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KITCHIGAMA LAKE AREA, ABITIBI TERRITORY

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GEOLOGICAL REPORT 12

KITCHIGAMA LAKE AREA

ABITIBI TERRITORY

by

W. W. Longley

QUEBEC
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1943

KITCHIGAMA LAKE AREA

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KITCHIGAMA LAKE AREA

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INTRODUCTION

The field work, the results of which are described in detail in this report, was done in 1938 and 1939. In order to make the main results of the investigations available at an early date brief reports (1) were published as soon as possible after the termination of the field work of each of these two years. These reports were accompanied by geological maps, printed with black and white designs, at a scale of two miles to one inch.

Location of Area and Means of Access

The Kitchigama lake area is about ninety miles due north of the town of Amos, Abitibi county (see Index Map). The area examined extends between latitudes 49°45'N. and 50°00'N. The eastern boundary is longitude 77°30'W. and the western boundary longitude 78°20'W.

Mattagami lake may be reached by canoe either from Senneterre by way of Bell river or from Rochebeaucourt bridge, about twenty miles north of the town of Barraute, by way of Laflamme and Bell rivers. At the time of writing, the latter is the shorter and easier route. There are five portages along the Laflamme, four of them short but one a little over half a mile in length. There are also five short portages along Bell river between the mouth of the Laflamme and Mattagami lake.

With the completion of the Rose Lake mine-road, still under construction at the time of our visit, a much easier and quicker route to the area will be by motor along this road from Senneterre to Cedar rapids on Bell river - a distance of about fifty miles - and from there by canoe down Bell river to Mattagami lake. The canoe trip entails six portages, but the longest of these is only about ten chains.

The eastern part of the map-area is readily accessible from Mattagami lake, and the south-central part by way of Allard river and MacIvor river and lake. The western part, however, is difficult to reach by canoe. The best route (see Figure 1) is down Nottaway river from Mattagami lake to the western end of

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(1) Advance Report, Mattagami Lake Map-area: (1) Western Section, Que. Bur. Mines, P.R. No.127, 1939; and Advance Report, Kitchigama Lake Area, Abitibi Territory, Que. Bur. Mines, P.R. No.146, 1939.

Soskumika lake and then southward through lakes A and B to the southwestern inlet of lake B. From there it is necessary to portage about one mile west to the small lake C, on the farther side of which there is still another portage of a mile and a half to a large tributary stream of Kitchigama river. At times of very high water it is possible to continue by canoe instead of portaging this distance. There are no rapids along this tributary nor up Kitchigama river to Kitchigama lake, and an outboard motor can be used for most of the distance. An alternative route, which entails a portage of over four miles largely through open muskeg, is from the headwaters of MacIvor lake to Rat lake and then down Rat creek to Imbeault river and Kitchigama lake. During dry weather there is not sufficient water in Rat creek for a canoe to pass along it.

Field Work

The field work of 1938 was confined to the portion of the area east of longitude 77°45'W., and the work of 1939 to the area west of this boundary. P.E. Auger (1) in 1938, mapped the area adjoining to the east.

To the south of Mattagami lake, land traverses were run by pace-and-compass at intervals of approximately one thousand feet. Their bearing was north-south, across the general structure of the area. Elsewhere, the traverses were at intervals of approximately half a mile, but modified so that all hills were crossed and areas of extensive muskeg were avoided where possible.

Two east-west picket lines were cut to serve as controls for the traverses east of Bell river. The more northerly of these extends eastward from Gouin lake; the other, $1\frac{1}{2}$ to $1\frac{3}{4}$ miles to the south, extends from Bell river eastward across the map-area and for several miles beyond it.

A chain-and-compass survey was made of the greater part of the southern shore of Mattagami lake. The remainder of the southern shore, the islands, and most of the northern shore of the lake were surveyed by pace-and-compass.

Heavy rains and floods about half-way through and late in the 1938 season hindered work considerably, and rough water on Mattagami lake also caused some delays.

Acknowledgments

The base-map upon which the geology of the area was plotted was compiled by the Quebec Bureau of Mines from provisional maps made from aerial photographs by the Topographical Survey, Ottawa, and from survey plans of the Department of Lands and Forests, Quebec. Many changes and additions were made as a result

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(1) Auger, P.E., Olga-Mattagami Map-area; Que. Bur. Mines, Geol. Rept. No. 10, 1942.

of the surveys by the writer. The aerial photographs, vertical for the western part of the area, and oblique for the eastern part, were a great aid in planning the field work and in the preparation of the report.

The party of 1938 included Leopold Garon of Laval University, and Jacques Gouin of Ecole Polytechnique, assistants; J.O. Senechal, cook; and Jim Pichette, Aimé Imbeault, and Emile Masse, canoemen. During the 1939 season, Yvon Cousineau of Queen's University, and Alan Watson of Sir George Williams College, acted as assistants; Xavier Angleheart as cook; and Paul Blondin and Aimé Imbeault as canoemen. All discharged their duties in a very satisfactory manner.

The writer wishes to express his appreciation to Ralph Leslie, pilot, and Harray Aird and Sid Walker, radio operators, of Dominion Skyways, Senneterre, for their efficient service and co-operation; also to several members of the Provincial Forest Protection Service who rendered many favours.

Description of Area

Topography and Drainage

The area is low and flat except for Mount Laurier ridge and its continuation in the vicinity of MacIvor hill, and a few scattered knolls. Mount Laurier rises about seven hundred feet, and MacIvor hill about five hundred feet, above Mattagami lake, which is approximately six hundred feet above sea level.

The southern part of the area is well drained by numerour small streams. The northern part, which is low, flat country largely occupied by open muskegs, is very poorly drained.

There are two large lakes in the area and several small ones. The Bell, Allard, and MacIvor rivers empty into the western part of the largest lake, Mattagami, which drains into James bay by way of Nottaway river. The western part of the area is drained by Imbeault river and several small streams which flow into Kitchigama lake, whose outlet, Kitchigama river, empties into Nottaway river a short distance above its mouth.

Timber, Fish, and Game

The major portion of the area is covered by growths of spruce, with some fir. In general, the trees are stunted or small second-growth, but there is a narrow belt of large spruce trees along the upper reaches of Kitchigama river and some of its tributaries. There are also quite extensive stands of spruce and white birch north of Mount Laurier ridge.

All the lakes and rivers are well stocked with pike; sturgeon and pickerel are less plentiful.

Muskrats are numerous along some of the streams which flow into Kitchigama lake, but little evidence was seen of other fur-bearing animals, with the exception of beaver. Much recent

'work' by beavers was observed south of Kitchigama lake, but there was also evidence that recent trapping is seriously threatening the existence of these colonies.

Moose are scarce in the area. No caribou were seen, but there are many caribou paths through the open muskegs in the northern part of the area.

A few partridge were observed, and, in the latter part of the season, some ducks and geese.

Previous Work

Although reconnaissance surveys by several investigators have included parts of the map-area, it had not previously been examined in detail. About 1928 there was considerable prospecting activity in the eastern part of the area, and some development work, including diamond drilling, was done on the Dunlop property, southeast of Dunlop bay, Mattagami lake. Since that time there has been little activity in the area.

The first geological mapping was by Robert Bell, of the Geological Survey, in 1895 and 1896. In his reports for these years, little mention is made of the geology, but his observations along the shores of Mattagami lake and Bell river are recorded on his map, published in 1900.

Mattagami lake is included in the area mapped by J.A. Bancroft for the Quebec Bureau of Mines in 1912. The Nottaway sheet, compiled by H.C. Cooke and issued by the Geological Survey in 1927, is based on the work of various investigators. Since that time, A.H. Lang, G.W.H. Norman, and B.C. Freeman, all of the Geological Survey, have worked in the eastern part of the area.

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FREEMAN, B.C., et al, Mattagami Lake, Map No.571A, Geol. Surv. Can., 1940.

GENERAL GEOLOGY

General Statement

A large part of the area is covered by glacial clays and till, exposures of bed-rock being confined in the main to hills, and ridges, and to the shores of lakes and rivers.

Rock outcrops are abundant along the southern shore and north arm of Mattagami lake and on the islands in the lake; they are almost continuous along Mount Laurier ridge and the ridges south and southwest of MacIvor lake; and are very numerous on the few knolls that occur in the area. There are scattered outcrops along the northern shore of Mattagami lake, the southern shore of Kitchigama lake, and in the low parts of the southern portion of the area.

In the northern part of the area, exposures are very scarce. None were seen along the northern shore of Kitchigama lake or in the flat country east of the lake.

The rocks of the area are all of Precambrian age. The exposureless sections north of Mattagami lake and north and east of Kitchigama lake are probably underlain by gneisses and granitic intrusives. The greater part of the southern half of the area is occupied by volcanics of Keewatin type, which are cut by several intrusive bodies.

Some conglomerates and other sedimentary rocks of late Keewatin or post-Keewatin age were observed on three islands in Mattagami lake and along the north shore of the lake just east of the largest island in the lake.

Two or more large gabbro dykes, and many small silicic dykes, occur in the area.

