they are now schistose and it is difficult to determine their original character. The composition and textures of the fragments suggest that they were originally greenstones, diorites, light-coloured felsites, and possibly fine-grained granites.

Sedimentary Gneisses. The sediments of Gaboury, Blondeau, and southern Guillet townships are intruded by numerous, large and small, irregular bodies and dykes of granite and pegmatite; they are also intimately injected by veinlets of quartzose granitic material that follow along the bedding and schistosity. As a result, they have been converted in large part to gneisses and schists. At some distance from the granite masses the rocks contain only small amounts of injected granitic material and are fine enough in grain to be called schists, but, as a body of granite is approached, the amount of injected material increases, the grain becomes coarser, and the rock is a gneiss rather than a schist.

The gneisses and schists are a monotonous succession of banded rocks composed of quartz, feldspar, biotite, and hornblende in various combinations and proportions. The banding is mainly due to the original bedding of the sediments, but in part is caused by the lit-par-lit injection of quartzose granitic material. The bands that represent the original bedding of the sediments are thin, averaging 6 inches or less, although thicker bands up to several feet in width are not uncommon. All the gneisses and schists tend to split along the schistosity and are characterized by bright, glistening cleavage faces of mica.

Light to dark grey quartz-feldspar-biotite gneisses and schists are the most common types. Dark grey, rusty weathering, biotite-hornblende gneiss and light weathering varieties composed largely of quartz and feldspar are also plentiful. All gradations exist between these two extremes.

Judging from the mineral composition and general character of the gneisses and schists it is probable that the original sediments from which they were derived were silts and sands ranging in composition from greywacke to arkose.

RELATION OF THE PRE-HURONIAN SEDIMENTS TO THE KEEWATIN

The evidence that the sediments are younger in age than the Keewatin lavas is based on determinations of the attitude of lava flows, tuffs, and sediments along and near the contact between the volcanic rocks and the sediments. In Guillet township the sediments and volcanics along the contact strike east to northeast and dip 60 degrees to 80 degrees south. Northwest of Caribou lake, within 1,500 feet of the contact, four determinations of the attitude of beds were made by observing the gradation in size of grain from coarse at the bottom to fine at the top. Three of these gradations in grain were observed in sediments southeast of the contact and the fourth in a band of tuffs within the Keewatin volcanics. In every instance the coarse grains are on the north side of the beds; the coarse material grades into fine on the south, thus indicating that the upper sides of the beds face south. On the west shore of the north arm of Soufflot lake, crossbedding in a sedimentary bed within 200 feet east of the Keewatin contact indicates that the top of the bed faces east and, therefore, that the sediments overlie the volcanics at this locality also.

In Blondeau and Gaboury townships the prevailing strike of the volcanics and sediments is east with a steep to vertical dip to the south. The metamorphism of the sediments and volcanic rocks, along the contact, which has been caused by shearing and the intrusion of granitic material, makes determination of the attitude of the flows and sediments extremely difficult. However, several fair to good determinations of the tops by the study of ellipsoidal lava flows were made within one mile of the contact; in all cases the upper sides faced south.

The contact between the Keewatin volcanic rocks and the overlying sediments appears to be gradational. In Guillet township northwest of Caribou lake there is a transition from rhyolite flows with interbedded tuffs and agglomerates to tuffaceous sediments and finally to true sediments. The same change takes place across the contact on the shores of Soufflot lake.

Two or more distinctive bands of basaltic amygdaloidal lava outcrop on Soufflot lake along the contact between the Keewatin and the pre-Huronian sediments. These flows are composed of dark green hornblende with light grey to white weathering nodules from $\frac{1}{8}$ inch to more than 1 inch in diameter, which project above the rock surface. The nodules that were originally amygdules are composed largely of zoisite and epidote with some carbonate. This unique rock outcrops on the island in Storey bay immediately west of the township line; it is exposed along the shore to the northeast, on the island at the mouth of the north arm of the lake, and again on the point on the west side of the north arm. It is next exposed on the west shore of the north arm and again along the shore of the lake to the north. Amygdaloidal lavas are thus in almost continuous contact with the pre-Huronian sediments for 3 miles along the strike. The same type of flow outcrops on the northwest shore of Caribou lake and is here also at the contact with the sediments to the southeast. The amygdaloidal flows evidently mark an horizon at or very near the

end of vulcanism in this vicinity. The conformable relations between the Keewatin volcanics and the pre-Huronian sediments appear, therefore, to be well established because, if a period of erosion had followed the period of volcanic activity, a thin band such as is represented by these flows would surely have been eroded in places along this length of 3 miles.

STRUCTURE OF THE KEEWATIN VOLCANICS, SEDIMENTS, AND GNEISSES

The contact between the Keewatin volcanics and overlying sediments of Gaboury and Blondeau townships strikes east and dips steeply south at angles of 60 degrees to vertical. Throughout this belt the east-west strike and steep southerly dip of the Keewatin flows is remarkably constant. The tops of the flows, where determined, in every case face south. The structure of the volcanics is, therefore, a monocline; it represents the southern limb of a major fold that has been cut off on the north by the granite.

In central Guillet township the contact between Keewatin flows and sediments strikes a little north of east and dips steeply south. The strike continues in this direction until on Soufflot lake it gradually swings to the north, and then to the northwest near the northern boundary of the township. Similarly, within the greenstone belt, the lava flows and tuffs near Guillet lake strike a few degrees north of east and dip steeply south. Going east the strike gradually swings to the north, so that north of the Fire Tower it is northeast, near Rainy and Pine lakes it is north, and on Devlin lake northwest. The tops of the flows throughout this area face toward the sediments, i.e., to the southeast and east.

From the attitude of the flows and the trace of the line of contact between flows and sediments, the major structure of the greenstone belt may be considered as a broad anticline plunging at an extremely steep angle to the southeast. This structure, however, is in part the result of later deformation. Throughout the greenstone belt and the adjoining sediments two distinct sets of drag-folds are present. One set plunges at gentle angles rarely exceeding 30 degrees. Determinations of the top of beds and flows from this set of drag-folds check with determinations of the tops made by gradation in size of grain in beds in the sediments, and by internal structures in the lava flows. The second set of drag-folds plunges at extremely steep to vertical angles. Determinations of the tops of flows and sediments by this set of drags do not agree with determinations of the tops by the gently plunging drags and other methods. Evidently the gently plunging drag-folds are the true secondary folds formed by differential movement between beds or flows during the initial longitudinal folding of the rocks along an east-west axis. The steeply plunging drag-folds were formed later by stresses that bore no relation to those responsible for the earlier longitudinal east-west folding.

Thus the earlier structure may be considered as a monocline striking east and dipping steeply to the south; it was similar to the present structure of the Gaboury-Blondeau greenstone belt. The gently plunging drags are directly related to this structure. The present apparent anticlinal structure plunging steeply to the southeast is due to the change in strike

of flows and sediments from east to north and northwest. The change in strike was a later development probably caused by the thrusting action of the invading granite. The steep to vertically plunging drag-folds were formed as a result of the deformation at this time; they bear no relation to the earlier longitudinal folding.

The Keewatin sediments and paragneisses to the south and east of the greenstone belts are in the form of a series of closely spaced folds that are, in many places, overturned to the north and northwest. The character of the folding within the sediments is thus in contrast with that within the greenstone. The massive, more competent flow rocks acted more or less as a unit, whereas the sediments crumpled into closely spaced, and in places overturned, folds.

BASIC INTRUSIVES

Small bodies of quartz diorite, diorite, and gabbro intrude the Keewatin volcanic flows throughout the area. It is unlikely that all are of the same age, but all of them are older than the granitic intrusives. There is some tendency for these intrusives to form sills in the flows, but many of the bodies are very irregular in outline. Due to the high degree of alteration no determinations of the composition of the feldspars were possible in the thin sections that were examined; it is believed that the majority of the intrusives are diorites, but some are undoubtedly gabbros.