Table of Formations

Quaternary	Pleistocene and Recent	Varved clays, glacial-lake silts and till
	Great unconformity	
Precambrian	Post-Keewatin Intrusives	Gabbro dykes (Keweenawan ?)
		Silicic dykes of various ages: granite, syenite, diorite, rhyolite, pegmatite, aplite
		Kitchigama granite: biotite-hornblende granite,
		Olga quartz-diorite: hornblende granite, quartz-diorite
		Mattagami gneiss: biotite diorite gneiss
		Dunlop intrusive: granite, syenite, monzonite, diorite
		Bell River complex: gabbro, anorthosite
		Migmatite: probably volcanic and sedimentary rocks, recrystallized and abundantly intruded by granitic material
	Intrusive contact	
	Late- or Post-Keewatin Sediments	Mattagami sedimentary series: conglomerate, banded argillite, greywacke, arkose
	Unconformity (?)	
	Keewatin (?)	Massive, ellipsoidal, and fragmental volcanic flows and tuffs

Keewatin (?) Volcanics

The volcanics of the area resemble rocks occurring elsewhere in the Canadian Shield that have been classified as Keewatin in age. For this reason, they, also, are assumed to be Keewatin.

The greater part of the area south of Mattagami lake, and probably also the greater part south of Kitchigama lake, is occupied by these volcanics. Excellent exposures occur along the southern shore of Mattagami lake; on the islands which lie north and west from the mouth of Bell river; in a belt which extends eastward from Inlet rapids along Mount Laurier ridge; and along the hills south and southwest of MacIvor lake.

The volcanics are in general little sheared or altered, and primary structures and textures are unusually well preserved, although the rocks have been isoclinally folded. The axis of the folding trends approximately east-west. All dips are nearly vertical, and the general strike is from slightly north of east to several degrees south of east.

The volcanics occur as an extensive series of narrow bands of massive, fragmental, and ellipsoidal lavas, with some banded tuffs. The outlines of the pillows of the ellipsoidal lava are well preserved in general, and in many places it is possible to make definite determinations as to the tops of the flows from the shapes of the pillows (see Plate II-B). The pillows in such places are gently rounded on the side toward the top of the flow, with their lower side conforming in shape to the surface of the underlying pillows. The zones of ellipsoidal flows range from ten feet to two hundred feet thick. Observed fragmental bands range from about one foot to two hundred feet in thickness, the majority being from two to twenty feet thick. With one exception, described later, the thinnest massive flow observed was about fifteen feet thick. These flows are in general thicker than the other lavas.

There are at least ten, and probably more than twenty, fragmental belts in the Mount Laurier ridge, in the vicinity of Mount Laurier and westward. There are also at least four ellipsoidal flows in the ridge. The crest of Mount Laurier is massive lava, but there is a fragmental band about ten feet wide some fifty feet south of the crest, and another, about fifty feet wide, two hundred feet north of the crest. There is also at least one band of finely banded tuff, about one hundred feet wide, on the southern slope of the ridge.

The best exposures of the ellipsoidal lava are along the lake-shore and on some of the islands in the vicinity of the mouth of Bell river, and in the vicinity of MacIvor lake. The best exposures of the tuff are along the shore of Mattagami lake east of the mouth of Bell river. There are many good exposures of fragmental lava along Mount Laurier ridge, and south of MacIvor lake, but the best seen are in the vicinity of Inlet rapids.

A short distance northwest of Inlet rapids, on the lake shore, there is an outcrop about thirty feet square which exposes massive, fragmental, and ellipsoidal lavas. The trend of the

rocks is about east-west and the dip is vertical. The southern part of the outcrop is massive lava. To the north, this passes into a fragmental lava with 'bombs'. The 'bombs' become larger and more abundant to the north, until, at the northern edge of the outcrop, the rock is ellipsoidal lava. Determinations made near this locality indicate that tops are to the north. Thus a series from massive lava, grading through fragmental to ellipsoidal lava, is indicated.

It is the opinion of the writer that, in the case of the Mount Laurier volcanics, a massive flow with a fragmental top indicates one volcanic outpouring rather than a quiet outwelling followed by an explosive stage. Probably the fragmentary material was produced by breaking of the crust on the lava flows, and by breaking of the 'bombs' (the 'bombs' were probably produced by ' 'fire fountains' in the lava streams).

Most of the fragmental beds consist of sharply angular fragments, nearly all of which are less than six inches across, the majory being from one to four inches. The interstitial spaces are filled with less coarse fragmental material. The fragments are grey to black in colour and usually 'cherty' in appearance. Those examined under the microscope were too fine grained for positive identification, but they are probably andesitic in composition.

At Inlet rapids and along the shore near the rapids there are some fragmental bands in which up to fifty per cent of the rock is made up of irregular shaped, though somewhat rounded, volcanic 'bombs'. These show a definite chilled margin or crust, about half an inch thick, and the interior is usually amygdaloidal. The majority of these bombs are from two to eight inches in diameter. A large proportion of the interstitial fragments are definitely recognizable as fragments of the 'bombs' (see Plate III-B).

The massive flows in general are dark grey to black, with a massive appearance and very fine grained, black, chilled contacts. In the majority of the outcrops examined the margins are amygdaloidal. The central parts of the flows are invariably much coarser grained than the margins, and feldspar laths up to three millimeters in length were observed. In many exposures, these feldspar phenocrysts are bleached white and the weathered rock has a light grey colour and the appearance of a diorite.

One flow, about fifteen feet wide, that is well exposed just south of Mount Laurier peak was examined in some detail. Both the bottom and the top of the flow are amygdaloidal, the upper amygdaloidal zone being much wider than the lower one. This appears to be true of all the flows in the map-area. In the coarser, central part of the flow, the feldspar phenocrysts attain a maximum length of about two millimeters. The increase in grain size is much more abrupt at the lower than at the upper margin of the flow.

Several thin sections of the massive flows were examined, and were found to be similar in their general features. The coarser grained central parts have a massive structure and the

finer grained margins are often trachytic. The mineral composition varied little in the sections examined, averaging, approximately, 50 per cent hornblende, 35 to 40 per cent andesine (An35), 5 to 10 per cent magnetite and ilmenite, and 5 per cent quartz. The feldspar shows 'wandering' extinction in most cases, even in sections from thin flows. Both the feldspar and the hornblende have been considerably altered. Magnetite and ilmenite are closely associated with the hornblende, and some pyrrhotite and pyrite are present.

The ellipsoidal flows in the area are unusually well preserved. They are probably all of andesitic composition. Few pillows as small as one foot in length were observed. Along the southern shore of Mattagami lake, about two miles west of the mouth of Bell river, there is a series of very well preserved flows in which the pillows average four to six feet long, and some are as much as ten feet long and four feet thick.

In general, the pillows have a chilled margin half an inch to one inch thick, then an amygdaloidal zone, and a massive centre. However, on the southern slope of Mount Laurier ridge, a narrow porphyritic ellipsoidal flow was observed in which there are phenocrysts of plagioclase from a quarter of an inch to half an inch long.

The ellipsoidal lava in the vicinity of MacIvor lake appears to be more silicic than that elsewhere in the area, and is somewhat unusual in character due to the abundance of amygdules, which, locally, occupy as much as 25 per cent of the volume of the rock. Few of them exceed a quarter of an inch in diameter, and their rounded shape has been very little distorted, if at all. The greater percentage of the amygdules are filled with quartz, but many contain amphibole, which may be partly or completely altered to chlorite. In some of the quartz-filled amygdules there is a rim or core of chlorite or amphibole.

The matrix between the pillows of the ellipsoidal lava is usually very fine grained, and often considerably altered to chlorite and carbonate. However, in an exposure a short distance south of Inlet rapids, the matrix consists of small fragments that are definitely of the same material as the pillows (see Plate II-B).

Banded tuffs are interbedded with the lavas in many places. The most persistent exposures are along the southern shore of Mattagami lake, in a synclinal trough. The fine banding is very prominent, and in places gradational bedding was observed. A band of fine, fragmental material, about half an inch wide, is interbedded with the tuffs on a small point jutting from the lake shore about one and three-quarter miles north of Inlet rapids (Plate V-A).

The tuffs have been extensively altered and in many places they are highly sheared and converted to chlorite and sericite schists. Much carbonatization has taken place along the shear-zones, and in places the rock has been silicified and mineralized with pyrite.

Two occurrences of massive flows of unusual type, with interbedded tuffs and overlain by fragmental lava, were noted,

one at a point about a mile north of Inlet rapids on the north side of the large island at the mouth of Bell river, the other at the northeast point of the larger of the islands immediately to the west. The best exposure is on the broad, rounded point of the island first mentioned, where at least fourteen layers of the lava are exposed. The individual flows are rather uniform in thickness, from one to two feet, and they are separated by thin tuffaceous layers that are from one to four inches thick (see Plate III-A). The lava is very fine grained, dark grey, and massive, and contains scattered amygdules. Thin flows such as these were not observed elsewhere in the area. Since the flows in the two occurrences are similar in appearance and lie along a common line of strike, it may be assumed that they represent one and the same series of flows, now separated by a gap of some two thousand feet.

A considerable portion of the northern part of the area is occupied by migmatite which, in the opinion of the writer, is composed in large part of recrystallized volcanics.

Late- or Post-Keewatin Sediments

Mattagami Sedimentary Series

Excellent exposures of conglomerate occur on two small islands, which are about two miles apart, near the middle of Mattagami lake, between the mouth of Bell river and Dunlop bay. On the eastern of these islands, the section of conglomerate exposed is nearly four hundred feet thick.