A large mass of basic intrusive rock south of lake Girard varies in composition from diorite to peridotite. The peridotite has in part been altered to serpentine. Several small bodies of rock that is entirely altered to serpentine occur in the Keewatin greenstone near McKenzie lake in Gaboury township, in range VII, Laverlochère, and in a few other isolated localities in Ville-Marie area. These rocks were originally pyroxenites or peridotites which have undergone complete serpentinization.

Quartz Diorite, Diorite, and Gabbro. Small bodies of diorite are numerous throughout the Keewatin volcanics of Gaboury and Blondeau townships. They vary considerably in appearance and in composition, but are commonly dark green, fine- to medium-grained rocks. The finer grained phases are extremely difficult to distinguish from the coarse lava flows. The weathered surface of the diorites is dark green, which serves to distinguish them from the later diabase which weathers a rusty brown. The diorites are everywhere greatly altered; as a consequence the minerals have a dull, waxy appearance.

Originally the diorites consisted of about equal proportions of hornblende and feldspar. The feldspar is now completely altered to zoisite, epidote, and mica. Leucoxene is abundant as an alteration product about grains of ilmenite or titaniferous magnetite. The hornblende is altered to chlorite and uralite, but on the whole is comparatively fresh. Small grains of quartz and secondary plagioclase are present in many of the thin sections. Some of this quartz has formed from the breaking down of the original basic plagioclase, but where much of it is present it is in part an original constituent of the rock.

Many, small, sill-like bodies of a light grey to green quartz diorite containing blue blebs of quartz, intrude the Keewatin south and east of Guillet lake. The quartz diorite was observed to grade into the normal diorite in several trenches. Under the microscope the quartz diorite is seen to be composed of approximately 70 per cent highly altered acid plagioclase, 20 per cent chlorite, and 10 per cent quartz. The quartz is present as a well-developed micropegmatitic intergrowth with the feldspar.

Serpentine. Small, irregular bodies of serpentine with intrusive relations to the Keewatin outcrop on the shores and to the east of McKenzie lake, and in range VII, Laverlochère township. The serpentine commonly weathers a reddish brown, but may weather a light grey to white. Weathering along intersecting sets of closely spaced joints occasionally gives the surface a checkered appearance, but normally it is smooth with a peculiar soapy feel. Close examination of the clean, weathered surface sometimes reveals the presence of the serpentinized remains or "ghosts" of pyroxene crystals ¼ inch to ⅛ inch in length. The pyroxene "ghosts" are particularly well preserved in the serpentine body on lots 18 and 19, range VII, Laverlochère, 2½ miles north of Lorrainville.

On fresh fracture the rock is fine-grained, massive, and dark green to black. Minute veinlets of cross-fibre chrysotile asbestos may commonly be seen cutting the massive serpentine.

Microscopic examination shows the rock to be composed of a mesh or mat of serpentine fibres, together with some magnetite and carbonate. The study of thin sections affords no clue as to the primary minerals of the rock. Even the "ghosts" of pyroxene crystals visible on the weathered surface cannot be recognized as such under the microscope.

An incompletely serpentinized peridotite outcrops one mile south of Girard lake on the west shore of the river. The peridotite is a basic phase of the gabbro and diorite which makes up the greater part of the basic intrusive body; it grades into the normal gabbro and diorite to the north along the shore of the river.

The rock is medium to coarse grained and weathers a rusty brown to black. Under the microscope it is seen to consist mainly of serpentine with some magnetite and carbonate, but the cores of olivine and pyroxene crystals which have escaped complete alteration to serpentine may be distinguished.

The association of the serpentinized peridotite with the diorite and gabbro south of Girard lake and the presence of "ghosts" of pyroxene crystals in the entirely serpentinized material at another locality suggest that the serpentine masses are ultrabasic phases of the gabbro and diorite which were serpentinized after emplacement.

ACIDIC INTRUSIVES

Albite and Quartz-albite Porphyries. Two irregular masses of albite-quartz porphyry intrude the pre-Huronian sediments to the east of the north arm of Soufflot lake. The rock is variable in composition and texture. The typical porphyry is a light grey to white weathering rock composed of closely packed, blocky phenocrysts of white albite and quartz

up to ½ inch in size in a fine-grained, dark grey groundmass. The quartz phenocrysts are entirely lacking in some phases of the porphyry. Locally, where the groundmass is coarser than average, the rock has an almost granitoid texture.

In thin section the abundant idiomorphic feldspar and quartz phenocrysts lie in a fine-grained groundmass of feldspar, quartz, and biotite mica. Small grains of epidote with some zoisite are plentiful throughout the groundmass. The feldspar phenocrysts are albite (Ab_{90-95}); no potash feldspar was recognized in the thin sections examined.

Narrow dykes of feldspar porphyry are very abundant throughout the Gaboury-Blondeau greenstone belt, particularly in the vicinity of McKenzie lake. The majority of the dykes are 10 feet or less in width, although an oval, stock-like mass of the porphyry ¼ mile in diameter is exposed southwest of McKenzie lake. The strike of the dykes is extremely variable and appears to have little or no relation to the strike of the Keewatin flows.

The dykes weather a light pinkish grey and are composed of light grey to white phenocrysts of feldspar that range from $\frac{1}{16}$ to ¼ inch in size in a dark grey, fine-grained groundmass. In thin section under the microscope the feldspar phenocrysts occur enclosed in a fine-grained groundmass of quartz, feldspar, biotite, and muscovite. The feldspar phenocrysts are mainly albite (Ab_{90}), but a few small phenocrysts of microcline are also present. The feldspars are considerably altered to sericite; small grains of secondary carbonate are plentiful, with minor amounts of chlorite, epidote, and zoisite. A few of the dykes contain quartz phenocrysts.

The albite-quartz porphyry north of Soufflot lake is younger than the pre-Huronian sediments which it intrudes. No crosscutting relations between the porphyry and the granite were observed, but the greater metamorphism of the porphyry suggests that it is the older rock.

The feldspar porphyry dykes, which are abundant in Gaboury and Blondeau townships, are somewhat similar to the feldspar and feldspar-quartz porphyries in the vicinity of Soufflot lake and may be of the same age. However, the absence of feldspar porphyry dykes in the sediments in Gaboury and Blondeau townships, in spite of their abundance in the greenstones immediately to the north, suggests that they may have been intruded before the period of sedimentation commenced.

A few small dykes of quartz porphyry cut the basic volcanics near and to the south of Guillet lake. The similarity of the porphyry dykes to the porphyritic rhyolite northwest of Caribou lake suggests that they are related to it; some of them, however, may be related to the granitic intrusives.

Granite, Granodiorite, and Allied Rocks. Granitic rocks underlie a large part of the area. They vary considerably in composition and appearance, but in general are light grey to pink, medium- to coarse-grained rocks containing 15 per cent or more quartz. So far as is known they are all of pre-Huronian age.

The granite outcropping along the shore of lake Timiskaming at points where the cover of pre-Huronian sediments has been removed by erosion is a coarse-grained, equigranular, deep flesh-red, biotite-microcline

granite. The predominant feldspar is microcline with a subordinate amount of acid oligoclase. The feldspars are stained with iron oxide, which is probably responsible for the deep red colour of the rock. The small amount of biotite present is considerably altered to chlorite.

The large mass of granite that extends easterly from range IV, Duhamel, through northern Laverlochère, Latulipe, and northern Blondeau to Devlin township is for the most part a light grey to pale pink, medium- to coarse-grained rock. Only five thin sections of the granite underlying this large area were examined, but in all of them the predominant feldspar is oligoclase; potash feldspar is either absent or if present makes up not more than 10 per cent of the total feldspar in the rock. It is unwise to generalize as to the composition as a whole from the few thin sections examined, but evidently a large proportion of the granite is highly sodic. The quartz content is generally high, averaging between 20 and 30 per cent of the rock; biotite is the usual ferromagnesian mineral, although hornblende is not uncommon. The feldspars show some sericitic alteration and the biotite and hornblende are commonly altered to chlorite.