The matrix of the conglomerate is greywacke and arkose. It is fine grained and well banded but has a massive, grey appearance, and contains frequent glassy quartz grains up to about one millimeter in diameter. The rock is foliated parallel to the banding, which strikes N.77°E. and dips 80°S. In places, shearing has been so intense as to convert the rock to a quartz-sericite schist. A study of thin sections showed about 25 per cent quartz grains and some feldspar grains in a matrix of fine grained quartz, sericite, chlorite, and feldspar. Many of the larger grains are well rounded.

The pebbles in the conglomerate are well rounded and show little distortion (see Plate V-B). They range in diameter from about one inch to six inches. The majority are granite, but syenite, diorite, quartz, and rhyolite pebbles are also present. No pebbles of the Keewatin lavas were seen. The pebbles are rather uniformly distributed through the matrix, about one to every fifteen square feet of surface. In narrow belts, they are less widely spaced.

Along the lake shore, on a point about half a mile north of the western of the islands referred to above, and east of the largest island in the lake, there is an exposure of a very fine grained, dark grey, banded rock that was probably originally an argillaceous sediment and to which now the term argillite may best be applied. This exposure is about two hundred feet long and fifty feet across strike. The rock has massive layers about two feet thick with many fine laminations along the margins. It has about the same strike and dip as the conglomerate. Three

and a half miles west and slightly south of this point there is a an outcrop of similar rock on a small island.

As indicated on the accompanying map, sedimentary rocks are believed to form a rather wide band across the southern part of the largest island of the lake, between the last two outcrops mentioned, although no exposures of these rocks were observed there.

Assuming the volcanics described previously to be of Keewatin age, it is possible that these sediments may be of Temiscamian age. Bancroft (1), who was the first to apply the name 'Mattagami' to this series of sediments, did not, at any point, observe them in contact with the volcanics and so was not able to determine their actual relationship to the latter. In his table of formations, however, he indicates the possibility of an unconformity between the two formations. The present writer was not able to determine definitely the relation of the sediments to the volcanics, but it was observed that they parallel them in strike and have nearly the same dip, which suggests that the sedimentary rocks may be interbedded with the volcanics. Such an interbedding has been observed by Auger (2) in the area adjoining to the east, and thus the possibility must be considered of the volcanic and sedimentary rocks of this region being of the same general, Keewatin(?), age.

North and northwest of Mattagami lake, considerable areas are occupied by migmatite, which is described on a later page of this report. In places, the recrystallized portions of the migmatite, composed chiefly of quartz, feldspar, biotite, and amphibole, show a sharp banding, with uniform layers from a quarter of an inch to four inches in thickness. The mineral composition, fairly uniform, in individual bands, differs considerably in adjacent bands. This banding suggests a sedimentary origin. No evidence of conglomerate was found in any of the migmatite observed by the writer; however, in Norman's preliminary map of the west half of Waswanipi area (3), a small body of conglomerate is shown about three miles east of the north arm of Mattagami lake, within the body of granitic rocks.

Post-Keewatin Intrusives

General Distribution

If, as assumed, the volcanic rocks are of Keewatin age, then the intrusives described below are all post-Keewatin. They may be post-Temiscamian if the Mattagami sedimentary series is assumed to be of Temiscamian age.

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(1) Bancroft, J.A., Basins of Harricanaw and Nottaway Rivers, Dept. of Colonization, Mines and Fisheries, Quebec, Report on Mining Operations, 1912, p. 157.
(2) Auger, P.E., Olga-Mattagami Area, Que. Bur. Mines, Geol. Rept. No.10, 1942.
(3) Norman, G.W.H., Geol. Surv. Can., Paper 37-8, 1937.

It is probable that at least half of the area is underlain by granitic rocks. North and northwest of Mattagami lake, the country is very flat and low, and, except along the actual shore of the lake, is practically devoid of rock exposures. However, the writer is of the opinion that this area is underlain by intrusives of at least two ages, in addition to much extensively recrystallized and injected banded rock that is best described as migmatite. Freeman (1) has described this group of rocks as the 'Mattagami gneiss', apparently including in the group the intrusive rocks (now gneissic) and the migmatite.

There are two large and several small intrusive bodies within the southern part of the area. In addition, two intrusive masses extend into the area from the east. One of these, a body of gabbro which Freeman (2) has designated the Bell River complex, crosses the southeastern corner of the map-area; the other is a lobe of a large batholith, named by Freeman (3) the Olga quartz-diorite, that extends from the east through the southern parts of Goéland and Olga lakes to terminate north of Garon lake, a short distance within the present map-area.

Of the larger intrusives wholly within the area, one is a narrow body, about four miles long, which extends eastward from Dunlop bay and which for convenience may be referred to as the Dunlop intrusive. The other extends southward from Kitchigama lake to Rat lake and is here named the Kitchigama granite mass.

Of the smaller intrusive bodies, three are similar lithologically to the Olga quartz-diorite and may be genetically related to it. Two of these bodies are along the southern shore of Mattagami lake, and one is a short distance south of Garon lake. Another intrusive body, about six miles southwest of MacIvor lake, resembles the Kitchigama granite. About four miles west of MacIvor lake there is a small body of intrusive rock similar to that of the Dunlop intrusive.

There are numerous dykes in the area. The largest and most persistent is a large gabbro dyke that crosses Allard river, near the southern boundary of the map-area, and is exposed on the islands in Mattagami lake and on the lake shore. A series of exposures of a similar gabbro some distance to the north suggests a parallel dyke.

There are also numerous, small, silicic dykes in the area. The majority of these are in the immediate vicinity of the intrusive bodies, and are in general of the same composition as those bodies but of finer grain.

Migmatite

From Mattagami lake westward through the northern part of the area, the country is low and flat, and is practically devoid

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(1) Freeman, B.C., Jour. of Geol., Vol. XLVI, 1938, p. 685.
(2) Freeman, B.C., Jour. of Geol., Vol. XLVII, 1939, p. 27.
(3) Freeman, B.C., Jour. of Geol., Vol. XLVI, 1938, p. 691.

of rock exposures except along the shore of Mattagami lake. The writer is of the opinion that this area is underlain largely by migmatite together with intrusives of at least two ages, which were responsible for the formation of the migmatite.

The primary rock of the migmatite has been so completely recrystallized, due to the action of the intruding magmas, that its original nature cannot be determined with any certainty. It is probable that it represents both sedimentary and volcanic rocks that have been completely recrystallized. It has retained a very marked banded structure, with a general east-west trend and a steep dip. The rock now consists chiefly of amphibole, feldspar, and quartz. The feldspar - andesine and orthoclase - occurs in grains that are somewhat rounded and fresh in appearance. The rock has been extensively injected, both parallel and transverse to the banding, by biotite-quartz-diorite, which has become gneissic; later by pink granite, probably a facies of the Olga quartz-diorite; and still later by aplite and pegmatite. The intrusive rock contains numerous inclusions of the recrystallized schist.

Freeman (1) apparently included the migmatite and the biotite-quartz-diorite gneiss in the series that he named 'Mattagami gneiss', but, as the biotite-quartz-diorite gneiss intrudes, and thus is younger than, the migmatite, it is now deemed advisable to separate the two types of rock and to apply the name to the gneiss only. This gneiss is described in later pages of this report.

Bell River Complex

As already noted, a body of gabbro - the Bell River complex - extends into the southeastern corner of the area. The margins of the body are, in general, rather fine grained and the central parts very coarse grained. However, there is great variation from place to place both in grain size and in the ratio of plagioclase to pyroxene or its alteration product, amphibole. In places, the rock is anorthositic. Stratiform banding, which is characteristic of these rocks, is well shown in exposures at Channel rapids, and even better examples of the banding may be seen in outcrops near the southern margin of the body, at Cold Spring rapids, about eight miles up Bell river from Channel rapids (see Plate I-B). This banding parallels the stratification of the volcanic and sedimentary rocks that have already been described.

Several thin sections of the rock were examined and in these the proportion of feldspar was found to range from about forty per cent to eighty per cent. Refractive index determinations by immersion of crushed fragments in oils showed that the feldspar is labradorite, between An50 and An60. In some of the specimens examined, the feldspar is quite fresh, but in general it is highly altered. It occurs as laths, sometimes euhedral, with pyroxene or secondary amphibole in the interstitial spaces.

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(1) Freeman, B.C., Jour. of Geol. Vol. XLVI, 1938, pp. 681-699.

Almost invariably, the ferromagnesian constituent of the rock is hornblende or uralite, probably representing, for the most part at least, original pyroxene. In two of the sections examined, however - one from Channel rapids and one from about two miles east of the rapids - pyroxene (diopside) is present, and in the rock from two miles east of the rapids it is quite fresh. The diopside shows a tendency to form rounded and embayed grains, which are surrounded by magnetite.

Magnetite ranges from about five per cent to twenty per cent, the latter in a specimen taken from Channel rapids. The magnetite is strongly magnetic, and much of it shows schiller structure. In some sections, partial alteration of some of the grains of black iron oxide to leucoxene indicates the presence of ilmenite. Pyrrhotite and pyrite are common accessories. In one specimen from Channel rapids, pyrite has formed in fractures in magnetite.