The granite underlying the eastern part of Fabre township and ranges III, IV, and V, of southern Laverlochère, is a light grey to pink, medium- to coarse-grained, highly sodic granite similar to the granite to the north.

The granite outcropping in Laperrière and the south parts of ranges IV, V, and VI, of Laverlochère, south of the Cobalt conglomerate, is of a different character. It is a medium- to rather fine-grained, brick-red, sugary rock. In thin section the predominating feldspar is microcline with subordinate amounts of acid oligoclase. The content of biotite and hornblende is variable even in the same outcrop; pegmatite dykes are abundant. It grades into the paragneisses to the east.

The granite intruding the sediments and paragneisses of Gaboury, Blondeau, and Guillet townships is variable in appearance and composition. The common type is a pink to red, medium- to rather fine-grained rock, high in quartz and accompanied by a large number of pegmatite and aplite dykes. In the thin sections that were examined potash feldspar, usually microcline, is the predominant mineral.

The Soufflot Lake granite mass is a pink to red, medium-grained, hornblende-biotite granite. Microcline and oligoclase are present in about equal proportions; quartz makes up about 20 to 23 per cent of the rock. Unlike the granites to the south and southwest it is not accompanied by much pegmatitic material.

The small oval boss or stock in the greenstone to the west of Soufflot lake is similar in appearance to the Soufflot Lake granite, but contains less microcline and quartz and approaches a granodiorite in composition.

Hybrid Granites. Large areas in southern Guillet township are occupied by intimate mixtures of granite, pegmatite, and paragneiss. The typical rock is a pink to grey, somewhat gneissose granite containing bands or schlieren of darker coloured, finer grained biotite or hornblende gneiss. Many dykes and sills of pegmatite are associated with this type of hybrid rock. All areas of rock containing less than 50 per cent of granitic material have been mapped with the paragneiss.

Hybrid granites of a different character are developed locally along the contacts of the greenstone and granite in the northern part of the area. Here little or no pegmatitic material is present and there is no tendency for gneisses to develop. Near the contact the granite becomes low in quartz, high in hornblende, and approaches the composition of a hornblende syenite or diorite. The presence of inclusions of greenstone in these basic border phases of the granite leaves little doubt that assimilation of the greenstone by the stoping action of the granite magma is responsible for the development of this rock.

Hybrid granites of this character, unlike the granite-gneisses to the south, are confined to narrow contact zones usually less than ¼ mile in width. They are developed at many places along the northern greenstone-granite contact in Gaboury, Blondeau, and Guillet townships. Abnormally wide zones of these rocks occur along the contact north of Kelly lake, west of Devlin lake, and at the ends of projections or tongues, and around small roof pendants of greenstone, in the granite of Baby and Latulipe townships.

Lamprophyres. Black biotite lamprophyre dykes cut the greenstones throughout the area. They are particularly abundant in the greenstone between Guillet and Thibault lakes. Many miles of trenching has been done on this ground and practically every trench of any length has one or more lamprophyre dykes exposed in it. Most of them are small and very irregular, but widths up to 70 feet were observed in some of the trenches.

The common variety is a dark green to black weathering rock characterized by hexagonal plates of biotite mica in a fine-grained, dark groundmass. This type is commonly well mineralized with pyrite. Dykes of a green hornblende and chlorite-rich variety cut the granite near the road between ranges VIII N and IX N, Fabre township.

HURONIAN

The Huronian sediments include the Gowganda and Lorrain formations. The Gowganda consists mainly of boulder conglomerate with interbedded greywacke and arkose; it rests unconformably on the pre-Huronian basement. The Lorrain is a pure, homogeneous, thickly bedded quartzite which was deposited on the conglomerate and, in places, directly on the pre-Huronian basement. Both formations are flat lying and relatively unmetamorphosed.

The Huronian rocks are confined to Ville-Marie area. They outcrop as prominent, hilly, upland areas which rise from the clay flats to heights of 250 feet or more. The pre-Huronian granite and Keewatin of the basement are exposed in many places around the base of the upland areas of Huronian sediments and in the lower lying ground between them.

GOWGANDA FORMATION

The Gowganda formation is a very variable and confused succession of boulder conglomerates, greywacke, impure quartzite and arkose, and fine-grained, dark grey to green argillite or greywacke. The conglomerate, which is by far the most abundant rock type, is very diverse in character

both as regards its included fragments and the matrix enclosing them. The matrix is generally a fine-grained, dark green to grey, argillaceous or slaty material which when examined microscopically is found to consist of small, angular fragments of fresh feldspar and quartz in a fine groundmass of chlorite and sericite. In many localities, however, the matrix is coarser and arkosic in composition. Conglomerate resting on or near areas of granite commonly has a more arkosic matrix than the matrix of conglomerate resting on areas of Keewatin greenstone. There are, however, exceptions to this generalization.

The pebbles and boulders of the conglomerate include examples of all the rocks of the pre-Huronian basement. In general, granite fragments predominate, but greenstones, porphyries, diorites, and vein quartz are all abundant. The size varies from small pebbles to boulders 2 to 3 feet in diameter even in the same outcrop. Bedding is rare. When it does occur it is usually in conglomerate with an arkosic matrix. In most of the conglomerate the pebbles are closely packed, but all the gradations occur between the closely packed variety and slaty argillite or greywacke which contains only occasional scattered pebbles.

At contacts with the pre-Huronian basement the character of the fragments is that of the rock lying immediately beneath and the conglomerate directly above such a contact is a closely packed breccia of angular fragments of the underlying rock. The change from angular breccia to normal conglomerate takes place within a few feet of the basement, and 25 to 30 feet above the contact the fragments are rounded and no longer preponderantly of the same type as the underlying rock.

The slate-like greywacke, although subordinate in quantity to the conglomerate, is an important member of the formation. It is a very fine-grained rock, dark green to grey, and weathers grey to reddish brown. Bedding is rare and in this respect it differs from the slaty greywacke of Cobalt district to the west which is commonly delicately banded. Microscopic examination shows it to be composed of fresh, angular fragments of quartz and feldspar in a fine groundmass of chlorite and sericite. The rock is very similar to the slaty greywacke matrix of the conglomerate.

A more or less regular succession in the Cobalt conglomerate has been recognized in many districts in Ontario. In Cobalt and adjoining districts the base of the formation is conglomerate that grades into slaty greywacke, which in turn is overlain by an upper conglomerate.[1] In Ville-Marie area the same rock types are present, but their distribution throughout the formation is extremely irregular. The slaty greywacke occurs at different horizons in nearby sections and in many places is altogether absent. No generalization can, therefore, be made as to the order of deposition of the different types of sediment.

The two highest hills of conglomerate within the area attain elevations of 350 feet above the level of lake Timiskaming. Since the conglomerate also outcrops on the shore of the lake it must, therefore, have been deposited over a vertical range of at least 350 feet.

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[1] Ont. Bureau of Mines, vol. XIX, pt. 2, p. 76.

LORRAIN FORMATION

The Lorrain quartzite forms the majority of the outcrops in the townships adjoining the east side of lake Timiskaming. It is resistant to weathering and forms high, flat-topped hills which rise precipitously from the clay flats. The quartzite rests on the Cobalt conglomerate and, in places, directly on the pre-Huronian basement.

By far the greater part of the quartzite is a remarkably homogeneous, thickly bedded, yellowish green rock of fine to medium grain. Microscopic examination shows it to be composed of angular to subangular fragments of quartz in a fine sericite matrix. The sericite matrix makes up such a large proportion of the rock that the majority of quartz grains are embedded in the matrix and are not in actual contact with each other. Near the base, where resting directly on the pre-Huronian granite, the quartzite contains a large proportion of altered feldspar grains. The composition rapidly changes, however, to the normal quartzite within 20 to 30 feet of the contact. Similarly the quartzite resting on the cobalt conglomerate is commonly contaminated and impure for a short distance above the contact. Apart from the basal beds a remarkable feature of the quartzite is the total absence of feldspar grains in all the thin sections examined by the writer.

In some localities, particularly along the shores of lake Timiskaming north of Ville-Marie and on Bryson island, the quartzite contains beds of well-rounded pebbles of white and pink, cherty quartz up to 1 inch in diameter. These bands or beds are seldom more than 18 inches in thickness and occur interbedded with the normal, yellowish green, thickly bedded quartzite.

RELATIONS OF THE GOWGANDA AND LORRAIN FORMATIONS TO THE PRE-HURONIAN EROSION SURFACE

In Ville-Marie area the Gowganda rests on a relatively clean, unweathered, pre-Huronian surface. The contact is sharp and there is no evidence of the existence of a covering of residual soil on the old erosion surface. The Lorrain quartzite, on the other hand, where in direct contact with the basement rests on a mantle of decomposed, deeply decayed bedrock regolith such as is found at the present time in unglaciated regions of the earth.

Accessible exposures of the contact between Gowganda conglomerate and Keewatin may be seen on the shore of lake Timiskaming, lot 57, range I, Fabre township, and on the island in the lake one mile to the east. At the first locality the conglomerate rests on steeply inclined dacite flows and an interbedded, cherty sediment. The line of contact is sharp, rising from the shore of the lake in a gentle arc with few irregularities, to a height of 80 feet above the water's edge. The conglomerate at the contact is a breccia composed entirely of large, angular fragments of the underlying dacite in a fine-grained, dark green, greywacke matrix. A gradual change takes place in the conglomerate above the contact and within 25 feet the conglomerate is of the normal type, consisting of a great variety of well-rounded fragments of dacite, greenstone, and porphyry in a dark

green, greywacke matrix. The contact exposed on the island to the west is similar except that here the conglomerate or breccia rests on a more uneven surface of Keewatin dacite flows.

Excellent exposures of the contact between Gowganda conglomerate and granite occur in the middle of lot 8, range IX N,[1] and on lots 13 and 15, range VIII N, of Fabre. At the first locality the conglomerate is in contact with a granite knob north of a small creek. The conglomerate is composed of a variety of fragments in a fine-grained greywacke matrix with angular granite fragments predominating near the actual contact. The conglomerate rests directly on the granite, the contact is sharp, and no arkose or decomposed granite is present. In lots 13 and 15, range VIII N,[2] the conglomerate at the contact with the granite is a breccia of angular granite fragments in a very fine matrix of slaty greywacke. On lot 15 north of the schoolhouse jagged blocks of granite 2 feet or more in size rest on the solid granite floor with the fine-grained, slaty greywacke filling the cracks between them. Many other contacts between the granite and conglomerate were observed in the area; in every case the conglomerate rests on a fresh, undecayed pre-Huronian surface.

Contacts between the pre-Huronian granite and the overlying Lorrain quartzite show entirely different relations. Actual contacts between the quartzite and granite are well exposed on lot 18, range II, and in the northern part of range IX, Duhamel township. In these localities there is a transitional relationship from granite through decomposed granite to arkose and quartzite. This relation was observed by A. E. Barlow at the first locality on the shore of lake Timiskaming.[3] His description of the various stages in the degradation of the granite and the gradual passage from decomposed granite to arkose and quartzite is in part as follows:[4]

" . . . it is clear that the quartzite originally transgressed upon the surface of the granite almost horizontally. The granite has been unequally eroded so that the present line of contact between the two rocks is undulating and irregular. . . . there is a gradual passage upward and outward from the main granite mass to the overlying arkose. Macroscopically this passage consists in a gradual loss of the red coloration of the unaltered granite and the progressive appearance in its arkose of a yellowish green hue, although along the visible contact there is no visible change in the position of the constituent minerals."

After describing the character of the unaltered granite in considerable detail Barlow continues with a description of the various stages of the degradation of the granite as seen in a series of thin sections. The first step shows the incipient sericitization of the feldspars and the alteration of biotite to chlorite. "This is closely followed, making what might be called the third step in the transition, by an appreciable advance in the alteration of the feldspar, especially of the plagioclase which becomes traversed with a series of cracks filled with sericite, the alteration extending outward into the main mass of the individual grains; but there is still no evidence of motion or shoving apart of the grains.

[1] One mile east of the Canadian Pacific railway.
[2] One mile north of rivière L'Africain.
[3] One-quarter mile east of Chabot point.
[4] Geol. Surv., Canada, Ann. Rept., vol. X, pp. 195-200.

"A fourth and somewhat sudden advance appears when the alteration of the feldspars has proceeded to an extreme degree while certain fragments have been shoved apart. Each individual grain still occupies the same relative position with regard to the other mineral constituents, but in places portions of the quartz and feldspar, especially the former, can be noticed to have changed their position along certain cracks traversing the grains, the portions, however, being never widely separated. . . . The microcline and orthoclase, though badly decomposed, have not undergone such complete alteration as the plagioclase. The fifth stage is reached when both orthoclase and microcline have undergone somewhat complete decomposition, some of the individuals being now represented by an intricate mass of their alteration products . . . . The sixth and final stage in the process shows that the feldspars have almost entirely disappeared, although occasionally irregular cores of the unaltered mineral remain. The groundmass is now seen to consist of a fine-grained, sericite material in which are embedded sharply angular or sub-angular fragments with very pronounced undulous extinction. The whole appearance of the rock both in hand specimen and under the microscope is that of a typical clastic (arkose)."

The transition from granite to arkose so well described above takes place over a vertical distance of a little more than 3 feet. A similar transitional contact between granite and quartzite was observed at the base of the large quartzite outcrop 10 chains north of the baie des Pères; the transitional zone of decomposed granite is here 20 to 25 feet in thickness. Wilson describes a contact in the northern part of range IV, Duhamel, where the "degradation of the granite surface is shown over a section 200 feet in thickness consisting of boulders and fragments of granite enclosed in an arkose matrix. . . . the line of junction cannot be fixed within a wide latitude[1]."

RELATION OF THE LORRAIN TO THE GOWGANDA

As the Lorrain was deposited after the Gowganda and both formations are practically flat lying, the quartzite would normally be expected to outcrop at higher elevations than the conglomerate. Such, however, is not the case. Many of the highest hills in the area are composed entirely of Gowganda conglomerate, whereas neighbouring outcrops several hundred feet below the tops of the conglomerate hills are composed of Lorrain quartzite. For example, in lots 15 and 16, range VI, Duhamel tp.,[2] a ridge-like hill of conglomerate rises to a height of about 250 feet above the clay flats. Three hundred feet to the southeast and separated from the conglomerate by a deep valley is an equally high hill composed entirely of Lorrain quartzite. Similarly, in lot 1, range IV, Duhamel tp.,[3] the conglomerate rests as a cap on Keewatin greenstone forming a hill more than 300 feet in height. Less than one mile to the west and also to the north are equally high hills composed entirely of quartzite. Many other localities were observed where hills of conglomerate are surrounded at lower elevations

[1] Geol. Surv., Canada, Pub. 106A, p. 26 (1910).
[2] One and one-quarter miles west of Gaboury village.
[3] One mile southwest of Miron.

by quartzite. Evidently the quartzite was deposited on a surface consisting of hills and ridges of conglomerate and pre-Huronian rocks which reached elevations of 300 feet or more. The quartzite first filled deeply trenched valleys before finally covering the higher ridges and hills of conglomerate.