Between this main body of gabbro and Mattagami lake there are several small masses of a rock which is similar in appearance but finer grained. These masses trend in a direction closely parallel to the stratification of the volcanics they intrude. Examination of thin sections of the rock shows that, apart from the finer grain, it is identical with the gabbro of the main body - in texture, mineral composition, and percentage and composition (An50-60) of the plagioclase. The feldspar in the associated volcanics is much less calcic (about An35). In view of these considerations, the writer is of the opinion that these small gabbro masses are sill-like offshoots from the main gabbro body.

The correspondence in strike and dip between the stratification of the volcanics and the stratiform banding of the gabbro indicates that the latter must have been intruded before the volcanics were folded. Also, since some of the smaller presumed offshoots from the main body of gabbro are near the top of the volcanic series, their intrusion must have taken place toward, or after, the close of the period of volcanic activity that produced the flows. The fact that the feldspars of the gabbro are more basic than those of the flows strongly suggests that the gabbro is not a differentiate of the magma that produced the flows. If, as is assumed, the volcanics are of Keewatin age, this would indicate a post-Keewatin age for the gabbro.

The gabbro dykes, which are described on page 21, are younger than the folding, and therefore, are not genetically related to the large gabbro body.

Dunlop Intrusive

The intrusive body which outcrops around the southern part of Dunlop bay, Mattagami lake, and extends eastward beyond the boundary of the map-area, has a length of slightly over four miles. Its width ranges from about a mile and a half to half a mile, the latter in the vicinity of the Dunlop prospect where, over an area about half a mile wide and one mile long, Keewatin volcanics project into the intrusive body from the southwest. Just north of this projection, also, there is an inclusion,

about a quarter of a mile long, of Keewatin rock in the intrusive. The outline of the intrusive, particularly along the southern side, is very irregular, probably due to faulting.

The surrounding Keewatin rocks, which at many points in the vicinity of the contact have been extensively altered and recrystallized, are cut by several dykes, offshoots from the main intrusive.

The Dunlop intrusive varies in mineral composition from place to place, presenting facies that range from granite through syenite and monzonite to diorite. The typical rock is pinkish on the weathered surface, medium to coarse grained, and massive. In places, it is faintly porphyritic, due to a strong tendency of the feldspar to form euhedral grains. Where seen in contact with the greenstones, the rock maintains its normal grain size. The essential mineral constituents are feldspar (both plagioclase and orthoclase), hornblende, pyroxene (probably titaniferous augite), biotite, and quartz. Plagioclase, with a range in composition from Ab50 to Ab90, is present in all the thin sections examined, but one or more of the other minerals mentioned may be lacking. Where pyroxene is present, it is usually accompanied by biotite and the plagioclase is calcic. In only one section of this facies of the rock was quartz observed. This dioritic type of rock occurs along the southern part of the body, east of the narrow zone referred to above, and it appears that, in general, the more calcic plagioclase is characteristic of the entire southern margin of the intrusive. In the western and northern parts, on the other hand, the rock is more acidic, the common association of minerals being sodic plagioclase, orthoclase, hornblende, and quartz.

This variation in composition strongly suggests differentiation in place, and that the intrusive is an irregular sill, with bottom toward the south. If this is true, the indications are that the sill was intruded before, or during the early stages of, the post-Keewatin folding. This would date the Dunlop intrusive as earlier than the other granitic intrusives of the area, but near in age to the Bell River complex, to which it may be related.

There are two other bodies of rock in the area which are lithologically similar to the Dunlop intrusive, and possibly are related to it. The larger of these is about two miles west and slightly south of MacIvor lake. This body trends in a general northwest direction and is at least a mile long; its possible extension to the northwest is concealed by overburden. The rock is coarse grained and contains feldspar, much amphibole, and a little quartz. Both the amphibole and the feldspar are highly altered. For the most part, the rock is hornblende diorite or syenite, but in part it has the composition of granite.

The second body referred to is about two miles east of the southeast corner of Kitchigama lake. Only two small outcrops were seen here, along a low ridge, so it is not possible to estimate the size of the body. The rock is similar to the more basic facies of the Dunlop intrusive, consisting of calcic plagioclase with considerable biotite and pyroxene, but containing no quartz.

Mattagami Gneiss

A belt of biotite-quartz-diorite gneiss occupies the northern shore of Mattagami lake from the North Arm to the large northwestern bay, and the islands in this part of the lake. Several exposures of similar rock about three miles northwest of the mouth of MacIvor river probably represent a continuation of this belt. No exposures were seen north or northwest of the latter group.

A second belt of the same rock, of undetermined length, extends westward from the central part of the North arm.

The biotite-quartz-diorite gneiss is coarse grained, grey in colour, and in places shows a well developed foliation. Conspicuous features of the rock are large biotite foliae, in places as much as half an inch in length, and glassy quartz grains, which are badly crushed, especially at their margins. The quartz usually makes up 20 to 25 per cent of the rock. The chief feldspar is a milky-white oligoclase. Some orthoclase and a very small amount of microcline are also present. The feldspars, like the quartz, have been crushed, chiefly along the margins of the grains. The biotite, which makes up about 10 per cent of the rock, shows as large, conspicuous foliae in the hand specimen. In thin section, these foliae are seen to consist of feathery aggregates of biotite flakes, with a nearly parallel alignment. Zircon and apatite are common accessories.

The Mattagami gneiss cuts the migmatite and is in turn cut by a pink hornblende-granite - which may be a facies of the Olga quartz-diorite - and also by many pegmatite and aplite dykes. As mentioned in an earlier page, Freeman, who was the originator of the name 'Mattagami gneiss', included with it the migmatite, but, for reasons already given, it is now deemed advisable to consider the migmatite as belonging to a separate and older group of rocks.

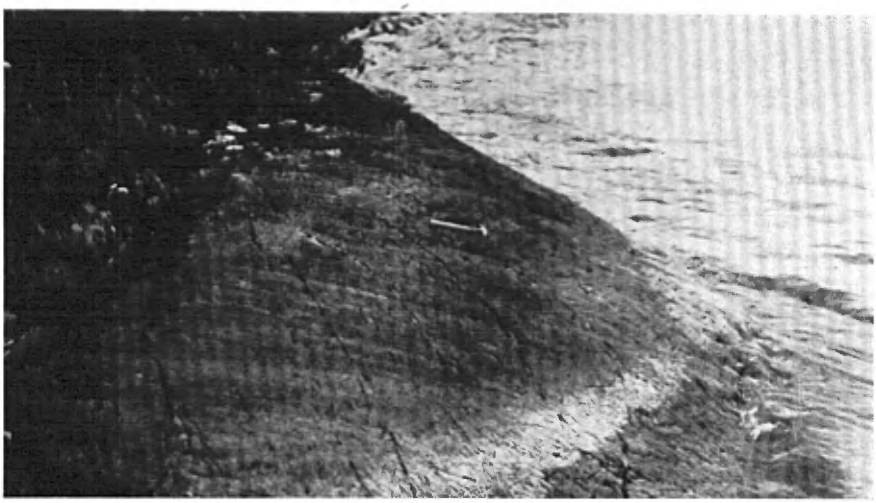
Olga Quartz-Diorite

A small lobe of the Olga quartz-diorite batholith extends into the eastern part of the area between Mount Laurier ridge and a low ridge of Keewatin lavas and intrusive gabbro. The latter ridge extends east-southeast from midway between Inlet and Channel rapids on Bell river.

The area between the two ridges is very low and swampy and is practically devoid of outcrops. Only two exposures of the Olga intrusive were observed, and from their location it is evident that this batholith extends at least two miles into the map-area. However, a dyke of similar rock was observed on the southern ridge about a mile and a quarter east of Bell river, and the rocks along the northern side of this ridge exhibit considerable hydrothermal alteration. These factors suggest that the Olga intrusive body may extend at least four miles into the area.

Southwest of Garon lake there is a small exposure of granite that is probably an apophysis of the Olga quartz-diorite.

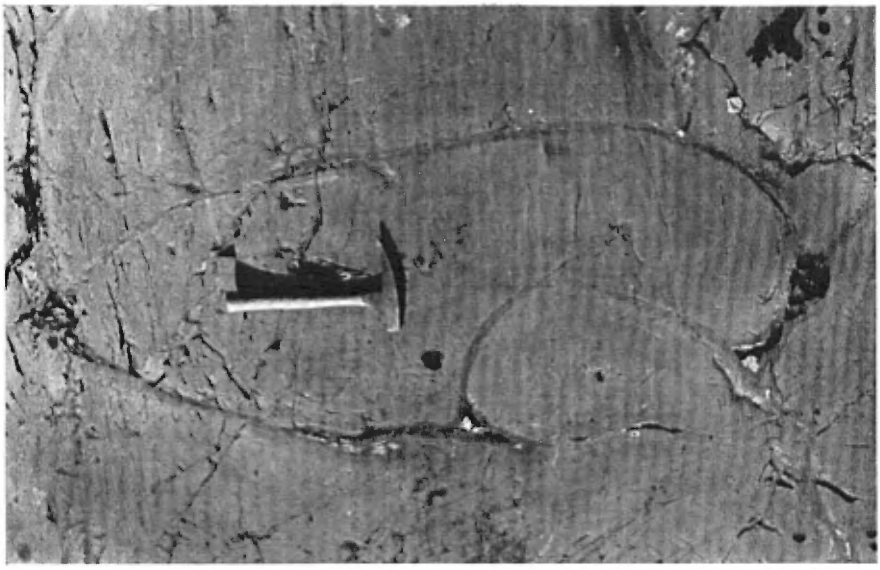
A.—Fragmental lava composed entirely of angular fragments, south of Mount Laurier.



B.—Intersecting glacial striae, south shore Kitchigama lake. Main striae in foreground trend slightly west of south; those near the hammer trend southeast.

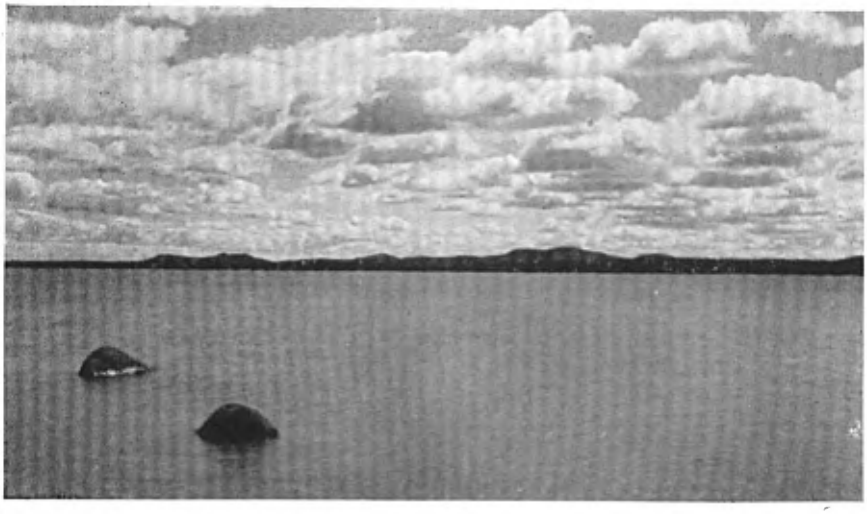
A.—A series of thin flows of fine-grained massive lava separated by narrow bands of tuffaceous material.

B.—Fragmental lava containing numerous irregular shaped "bombs" with chilled margins, Inlet rapids.



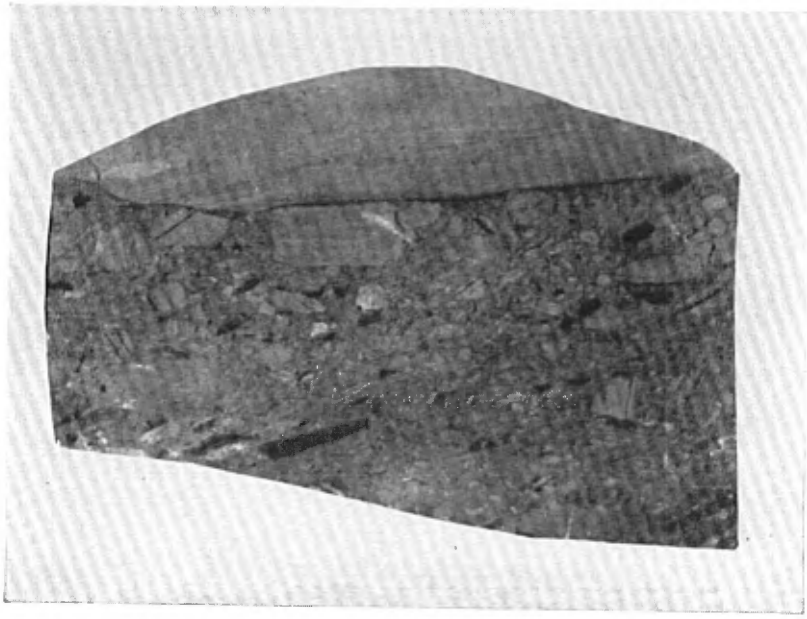
A.—Pillow in ellipsoidal lava. Note that the lower side of the pillow conforms to the underlying surface, whereas the upper side of the pillow is gently rounded.

B.—Fragmental matrix in ellipsoidal lava.

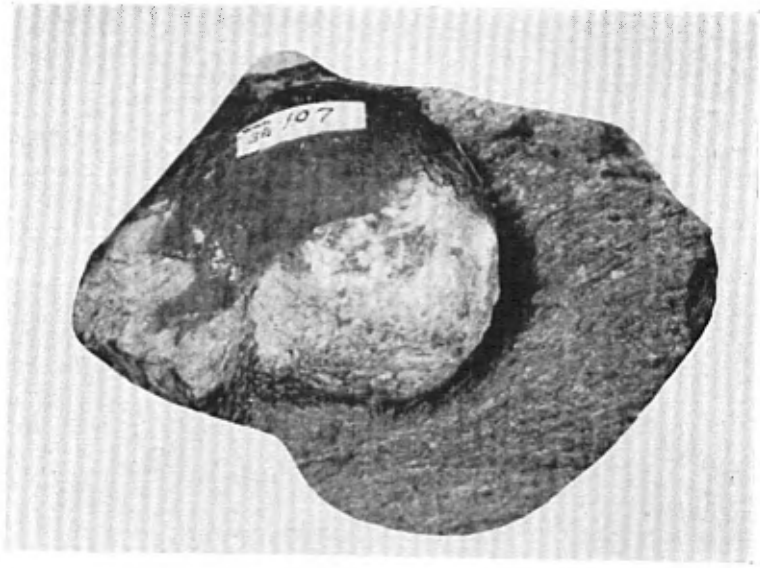


A.—Mount Laurier ridge, viewed from the north side of Mattagami lake.

B.—Stratiform banding in Bell River complex, Cold Spring rapids, south of the map area.

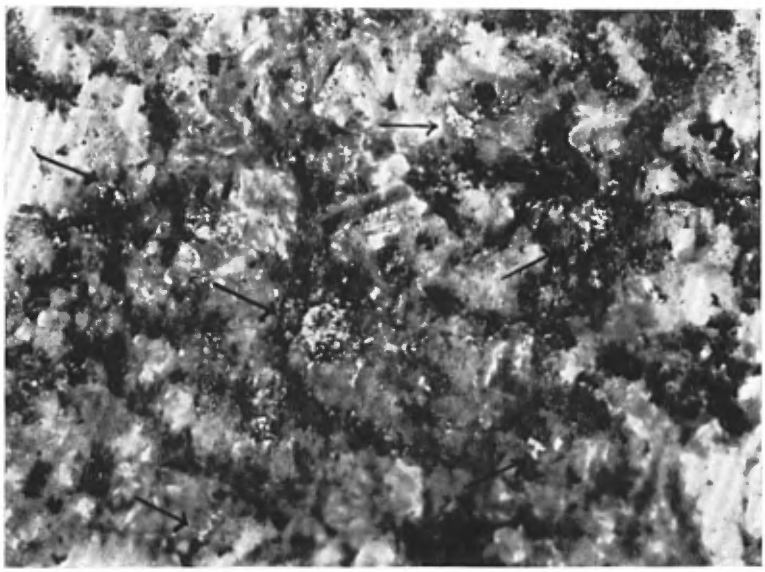


A.—Section showing narrow fragmental layer in banded tuff. ×5.

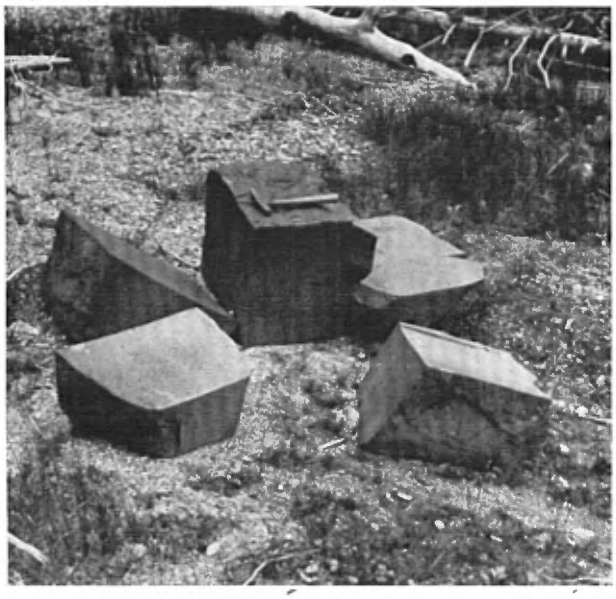


B.—Rounded pebble from conglomerate, Mattagami lake.
(About half natural size).

A.—Fragmental lava, west of Dunlop bay. The fragments have been selectively replaced by pyrrhotite (P), and pyrite (Py), and stringers of pyrite cut the pyrrhotite.



B.—Disseminated chalcopyrite (small irregular light grey areas) in granite dyke, west of Dunlop Bay. ×5.



A.—Boulder of fine grained massive black fragmental rock, showing unusually well developed parting. southwest shore of Mattagami lake.

B.—Unusual arrangement of schist fragments, west beach of island east of Dunlop Bay.

The rock in the outcrops observed is medium grained and light grey in colour. Glassy quartz and a paucity of dark minerals are conspicuous features in the hand specimen. Only one thin section of the rock was examined. It contains about 65 per cent plagioclase, 30 per cent quartz, and 5 per cent hornblende and biotite. The plagioclase (calcic oligoclase) shows an unusual amount of zoning, which is made more pronounced by a partial alteration to sericite. The rock may be classed as a quartz-diorite, although the content of dark minerals is rather low for this classification.