Actual contacts between the conglomerate and quartzite may be observed on the point to the south of Joanne bay and on lots 16[1], 26, and 27[2], range V, Duhamel tp. On the point south of Joanne bay pure quartzite rests directly on greywacke conglomerate. In the section exposed along the shore of the lake the conglomerate rises as a mound or hill to a height of 50 feet or more above the lake. The overlying quartzite is in direct contact with the conglomerate hill and partly covers it; the bedding of the quartzite conforms with the outline of the conglomerate hill. In range V, Duhamel township, the conglomerate is also overlain by quartzite, but the contact is more gradational in character. The basal beds of quartzite are contaminated with material of the underlying greywacke conglomerate; they approach a greywacke or arkose in composition and contain interbedded bands of conglomerate from a few inches to one foot in thickness. The bedding of the quartzite conforms with the conglomerate.

In 1905 Miller and Knight divided the Huronian of Cobalt district into a lower series of boulder conglomerate and greywacke and an upper Lorrain series of quartzite, on the basis of an unconformity found at the base of the quartzite[3]. Subsequent field work in the Cobalt and neighbouring districts leads to the belief that the unconformity is local and that the Gowganda and Lorrain are, in general, conformable, with no interval of erosion separating them. Evidence obtained during the mapping of Ville-Marie area establishes fairly conclusively that a period of erosion of considerable length did precede the deposition of the Lorrain quartzite and that, therefore, an unconformity of some importance does exist between the two formations. The evidence favouring the existence of an erosional unconformity between the Gowganda and the Lorrain is as follows.

The conglomerate rests on a fresh, undecayed pre-Huronian erosion surface. The quartzite, on the other hand, where in contact with the basement, rests on a mantle of decomposed rock. The decomposition of the pre-Huronian surface occurred either before or after the deposition of the conglomerate. If it occurred before the conglomerate was deposited one would expect to find not only the quartzite but also the conglomerate resting in places on a decomposed surface. Since the conglomerate rests on an unweathered, fresh surface the weathering and decomposition of the pre-Huronian surface probably occurred at some time subsequent to the deposition of the conglomerate. Moreover, the formation deposited on a regolith of decomposed rock material would be derived in part from that material and would possess the characteristics of a sediment derived from such a terrain. The Gowganda conglomerate is a detrital sediment, derived from mechanically disintegrated rock material and possesses none of the characteristics of a sediment derived from chemically decomposed material. The Lorrain quartzite, on the other hand, consists of quartz grains in a

[1] Lot 16 (1½ miles west of Gaboury village).
[2] Lots 26 and 27 (1 mile southeast of Dumais lake).
[3] Ont. Bureau of Mines, vol. XIX, pt. 2, p. 75 (1913).

matrix of secondary minerals; it is the type of sediment that could normally be derived from a regolith of chemically decomposed rock. The formation deposited directly on the regolith of decayed rock was, therefore, probably the Lorrain quartzite rather than the Gowganda conglomerate; that is the conglomerate was deposited before the rotting of the pre-Huronian surface occurred.

The sudden change in the character of the sedimentation from a confused succession of boulder conglomerate, greywacke, and arkose to a pure and well-bedded quartzite suggests a great change in the conditions of deposition and of the source of material. An interval of considerable duration between the deposition of the conglomerate and quartzite would account for the contrasting character of the sedimentation.

As already described, the Gowganda prior to the deposition of the Lorrain quartzite did not form an evenly distributed mantle of material on the pre-Huronian surface. It was present as erratically distributed hill or ridge-like deposits which reached elevations of more than 200 feet. This peculiar distribution may be accounted for in two ways. (1) The original mantle of conglomerate was dissected and in part removed during a period of erosion prior to the deposition of the Lorrain quartzite. In this manner hill and ridge-like masses of conglomerate would be left with the pre-Huronian basement exposed in the deeply trenched valleys. (2) The alternative is that the conglomerate was originally deposited as these hill or ridge-like masses. Deposits laid down by torrential streams would be as erratic in distribution. They would not, however, be deposited as a capping on the higher elevations of the pre-Huronian surface, nor would they be likely to be deposited as hills equal in elevation to the highest hills on the old pre-Huronian surface. Glacial morainal deposits laid down at or near the edge of a continental ice-sheet are similar in form to the deposits of Gowganda conglomerate in Ville-Marie area. As many authorities believe the Gowganda conglomerate to be of glacial origin this explanation of the form of the deposits is well worthy of consideration. However, even if the peculiar form and distribution of the deposits of Gowganda conglomerate are original characteristics and are not the result of dissection, other lines of evidence already presented are sufficient in themselves to indicate the presence of an erosional unconformity of some importance between the Gowganda and the Lorrain quartzite.

The presence of an unconformity between the Gowganda and the Lorrain in Ville-Marie area does not necessarily imply that this unconformity exists throughout the Huronian of Ontario. The Gowganda formation north of lake Huron is lithologically similar to Cobalt conglomerate of Cobalt district and has been correlated with it.[1]

In Ville-Marie area the maximum thickness of the Gowganda is not more than 400 feet. Yet the Gowganda formation of the north shore of lake Huron with which the Cobalt conglomerate is correlated has a thickness of 2,500 to 3,500 feet. Possibly the development in Ville-Marie area is only a part of the Gowganda formation and, considering its character, it is most probably the basal part. The upper 1,000 to 2,000 feet were either never deposited in this area, or if deposited were removed during a period

[1] North Shore of Lake Huron; Geol. Surv., Canada, Mem. 143, p. 63.

of erosion prior to the deposition of the Lorrain quartzite. While the upper part of the Gowganda was being deposited north of lake Huron denudation was probably proceeding in Ville-Marie area. This was followed by the shallow submergence of the whole region and the deposition of the Lorrain quartzite. The quartzite would thus be deposited with conformable relations to the Gowganda formation north of lake Huron, but with unconformable relations to the conglomerate of Ville-Marie area.

DIABASE DYKES

Many small dykes of diabase cut the granite and older rocks throughout Ville-Marie area. The great majority are narrow and cannot be traced any distance along their strike; widths of more than 50 feet are rare, although one dyke-like mass northeast of Otter lake is at least 600 feet in width. The number of dykes decreases to the east; in fact only one diabase dyke was observed in Guillet Lake area. A remarkable feature of the dykes is the consistency of their strike which lies within the narrow limits of north 5 degrees to 25 degrees east.

The contact of the diabase dykes with the adjoining rocks is always sharp and well defined with the dyke at the margin chilled to a dense, black, fine-grained rock. The chilled margin within a few inches from the contact passes into a coarsely crystalline phase in which the crystals of augite and plagioclase may be distinguished. The grain size is variable, depending on the width of the dyke. Some of the smaller dykes a foot or less in width are dense black trap rocks across their entire width; in the larger dykes the lath-like feldspar crystals attain lengths of $\frac{1}{4}$ inch or more.

The weathered surface is always a rusty reddish brown. On fresh fracture the rock is a mottled grey and black and the typical ophitic texture is generally apparent. Microscopic examination shows the rock to be composed of about equal proportions of plagioclase feldspar and augite with a few shreds of brown biotite mica. The augite is somewhat altered to green amphibole and chlorite. The plagioclase, which is usually a fresh labradorite (Ab_{30-40}), occurs as lath-shaped crystals with ophitic relationships to the augite. A small amount of quartz is present as a micrographic intergrowth with feldspar, filling the interstices between the larger grains. Magnetite, apatite, epidote, and zoisite are the accessory minerals.

The diabase cuts the volcanics, the pre-Huronian sediments, and the granite, but no dykes were found cutting the Huronian sediments. It is not definitely known, therefore, whether the diabase is pre- or post-Huronian in age. The similarity of the rock to the post-Huronian dykes of Cobalt district suggests that it is of the same age.