North of Mattagami lake there are several small exposures of a pink hornblende-biotite granite, which cuts both the migmatite and the Mattagami gneiss. Along the south shore of the lake there are three exposures of a lithologically similar rock that appear to be isolated bodies. One of these is on a small point in the extreme southwest bay of the lake; another is on the northern edge of a broad, rounded point two miles west of the outlet of Dunlop bay; and the third is just east of longitude 77°30'

The granite is medium to fine grained and for the greater part of a pinkish colour. It is composed of quartz, orthoclase, microcline, albite, hornblende, and biotite. The exposure on the broad point west of Dunlop bay is in contact with the volcanics to the south. Near the contact, the rock is fine grained and shows some shearing and flow structure. A short distance from the contact the feldspar grains are euhedral and the quartz occurs in large, glassy, somewhat corroded grains.

Lithologically, these several occurrences of granite are similar to one another, and are unlike any of the other intrusive bodies of the area, except certain phases of the Olga quartz-diorite. It is considered probable that they, and quite possibly also the Olga quartz-diorite, are genetically related.

Kitchigama Granite

A small batholith of granite extends southward from the central part of Kitchigama lake. It has a known diameter of about five miles but it may be much more extensive than this, since its outcrop area is surrounded by flat, swampy ground devoid of exposures. The outcropping ridges have a general northwest trend.

Southeast of this body, about six miles southwest of MacIvor lake, there are several exposures of a similar granite in a ridge which also has a northwest trend. The writer is of the opinion that these two occurrences of granite are genetically related and, indeed, that they may represent a single body of the rock, continuous beneath the intervening overburden.

The rock is medium grained, massive, and fresh in appearance. In general, it has a pink colour, but in places it is grey. Orthoclase is the most abundant constituent, followed by quartz (about 20 per cent); oligoclase, microcline, biotite, and hornblende are all present in appreciable amount. There is about twice as much biotite as hornblende. Magnetite, apatite, and zircon are conspicuous accessory minerals.

Field relations are lacking which might throw light on the age of this granite relative to the other intrusive bodies of the area. However, the freshness of the rock suggests that it is one of the younger intrusions. Lithologically, it is similar to the Olga quartz-diorite, and although it is discussed here as a separate intrusive, it is possible that the two are genetically related.

Silicic Dykes

Many small silicic dykes occur in the area, the majority of them in the immediate vicinity of intrusive bodies to which they are related. In such cases, the dykes are similar in composition to the parent body but are usually finer grained. Dykes are most abundant in the area north of Mattagami lake, where the migmatite in particular is cut by numerous dykes of quartz diorite, hornblende granite, pegmatite, and aplite. Pegmatite and aplite were not observed in other parts of the area. In two localities, a silicic dyke was observed cutting a gabbro dyke. These occurrences are described on page 21, where the age of the gabbro dykes is discussed.

Many of these dykes could not be related to any definite intrusive body, and for these, consequently, little could be determined regarding their relative age. This is particularly true of certain 'rhyolite' dykes, some of them with conspicuous phenocrysts of quartz and occasionally also of feldspar. Many such dykes with quartz phenocrysts were observed in the vicinity of MacIvor hill, and similar rhyolite, with an outcrop width of at least two hundred feet, occurs on a hill four miles southwest of Rat lake.

This rhyolite is usually dark grey to black in colour and very fine grained, with a sharp conchoidal fracture. The phenocrysts of quartz are prominent and glassy in appearance, and often have a bipyramidal, almost square, outline. Scattered specks of pyrite are common.

Two sheared rhyolite dykes that are well mineralized with pyrite were observed: one a short distance northwest of the mouth of Imbeault river, the other on a point about two miles west of the mouth of Dunlop bay, Mattagami lake. The latter, especially, has been heavily sheared and extensively replaced by pyrite.

About half a mile west of Dunlop bay, a granite dyke, which may be related to the Dunlop intrusive, contains considerable disseminated pyrite.

On the east side of Allard river, opposite the large embayment in the river east-southeast of MacIvor lake, a large dyke composed chiefly of white feldspar, with some quartz and a very minor amount of ferromagnesian mineral, cuts the greenstone. This dyke has been considerably sheared and contains much disseminated pyrite.

Gabbro Dykes (Keweenawan ?)

Two gabbro dykes, each about two hundred feet wide, probably extend completely across the area. Both have a general northeasterly trend.

One of these dykes, exposed intermittently for a distance of four miles, crosses Allard river slightly more than a mile from the southern boundary of the map-area. In Mattagami lake a similar gabbro outcrops on a string of four small islands, for a distance of about half a mile in all. The strike here is N.30°E. Two miles farther to the northeast, gabbro appears again on the southern tip of the largest island in the lake and from here it is exposed at intervals for a distance of about six miles, across the island and along the northern shore of the lake, the general strike being east-northeast. These exposures probably represent a continuous dyke, concealed at intervals beneath overburden and the waters of the lake.

The other large gabbro dyke is parallel to, and from two to four and a half miles northwest of, that just described. In the present map-area, it first outcrops about three miles southwest of MacIvor lake, and from there northeastward to a small island in the lake, a distance of at least five and a half miles, the gabbro is exposed intermittently. Still farther northeast, after a long intervening gap but more or less in line with the last exposures, there are outcrops of similar gabbro, first on the east side of the large bay that forms the northwestern end of Mattagami lake, and again at isolated points a short distance west of the North arm of the lake.

A wide chilled margin is characteristic in all exposures of these gabbro dykes. The central parts are coarse grained, with plagioclase laths up to four millimeters in length. The weathered surface of the rock is light grey - due to weathering of the feldspar - mottled with brown spots.

The rock exposed on the north shore of Mattagami lake, about a mile and a half northeast of the largest island, was examined in thin section. It is composed essentially of plagioclase laths (An65), which make up about 60 per cent of the volume of the rock, and interstitial diopside. Both minerals are fresh. Magnetite and ilmenite together form about five per cent of the rock. The magnetite grains are interstitial to the feldspar and are often intergrown with the diopside or appear in embayments in the grains of this mineral.

Sections of the rock from other exposures are almost identical with that just described, but in some there has been considerable alteration both of the feldspar and the pyroxene, with the latter largely or completely gone over to secondary amphibole. Some of the sections examined contain up to ten per cent of quartz.

The age of these gabbro dykes is not definitely known. One of them, exposed on the shore of Mattagami lake immediately east of the southern tip of the large island in the lake, cuts banded sediments of the Mattagami series, and a little farther to

to the east and north it was observed also cutting biotite-diorite gneiss. Thus the gabbro is one of the younger intrusive rocks of the area.

These dykes are not related to the gabbro of the Bell river complex, as this body was intruded before the area was folded, whereas the dykes were intruded after the folding. Similar gabbro dykes occurring at numerous points within the Canadian Shield have been assigned to the Keweenawan period. It appears reasonable to conclude that those in the present map-area, also, are of Keweenawan age.

A pink, medium grained quartz-diorite dyke, about five feet wide, cuts the exposure of gabbro on one of the islands near the western end of Mattagami lake. This quartz-diorite dyke is not similar to any of the larger granitic bodies of the area.

However, a dyke about one inch wide that is lithologically similar to the Kitchigama granite cuts the gabbro dyke exposed just north of the southern boundary of the map-area, a little more than a mile west of Allard river. In hand specimen, the contact between the two rocks is sharp, a feature emphasized by the fact that the gabbro is grey and the granite pink. In thin section, on the other hand, the contact appears irregular and indistinct. A conspicuous difference between the rocks, however, is that the feldspar of the granite is fresh whereas that of the gabbro is highly altered. This suggests that the granite dyke is not a differentiation product of the gabbro but rather a later intrusion, and it raises the further possibility that some of the larger intrusives of the area, namely, the Kitchigama granite, and the Olga quartz-diorite, may be later than the gabbro dykes.

Pleistocene and Recent

The area lies within the clay belt which extends through eastern Ontario and western Quebec. Much of it is low and flat and is covered with glacial clays. Numerous exposures of varved clays may be seen on the shores of Mattagami and Kitchigama lakes. Exposures of bed-rock occur only on ridges and hills, along the shores of rivers and lakes, and on islands within the latter, where the glacial débris has been removed by erosion.

A ridge about two and a half miles north of Bleu lake appears to be of glacial origin and is possibly a drumlin. It is about fifty feet high and a mile long, with southeast trend. There are also two flatter ridges in the area that appear to be of glacial origin. One of these is about two miles southwest of Inlet rapids, and the other, some five miles farther west, is about a mile east of Allard river. Although no gravel was seen in any of these ridges, even where they are dissected by stream erosion, the ridge north of Bleu lake is probably composed largely of gravel.

There are many wide gravel beaches along the shores of Mattagami lake, and from casual inspection it might be thought that they represent important deposits of gravel. However, this is not the case. Usually, the gravel is merely a surface layer, not more than a foot thick, resting on glacial clays.

Glacial striae were observed on rock outcrops in numerous localities, and generally their trend is slightly west of south. On the southern shore of Kitchigama lake, however, many outcrops show strong striae trending in a southeasterly direction, which cut across those trending in a southerly direction (see Plate IV-B). Wherever reliable observations could be made, it was found that the north-south striae have been obliterated on the western side of the outcrop but have not been damaged on the eastern side. Also, the striae trending southeast are present only on the northern side of the outcrop. The southeast striae are in general not as strong as the north-south striae. Faint but definite striae trending in a southeast direction were observed also on outcrops near the mouth of Allard river, and on one of the islands in Mattagami lake opposite the mouth of Bell river.