ORDOVICIAN

Sandstones and conglomerates of Ordovician age occur as scattered outcrops along the shore of lake Timiskaming and as isolated outcrops inland to the east of the lake. G. S. Hume has called the Ordovician rocks in this vicinity the Liskeard formation and correlates them with the Trenton of other districts[1].

[1] Hume, G. S.: Geol. Surv., Canada, Mem. 145 (1925).

The conglomerate consists of pebbles and boulders of the Precambrian Lorrain quartzite, on which it rests. The matrix is a sandstone composed of angular to subangular grains of quartz and in places contains a little limy material. The conglomerate grades upwards, within a few feet, into a finer grained sandstone composed of angular to subangular grains of quartz derived from the underlying Lorrain quartzite. A little limy material is present in many places cementing the grains together, but most of the sandstone near the base is very pure.

Two thin beds near the top of the outcrop of sandstone in the eastern end of lot 19, range II, Guigues tp., 2 miles west of St. Bruno, are rich in fossil remains. Alice E. Wilson has examined specimens of the fossils collected by the writer and her report on them is as follows.

"There are fragments of two types of cephalopods present.

"One of them, very poorly preserved, is 16 inches long. It has broad, shallow constrictions about $\frac{1}{8}$ to $\frac{3}{16}$ inch in width, placed from one to one and a quarter inches apart. All structure is lost. Its general appearance is different in some proportions but is suggestive of the siphuncle of a *Narthecoceras*. But it is too poor to compare definitely with that genus.

"The other form is definitely new. It belongs to the group of cephalopods having a highly developed siphuncle with endocones. This group has generally appeared in Ordovician rocks. In a study of the growth of cephalopods Neaverson states that the acme of siphuncular development is in the Ordovician.

"The specimens occur near Ville-Marie, Quebec, in a coarse sandstone matrix with many included quartz pebbles. The two cephalopods present cannot be correlated directly with known forms but from the above remarks it will be seen that they are rather suggestive of late Ordovician types."

CHAPTER IV

ECONOMIC GEOLOGY

GOLD

The western, or Ville-Marie area, adjoining lake Timiskaming, has been prospected intermittently for silver and gold since the discovery of the rich silver veins near Cobalt in 1905. The silver veins of Cobalt district are genetically related to diabase sills and dykes. The absence of similar diabase intrusives of large dimensions makes it unlikely that silver deposits of importance will be found in Ville-Marie area. The areas underlain by the Keewatin volcanic rocks and pre-Huronian sediments are of more economic interest. They are similar in character to the Keewatin and early Precambrian sediments of other parts of the Canadian Shield in which the majority of the gold and copper deposits of Canada occur. In Ville-Marie area much of the Keewatin is covered by the Huronian sediments, but a number of small areas are exposed where the Huronian formations have been removed by erosion. Gold deposits have been found in several of these areas.

In the eastern or Guillet Lake area the Gaboury-Blondeau and Guillet belts of Keewatin greenstones are bounded on the north by granite and on the south by pre-Huronian sediments and gneisses. Many mineralized veins of quartz occur in the Gaboury-Blondeau greenstone and the majority of the bands of tuff and iron formation are mineralized with iron and copper sulphides. Although the assays reported are low, the presence of at least some gold in many of the veins, mineralized tuffs, and iron formation is encouraging.

Several promising gold-bearing veins have been found to occur in the belt of Keewatin greenstone in Guillet township. On the property controlled by McIntyre Porcupine Mines, Limited, north of Guillet lake, sufficient ore has been indicated to justify the erection of a 100-ton mill. The majority of the gold-bearing quartz veins within this area are closely associated with bands of cherty, volcanic tuffs within an area in which the Keewatin greenstones are cut by many dykes and small, irregular bodies of diorite, feldspar porphyries, and lamprophyres. The banded tuffs are hard, brittle rocks lying between thick, volcanic flows. They seem to have fractured more readily than did the greenstone during the period of folding and thus localized channel-ways for the vein-forming solutions. The vein quartz deposited by these solutions fills fractures in, and replaces, the tuffs. The gold is apparently confined to the quartz, for, although the tuffs are generally well mineralized with sulphides, no assays greater than a few cents a ton have been reported from them. Of equal importance are deformed, sheared, and drag-folded zones in the greenstone which, like the tuffs, afforded channel-ways for the vein-forming solutions. In this type the greenstone schist has been injected and replaced by discontinuous lenses and stringers of gold-bearing quartz.

Pyrite, chalcopyrite, and pyrrhotite are the common sulphide minerals in vein and wall-rock, but seem to bear little relation to the gold content. Sphalerite and galena, on the other hand, are closely associated with the gold, although this is not an invariable rule.

All the gold deposits that have been found to date are in the Keewatin volcanic rocks and they are probably the most favourable in which to continue the search. However, the overlying pre-Huronian sediments should not be neglected, particularly along and near the contact with the Keewatin greenstones and rhyolites in Guillet township. Sediments that have been changed to gneisses by the injection of much pegmatite and granitic material are not favourable rocks in which to prospect.

Description of Mineral-Bearing Prospects and Properties

GUILLET TOWNSHIP

Only a cursory examination of the mining properties within Guillet township was made by the writer. The properties briefly described include only a few of those within the township on which a considerable amount of development work has been done. For a more complete description the reader is referred to the report by B. T. Denis of the Quebec Bureau of Mines who in 1935 made a detailed examination of the properties within the township.

The greatest amount of development work has been done on the ground controlled by McIntyre Porcupine Mines, Limited, between Thibault and Guillet lakes. The original or No. 1 vein on claim R-20522 occurs in a narrow band of light grey, cherty, siliceous tuff interbedded with andesite flows. The vein quartz that carries the gold fills fractures in, and replaces, the tuff; the vein varies from 1 to 2 feet in width. The band of tuff has been trenched and stripped for a length of 1,000 feet or more; surface sampling indicates a shoot of vein material of ore grade 160 feet in length. The vein quartz is sparingly mineralized with pyrite and some sphalerite and galena. The tuff near the vein is well mineralized with pyrite, but the gold is confined to the vein itself.

The No. 2 vein in the northwest corner of claim R-20520 is in pillowed andesite. The vein pinches and swells from less than a foot to more than 6 feet in width and averages about 3½ feet. The strike of the flows in this vicinity is northeast; the strike of the vein is variable, but tends to cut across the general strike in an east-west direction. The dark blue, cherty vein quartz is sparsely mineralized with pyrite, chalcopyrite, and some sphalerite and galena; the wall-rock, which is a chlorite schist near the contact with the vein, is well mineralized with pyrite, chalcopyrite, and pyrrhotite. The gold is confined to the vein quartz and appears to be closely associated with the sphalerite and galena.

A shaft was sunk on this vein during the latter part of the winter of 1935 and development work on three levels has been in progress since the completion of the shaft in the spring of 1935.

The McDonald, or No. 11, vein in the northeast corner of claim 20433 was discovered in May 1935, and is the largest and richest vein so far

found on the property. It has been stripped for a length of 375 feet to show an average width of 15 feet. Surface sampling indicates an average gold content of between 0·4 and 0·5 ounce a ton.

As exposed on the surface the vein has the form of a large, S-shaped drag-fold with numerous crenulations on the limbs. The general strike is a few degrees south of east, or at an angle to the prevailing strike of the andesite flows, which is north 70 degrees east; the dip of the vein is about 65 degrees south. The vein is composed of pure white, sugary quartz, although in places it has a bluish grey cast. The quartz is mineralized with minute grains of pyrite and chalcopyrite; sphalerite and galena are also present. The gold occurs in a fine, powdery form in the quartz. Throughout the greater part of the vein, the minerals are so sparsely and finely disseminated that it is difficult to see them with the naked eye.

Coniagas Mines have done a considerable amount of surface work on a group of claims controlled by them at the southeast end of Guillet lake. At the main showing near the western boundary of claim 20389 an intensely drag-folded and contorted zone in the greenstone has been stripped and trenched for a length of more than 300 feet and in places is 50 feet or more in width. The greenstone schist has been injected and replaced by discontinuous lenses and stringers of sugary white quartz, which vary in width from very small to 18 inches or more. Both the schist and introduced quartz are mineralized with pyrite, pyrrhotite, and chalcopyrite; sphalerite and possibly galena are also present, but occur only within the quartz. The gold is found in the quartz and apparently is largely confined to it.

Several, narrow, gold-bearing quartz veins were uncovered during the summer on ground under option to Noranda Mines east of the McIntyre holdings. In the main showing the gold-bearing quartz occurs as a series of lenses and stringers in a narrow band of silicified, light grey, cherty tuffs. The bluish quartz is mineralized with fine pyrite, chalcopyrite, sphalerite, and galena. The wall-rock tuffs although well mineralized with pyrite contain only a negligible amount of gold.

A narrow, high-grade gold quartz vein was discovered near the northwest shore of Guillet lake on claims 19877 and 19879 which were under option to Prospector's Airways. The vein is in siliceous, cherty tuff and is similar in mode of occurrence and mineralization to the gold-bearing veins on the McIntyre and Noranda holdings.

Vigorous exploration programs were carried on by many companies in addition to those mentioned above. Several of these companies report the finding of gold in veins during the summer of 1935.

BLONDEAU TOWNSHIP

S. Briens and associates hold a group of twenty claims on the east and west sides of Lett lake. On the west side a band of iron formation 4 to 5 feet in width outcrops about 500 feet from the shore of the lake along the contact between porphyritic rhyolite on the north and andesite on the south. The iron formation strikes north 60 degrees east and dips 85 degrees south; it has been impregnated and replaced by sulphides. In one trench it has been almost completely replaced by massive, fine-grained pyrrhotite and pyrite with some chalcopyrite. Several, small quartz veins

mineralized with pyrite outcrop nearby. The owners report low gold assays were obtained from the mineralized iron formation.

Auguste Lavallée holds a group of claims south of Heart lake. A quartz vein 8 inches in width, mineralized with chalcopyrite and pyrite, outcrops on the south shore of the lake. The vein occurs in andesite, strikes north 70 degrees east, dips steeply to the south, and is exposed over a length of 30 feet. The vein quartz and mineralized wall-rock are reported to give low assays in gold.

A group of claims held by Viateur Bellehumeur lie north of lake Renard. The main showing is about one-half mile north of the most northerly bay of the lake. A good trail leads from the lake to the vein. Two deep trenches 150 feet apart have been cut across a quartz vein in sheared andesite; a width of more than 10 feet of quartz is exposed in both trenches. A small trench midway between the large trenches has exposed two narrow quartz veins separated by sheared andesite. Apparently the vein consists of two large quartz lenses rather than a single vein. The vein and the shear zone on which it occurs strike east and dip 75 degrees south. The white vein-quartz is, in places, well mineralized with coarse pyrite and chalcopyrite. Selected samples of the sulphides are reported to give good assays in gold; channel samples across the vein average $1 a ton or less in gold.

J. B. Boucher and Auguste Lavallée hold a group of claims adjoining the Bellehumeur claims on the north. A white, sugary quartz vein up to 18 inches in width, which occurs in a small diorite sill intruding the andesite flows, has been stripped over a length of 60 feet. The vein strikes north 60 degrees east and dips steeply to the south. It is well mineralized in places with pyrite and chalcopyrite and grab samples are reported to assay more than $4 a ton in gold. A strong east-west shear about 50 feet in width occurs in greenstone and tuffs 100 feet southeast of the vein described above. Quartz stringers in the schist up to 2 inches in width are mineralized with pyrite and chalcopyrite. Good assays in gold are reported to have been obtained from samples of the quartz stringers.

GABOURY TOWNSHIP

Two or more narrow bands of cherty iron formation occur interbedded with andesite flows on the point on the south shore of lac des Bois east of the south arm. In places the iron formation has been impregnated and replaced by pyrrhotite and pyrite and is reported to carry small amounts of gold. A band of volcanic tuff and agglomerate outcrops in the locality about 100 feet south of a small diorite sill. The band, in places, is more than 30 feet in width and is composed of fragments of iron formation and greenstone in a fine-grained, tuffaceous groundmass. The band can be traced by scattered outcrops southwest to the shore of the south arm of Timber lake. The fragmental rock contains many small stringers and lenses of glassy vein quartz that are mineralized with pyrite and pyrrhotite. The amount of mineralization varies along the strike of the band, but for the most part is rather sparse. Messrs. Lavallée and Boucher who hold the claims report assays of 70 cents to $1 a ton in gold from the better mineralized sections.

W. P. McClure holds a group of claims east of rivière des Bois. The main showing is on the south side of the creek draining Lett lake 35 chains east of its juncture with rivière des Bois. The country rock in this vicinity is a highly altered, hybrid granite rich in chlorite and containing many large inclusions of greenstone. A quartz vein occurs in a strong shear in the granite at the base of a 40-foot cliff on the south bank of the stream. The shear zone is approximately 15 feet in width, strikes north 65 degrees east, and dips 55 degrees south; three trenches have been dug across it. In the middle trench the quartz vein is 10 inches in width and occurs in a band of chlorite schist 4 feet wide in the granite. The vein and enclosing schist are sparsely mineralized with pyrite. Another trench 100 feet to the southwest is also in a narrow band of chlorite schist enclosed in granite. The schist contains a few quartz stringers up to 2 inches in width mineralized with pyrite. The third trench 60 feet northeast of the middle trench is in the same shear zone. The country rock to the south of the shear zone at this point is a complex mixture of greenstone inclusions and hybrid dioritic granite cut by dykes of normal granite. The rock of the sheared zone as exposed in this trench is a light-coloured mica schist that was probably an original aplite. Small quartz stringers sparsely mineralized with pyrite occur in the schist.

LAVERLOCHÈRE TOWNSHIP

Aura Mines, Limited, holds a group of claims around Rousselot lake. A considerable amount of trenching and stripping has been done north of the lake on the west half of lots 35 and 36, range V. The southern end of the hill to the northwest of the mine buildings on the shore of the lake is a grey lava or dacite; the northern part of the hill is andesite. Several shear zones in the dacite and andesite have been stripped and trenched. The largest of these, on the top of the hill, in the dacite, has been stripped for a length of 75 feet. The shear zone strikes north-south across the strike of the dacite flows, which is north 60 degrees east in this vicinity. Small stringers of white quartz have been introduced along the sheared and somewhat silicified dacite. The stringers and the schist are sparsely mineralized with chalcopyrite, some pyrite, and a little fine pyrrhotite. A number of shallow trenches have been cut across the shear zone which averages 2 to 3 feet in width. Several other small shear zones in the same outcrop, containing small stringers of quartz mineralized with chalcopyrite and pyrite, have been stripped and trenched. The owners report that the quartz exposed in several of the trenches carries small amounts of gold.

Six hundred feet east of Rousselot lake, in lot 34, range IV, a band of iron formation 3 to 8 feet in width has been stripped for a length of 500 feet. The band occurs in andesite flows, strikes north 55 degrees east, and dips steeply to the south. It contains small stringers or lenses of vein quartz up to 3 inches in width. Both the vein quartz and the iron formation are, in places, well mineralized with pyrite, chalcopyrite, and pyrrhotite. An outcrop of iron formation on the south shore of the lake south of the island is probably a part of the same band. Another band of cherty iron formation outcrops one chain south of lot post 34-35 R.L. IV-V. The

band is interbedded with andesite flows, strikes north 60 degrees east, and is 3 to 4 feet in width. It is considerably sheared, contains small stringers and lenses of quartz, and is heavily mineralized with pyrite. A band of cherty iron formation that is probably the continuation of the one described above outcrops 350 feet to the southwest. As exposed in a trench, the band is 3 feet wide, contains much vein quartz in lenses up to 5 inches wide, and is well mineralized with coarse chalcopyrite and pyrite. Several other small quartz veins and bands of cherty, tuffaceous sediments mineralized with pyrite have been stripped and trenched in this vicinity.