These observations indicate that there were two movements of ice over the area, the first in a direction slightly west of south and the second toward the southeast; also that the scouring of the second advance was not as strong as that of the first.

A further record of the ice age is seen in a glacial-lake boulder-beach on the southern slope of Mount Laurier ridge, about half a mile west of the peak. This beach is at an elevation of approximately two hundred and seventy-five feet above the level of Mattagami lake.

Numerous fragments and slabs of fossiliferous limestone of Devonian or Silurian age are strewn along the entire length of the shore of Mattagami lake. The largest slab observed was about three feet long and two inches thick. With them are boulders of a well-cemented, massive, black rock, composed chiefly of small angular fragments of quartz and feldspar, and showing very prominent, clean-cut jointing planes (see Plate VII-A). It would appear most probable that these erratics were carried here from the region south or west of James bay by the second, southeasterly, advance of the ice.

STRUCTURAL GEOLOGY

The general trend of both bedding and foliation is east-west, being slightly south of east along Mount Laurier ridge and south of MacIvor lake, and slightly north of east along the shore of Mattagami lake and on the hill twelve miles west of MacIvor lake. The sediments and volcanics of the area are tightly folded, with steep dips. The foliation of the gneisses north of Mattagami lake is also in an east-west direction.

In many places, study of the ellipsoidal lavas made possible the determination of the attitude of the flows. For a distance of three miles west and a mile and a half north of Inlet rapids, the tops of the flows were found to face north. This is true also of the lavas exposed on most of the islands to the northwest of the rapids. On the other hand, observations made on the ellipsoidal lavas on the northern end of the largest island at the mouth of Bell river, and, east of this island, along the southern shore of Mattagami lake and thence to the eastern boundary of the map-area, indicate that here the tops of the

flows face south. Thus a synclinal axis is indicated between these zones of opposing dip. This axis, trending east-northeast from a point about midway between the mouths of Bell and Allard rivers, apparently passes by the southern end of the large island mentioned. East of this island, however, between it and the mainland of the bay at the mouth of Bell river, the axis appears to be offset about 2,000 feet toward the north, for there the axis apparently is at a point east of and opposite the northern end of the island. From this point it continues east-northeast, about parallel to the south shore of Mattagami lake, lying just south of the lake as far as the eastern boundary of the map-area.

If the sedimentary rocks are younger than the main body of volcanics, their presence on the north shore of Mattagami lake and on some of the islands would suggest that another syncline passes centrally through the lake.

South of MacIvor lake, the tops of the ellipsoidal lavas are on the north side of the flows, whereas on the hill twelve miles west of this lake, or five miles southwest of Rat lake, the tops are on the south side. A synclinal axis is thus indicated as extending east-northeast from a point south of that hill through or immediately north of MacIvor lake. This syncline may be the westward extension of the one that follows near the southern shore of Mattagami lake, or of the one presumed to pass through the sedimentary belt in the middle of the lake.

The large body of gabbro in the southeastern part of the area was probably intruded into the Keewatin volcanics before they were folded. This is indicated by the stratiform banding in the marginal zones of the gabbro body being parallel to the stratification of the flows (see Plate I-B). Freeman (1) interprets the structure of this body as a tightly folded syncline. This would require an anticlinal axis somewhere south of Inlet rapids, and probably south of Mount Laurier ridge. The several small bodies of gabbro are believed by the writer to be sills injected as offshoots of the main gabbro body, and not to be the same body repeating itself on a series of folds.

There has been much shearing in the area and also faulting, although there are few localities in which an offset can be actually demonstrated. The writer is of the opinion that the straight, southern shore of Mattagami lake is controlled by a strike fault. The most extensive shearing of the area is along the southern side of Mattagami lake and is closely parallel to the general trend of the lake. This shearing is most pronounced in the tuffs. Evidence observed in many places indicates that the relative movement along this shear-zone has been of the northern side to the east. The writer is of the opinion that this zone of shearing continues to the west for a considerable distance, probably passing immediately north of MacIvor lake.

Freeman, B.C., Jour. of Geol., Vol. XLVII, 1939, p. 31.

Several of the shear-zones trend in a northeasterly direction. The most interesting of these are on the Dunlop prospect and on the prospect west of Dunlop bay, along both of which the rock is replaced to some extent by sulphides.

The axis of the syncline along the southern shore of Mattagami lake is offset, apparently by a fault, along the main channel northward from the mouth of Bell river, with the eastern side displaced toward the north. There are many sharp breaks cutting through Mount Laurier ridge, and also through the hills south and southwest of MacIvor lake, in a general north-south direction. It appears probable that the North arm of Mattagami lake and the deep break through Mount Laurier ridge south of the North arm are controlled by a fault; and the same is probably true of Dunlop bay, the large bay northward across the lake from there, and the sharp bay trending southwest from the North arm.

From Inlet rapids to Olga lake, Mount Laurier ridge is bounded by closely parallel sides, and the rocks of the ridge are the same as many in the adjacent lowlands. Also, in many places, the rock structures cut across the general direction of the ridge. These features indicate that the ridge may be bounded by fault escarpments.

ECONOMIC GEOLOGY

Considerable prospecting and some development work was carried on in the eastern part of the area in 1928. At that time, five diamond-drill holes, with a total length of about two thousand feet, were put down on the property of Dunlop Consolidated Mines, Limited, southeast of Dunlop bay, but the results were not of commercial interest. Little prospecting has been done in the area in recent years.

There is much disseminated mineralization in the area. Practically all specimens of greenstone show scattered specks of pyrite or pyrrhotite. Several shear-zones were observed in which there has been considerable sulphide replacement. The larger of these are in fragmental lava and the sulphide is chiefly pyrrhotite. Others are zones in which there has been much silicification and, in some, carbonatization, and in these the chief sulphide is pyrite, with very little pyrrhotite. One interesting deposit which does not fit in either of these groups is a medium grained granite dyke containing considerable chalcopyrite.

Prospecting in the area has been devoted mainly to the sulphide replacement deposits. Although little success has attended these efforts in the past, geological conditions warrant the hope that, eventually, gold or copper, or both metals, will be found in the area in replacement deposits of commercial size and grade.

Four replacement zones were examined in some detail. In order of size as exposed, these are as follows: the Dunlop prospect, about a mile southeast of the southeastern part of Dunlop bay; a zone on the southeastern side of the large bay one and three-quarter miles west of the outlet of Dunlop bay; a zone half a mile east of the outlet of Gouin lake; and a zone three-

quarters of a mile southwest of the southwestern corner of Dunlop bay. Assays were made of selected samples from each of these zones, but no gold or copper values of interest were obtained.

These four sulphide replacement zones have several features in common, and their distribution suggests that they are all genetically related to the Dunlop intrusive. In each of them, pyrrhotite is the replacing sulphide; all are irregular lenses along shear-zones with a general northeasterly trend; and all are replacements in fragmental lava. Often there has been selective replacement of the fragments (see Plate VI-A), but in some places the whole rock has been almost completely replaced by sulphides, within which a little of the fine-grained, sheared matrix appears as streaks or lens-like inclusions.

Where pyrite is present in a replacement zone it often occurs as minute veinlets along fractures in the pyrrhotite, indicating that it is later than the latter. Chalcopyrite is scattered very sparsely through the other sulphides. It is later than the pyrrhotite and probably later than the pyrite.

The surface exposures on the Dunlop property occur along a ridge some four hundred feet long, with a crest about fifty feet wide. The ridge trends about N.55°E. On its northern side it descends rather steeply to a valley about a hundred feet wide. The mineralization is in irregular lenses that parallel the bedding of the sheared lavas and have a general trend N.40°-45°E., with dip 70° to the southeast.

A diamond-drill hole put down at a point near the northeast end of the ridge, on its southern side, cut two wide and two narrow zones of mineralization, with a total thickness of about one hundred and twenty feet (see Fig. 2). This illustrates the lens-like nature of the ore occurrence and also suggests that mineralized zones continue beneath the valley to the north of the ridge. Other drill holes, to the east of that mentioned, show that the thickness of the mineralized zones diminishes rapidly in that direction. A dip-needle survey indicates that the mineralization extends only a short distance west of where it is seen in surface exposures.

A sample (No.21) taken by the writer from the main mineralized zone of the prospect, and another (No. 3) from the same zone, about a thousand feet farther to the northeast, carried only traces of gold (1).

The replacement deposit a mile and three-quarters west of the mouth of Dunlop bay is not well exposed, despite some trenching in former years. It occurs along a zone of shearing, trending about N.60°E., in which striations indicate horizontal movement. The mineralized zone is narrow and irregular. It extends along the shore of the bay for about a hundred and fifty feet, and dip-needle readings suggest that it continues southwestward

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(1) For assays of samples referred to on this and following pages, see table of assay results at end of report.

into the lake for three hundred feet or more. The zone could not be traced northeastward. Three selected samples from this zone, Nos. 6, 7, and 8, were assayed.

East of Gouin lake, two trenches, about four hundred feet apart, have been opened across a mineralized zone which trends N.35°E. The width of mineralization intersected is about thirty feet in each trench. However, intervening rock exposures indicate that the mineralization exposed in the two trenches does not form a continuous body but rather represents two distinct lenses along the zone. Selective replacement of fragments of the fragmental lava is quite marked in this deposit (see Plate VI-A). Two samples, Nos. 19 and 20, were assayed.