Ernest Broult has trenched a shear zone in altered andesite near the east end of lot 1, range IV, Laverlochère tp. The shear zone is about 25 feet in width, strikes north 30 degrees east, and dips vertically. Two trenches 50 feet apart have been made across it. The chlorite schist contains many small lenses of quartz and both the schist and quartz are well mineralized with pyrite. In one trench quartz stringers make up more than 50 per cent of the rock for a width of 15 inches; in other places the amount of quartz is less and there is a corresponding decrease in the amount of pyrite. Gold assays of more than $2 a ton are reported from samples taken over a width of 2½ feet of the well-mineralized quartz and schist.

Albert Laperrière has done some stripping and trenching on a band of iron formation 2 feet in width in the northeast corner of lot 2, range IV, Laverlochère tp. The iron formation strikes north 55 degrees east, dips vertically, and is mineralized with pyrite. It is reported to contain low values in gold.

United Gold Exploration, Limited, holds lots 18 and 19, range IV, Laverlochère tp.,[1] this being the property formerly owned by the Bellehumeur Mining Company, Limited. The greater part of the property is underlain by Keewatin andesite and rhyolite, the contact of these rocks with a large granite batholith passes through the lots about one-quarter mile from the eastern boundary. The original showing on this property is near the north boundary of lot 19 about 75 feet east of the centre line of the lot, where a pocket containing much free gold is reported to have been found at the end of an aplite dyke intruding andesite. The dyke is from 8 to 10 feet in width, is exposed over a length of 200 feet, and strikes south 10 degrees east cutting across the strike of the andesite flows, which is south 75 degrees east. The aplite is a pink, fine- to medium-grained rock consisting mainly of quartz and feldspar. The aplite dyke contains many small quartz stringers sparingly mineralized with pyrite; some quartz stringers also occur in the andesite. As the dyke is followed north it narrows in width and the number of quartz veinlets increases, so that near the end it becomes a quartz vein. Two pits have been sunk at the end of the dyke where it is not more than 2 feet in width and composed mainly of quartz. In the most southerly pit, at the very end or tip of the dyke or vein, a considerable amount of free gold is reported to have been found.

A large body of rhyolite outcrops to the south of the aplite dyke described above. A large area of the rhyolite has been stripped and trenched in lot 19 about 150 feet east of the centre line of the lot. The rhyolite is a fine-grained, light grey rock cut by numerous granite and aplite dykes. It contains many quartz lenses, the largest of which is 2

[1] One and one-half miles south of Trudeau lake.

feet wide and 20 feet long; most of them are under 6 inches in width. Two trenches have been cut across the rhyolite containing the quartz lenses. Some of the quartz lenses contain a considerable amount of coarse pyrite, but mineralization on the whole is sparse.

DUHAMEL TOWNSHIP

An old gold prospect known locally as the Baldface mine is situated on lot 3, range V, Duhamel tp. No development work has been done on this property for many years. The property is underlain by Keewatin rhyolite and agglomerate striking south 55 degrees east and dipping vertically. The Keewatin is overlain to the east and northeast by Huronian conglomerate and quartzite. An échelon series of large lenses of vein quartz occurs in a band of highly sheared agglomerate. The lenses strike and dip parallel to the agglomeratic beds. The largest quartz lens is 85 feet in length with a maximum width of 15 feet. Another large lens is offset 30 feet to the northeast; it is 50 feet long with a maximum width of 14 feet. Five smaller lenses each offset 5 to 40 feet from its neighbour, in échelon arrangement, occur to the northeast. The quartz is heavily mineralized with pyrite and chalcopyrite. The pyrite occurs disseminated through the quartz and as veinlets of finely crystalline material up to one-eighth inch wide. The chalcopyrite is not as plentiful as the pyrite; it is present as large, rather coarsely crystalline blebs in the quartz and also in the pyrite. A shaft said to be 45 feet in depth has been sunk on the largest lens and two trenches have been cut across the adjoining quartz lens.

OTHER GOLD OCCURRENCES

A number of gold occurrences in Blondeau, Gaboury, and Laverlochère townships were examined and described by J. A. Retty in 1930.[1] Descriptions of these properties are not included in this report as little or no additional development work has been done on them since that time.

SILVER

The Wright mine is the only silver deposit within the area. It is situated on the east shore of lake Timiskaming[2] on lot 62, range II, Duhamel tp. The property is of particular interest because it was discovered in 1686 by a party of French explorers and is, therefore, the first mineral deposit to be found in northern Canada. The deposit outcrops on the shore of the lake in a volcanic agglomerate of Keewatin age. The agglomerate is composed of subangular fragments of dacite varying from 4 to 5 inches to more than 1 foot in diameter, in a matrix of similar material of finer grain. The dacite is a light green, fine-grained rock containing small quartz and feldspar phenocrysts. The agglomerate is well exposed along the shore to the west of the ore deposit; several well-defined beds in the agglomerate strike north 40 degrees east and dip 75 degrees south. A cliff of Cobalt conglomerate outcrops 200 feet to the south of the deposit. The ore as exposed at the surface consists of a breccia composed of angular

[1] Quebec Bureau of Mines, Ann. Rept. 1930, pt. B, p. 53.
[2] North of Joanne bay.

fragments of the dacite agglomerate cemented by a matrix of coarsely crystalline calcite and argentiferous galena with some pyrite and quartz. The brecciated zone exposed on the shore of the lake is about 31 feet by 65 feet.

A shaft reaches a depth of 330 feet and levels have been run at depths of 50, 100, 179, 230, and 330 feet. The property has not been worked for many years and the shaft and underground workings are flooded. For a very complete description of the property the reader is referred to the report by H. C. Cooke who examined the underground workings when the mine was dewatered during the summer of 1925.[1]

ASBESTOS

Chrysotile asbestos occurs in many of the small serpentine bodies in Gaboury township near McKenzie lake and in range VII, Duhamel township. Some trenching has been done on the deposits east of McKenzie lake. They have been adequately described by J. A. Retty who examined the properties in 1930.[2] Little or no additional development work has been done since that time.

SILICA

An isolated outcrop of basal Ordovician sandstone is being quarried by Flint Sands, Limited, near the eastern end of lot 19, range II, Guigues tp., 2 miles east of St. Bruno. A very pure silica sand averaging 97 per cent SiO_2 is produced that is suitable for sand blasting and filtering.

The outcrop of sandstone rises abruptly from the clay flats to a height of 40 or 50 feet. The Precambrian Lorrain quartzite on which the sandstone rests is not exposed at the base of the cliff, but probably lies within a few feet of the surface as the Lorrain quartzite outcrops only a short distance to the southwest. The sandstone is a well-bedded, loosely consolidated, friable rock composed of angular to subangular grains of quartz. The grains are poorly sorted and vary in size from 5 mm. to ½ mm., or less. The upper 10 to 20 feet of the outcrop contains much limy material and is, therefore, unsuitable as a source of silica sand.

The sandstone is drilled for blasting by hand auger. No crushing is necessary as the blasting converts the friable sandstone to sand. The sand is dried by running it over hot plates fired by wood. It is then classified by vibrating screens into three grades. The medium grade is marketed for sand blasting. No market has yet been found for the fines; the coarse material is suitable for filtering. The management hopes in the near future to find a further market for their product as a glass sand.

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[1] Geol. Surv., Canada, Sum. Rept. 1925, pt. C, pp. 20-27.
[2] Quebec Bureau of Mines, Ann. Rept. 1930, pt. B, p. 75.

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