The mineralized zone three-quarters of a mile southwest of the southwestern corner of Dunlop bay is similar to those described above, but smaller. There are other similar deposits along the hill to the southeast. Sample No. 13 is from this zone.

Many small shear-zones were observed in the hilly country south of MacIvor lake and on the hill five miles southwest of Rat lake. A majority of these have a general east-west trend and occur in the more silicic phases of the greenstone, particularly in the fragmental lava. A number of them have undergone some hydrothermal alteration and silicification, and are sparsely mineralized with disseminated pyrite. Samples from six of these shear-zones were assayed: Nos. 29, 30, and 31 from south of MacIvor lake; No. 36 from south of Wabassee lake; and Nos. 44 and 45 from the hill five miles southwest of Rat lake. The assay results are not encouraging.

Some trenching has been done on a shear-zone on the eastern side of Bell river, about three-quarters of a mile southeast of Inlet rapids. The zone, which cuts fragmental lava, trends slightly south of east and dips steeply to the south. In places, shearing has been quite strong, and the zone is extensively carbonatized and to some extent replaced by pyrite. Sample No. 16, from this locality, contained a negligible amount of gold. What may be a continuation, or a branch, of this shear-zone is seen on the west side of the river. In some places there is pyrite replacement, and sample, No. 15, taken here assayed about fifty cents per ton in gold.

A small shear-zone, trending N.60°E., on the northwestern side of the island which lies a mile and a half west of the outlet of Dunlop bay shows some pyrite replacement and also stringers of pyrite in tension cracks. Sample No. 9, taken from this zone, showed no values of interest.

There is slight shearing in the greenstone at two points along the south shore of Kitchigama lake, one about a mile, and the other half a mile, northwest of the mouth of Imbeault river. The shear-zones are sparsely mineralized with pyrite and in some places with chalcopyrite. Considerable carbonate occurs locally in some of the zones. A narrow rhyolite dyke that is highly sheared and mineralized with pyrite cuts the greenstone, trending slightly south of east. Several samples from these localities

were assayed but, with one exception, they contained no values of interest. Samples 41 and 48 were taken from the greenstone area about a mile northwest of Imbeault river. Sample 42 is from angular boulders of sheared rhyolite along the lake shore in this area; these were extensively silicified and mineralized with pyrite. The writer is of the opinion that they are lying only a few feet from their source. Samples 39, 47, and 49 are from a small rock-island about 500 feet off-shore from the eastern end of this zone of shearing. Sample 47 is from a narrow quartz stringer that contains some chalcopyrite mineralization.

Sheared greenstone, in an exposure about five feet long, was seen again at a point about half a mile northwest of the mouth of Imbeault river. The zone of shearing trends north-south and is slightly silicified and mineralized with chalcopyrite, which appears in small, irregularly distributed patches replacing the country rock, and in stringers traversing it. A selected sample, No.46, from this occurrence assayed 0.162 oz. gold per ton. A few feet north of this exposure is a narrow, sheared rhyolite dyke, trending slightly south of east, mineralized with pyrite, and a few feet to the east the greenstone, sheared in an east-west direction, contains numerous small crystals of garnet and is slightly mineralized with chalcopyrite. The gold content, however, is negligible (sample No. 40). Assay of a sample (No. 38) taken from a zone of slight shearing about a quarter of a mile north of the mouth of Imbeault river also showed only a trace of gold.

Near the eastern end of the southern shore of Kitchigama lake, at the contact between the Kitchigama granite and the greenstone, there is a zone of shearing, trending slightly south of east, that has been extensively silicified and mineralized with pyrite. It carries practically no gold, however (sample No. 43).

Two miles west of the outlet of Dunlop bay there is a rounded point, the northern side of which consists of granite. Immediately south of the granite, a rhyolite dyke extends across the point. It is about fifteen feet wide, trends slightly north of east, and dips steeply to the south. The dyke is strongly sheared and is also silicified. At the western end of the exposure it has been extensively mineralized with pyrite, and at the eastern end, also, there has been considerable mineralization. Assay of a sample, No. 5, from the eastern end yielded neither gold nor silver, and one from the western end, No. 10, showed only traces of the precious metals.

Along the eastern shore of Allard river, about three miles east-southeast of MacIvor lake, a series of five rocky points, spaced over a distance of about a thousand feet, jut out into the river. The individual points are narrow, and between them there are breaks in the rock exposures along the river shore. Over most of this section, the rock is a medium grained light coloured granite containing little dark mineral, or a rhyolite containing abundant phenocrysts of quartz and feldspar, or some type intermediate between these. In the southern part of the section, the granite and rhyolite occur as easterly trending dykes cutting basic greenstone, but in the northern part little

greenstone is present. Over a width of three hundred feet across the northern part of the section, the rock is strongly sheared in a direction slightly south of east, and there are many irregular zones and stringers heavily mineralized with pyrite. The rock on each of the rocky points referred to contains more or less disseminated pyrite. Four selected samples (Nos. 33, 34, 35, and 36) from the northern part of the section, and one (No. 32) from the southern part, gave negligible assays for gold.

Quartz veins are exposed in shear-zones at four points along the southern shore of Mattagami lake, as follows: three-quarters of a mile from the eastern boundary of the area; three-quarters of a mile east of the outlet of Dunlop bay; on the eastern side of the point a mile and three-quarters west of the outlet of Dunlop bay; and on the island just east of the outlet of Dunlop bay. There is some mineralization, chiefly pyrite, in the three first named localities, but assays of samples (Nos. 2, 1, and 4, respectively) gave negligible values in gold. The vein at the fourth locality is only about four inches wide and is exposed for a length of not more than six feet. It is a grey-black, massive quartz that has been somewhat sheared, and is mineralized, chiefly along the zones of shearing, with considerable pyrite, and some chalcopyrite, pyrrhotite, and galena. A sample (No. 12) from this vein assayed only 0.007 oz. gold and 0.097 oz. silver per ton, and 0.38 per cent copper. However, the vein appears worthy of further examination.

On a small island of ellipsoidal lava, a mile and a quarter northwest of Inlet rapids and a quarter of a mile west of Indian Cemetery island, a zone of slight shearing, trending about north-south, contains three narrow quartz veins that are not over two inches wide. Scattered pockets of chalcopyrite occur in irregular fractures along the veins. A sample (No. 18) of the chalcopyrite assayed 0.344 oz. gold (about $12) per ton. This vein in itself is not of commercial interest, but the surrounding area merits close examination. About half a mile south of the island many similar quartz veinlets were observed that are heavily iron-stained, but in these no chalcopyrite was seen.

There are frequent exposures of banded tuffs along the southern shore of Mattagami lake. These are near the axis of a syncline and they have been extensively sheared in an east-west direction. This shearing, and the silicification, carbonatization, and mineralization, are most intense along the western and central parts of the south shore of the lake than farther eastward. Six samples from mineralized zones in the tuff were assayed. Two of these were taken at points east of the mouth of the Bell river, one (No. 27) half a mile northeast, and the other (No. 26) three-quarters of a mile northeast, of the northern end of the largest island at the mouth of the Bell river. Sample No. 17 was taken from a small island three-quarters of a mile west of the north end of this island. The remaining three samples (Nos. 23, 24, and 25) were taken from zones two and three-quarters miles west and slightly north of Inlet rapids. Of the six samples assayed, No. 23 contained no gold and gold values in the others ranged from 0.003 oz. to 0.030 oz. per ton. No. 24, which yielded the highest value, was nearly pure pyrite.

A sample (No. 28) from a large boulder found near the northeastern end of the small island half a mile north of Indian Cemetery island contained a 'trace' only of gold and silver and 2.64 per cent copper. A belt of tuff crossing the northeastern corner of this island is strongly sheared and extensively carbonatized. The boulder referred to is sharply angular and identical in appearance with the rock of the shear-zone. The writer is of the opinion that the source of the boulder is in the immediate vicinity of the island, and probably in the same shear-zone as that which crosses the point.

On the eastern shore of Bell river at Channel rapid, a medium grained, massive anorthositic band in the gabbro, trending slightly south of east, has been somewhat brecciated and sheared in places, and contains considerable disseminated pyrite. Sample No. 22, of this material, assayed 0.006 oz. (about twenty-one cents) in gold per ton.

There is an interesting granite dyke a quarter of a mile south of the narrow, deep bay which is one mile west of the outlet of Dunlop bay. It cuts the eastern end of a small ridge of massive andesite, with strike N.65°E. The dyke is exposed for a length of about thirty feet, chiefly as a result of stripping by prospectors. Its width is very irregular and would probably average about ten feet. The dyke is medium grained, grey, biotite granite, containing about five per cent biotite and twenty per cent very fine-grained quartz, and it is well mineralized with disseminated chalcopyrite and some pyrite (see Plate VI-B). A thin-section study showed that the chalcopyrite is associated with the quartz, occurring as an irregular replacement between quartz grains. Although this replacement has a somewhat linear arrangement, the chalcopyrite in the thin section examined was not observed in fractures, nor was there any evidence of healed fractures extending from the replaced zones. This relation of the chalcopyrite suggest that, although it was formed later than the quartz, it may have been an original constituent of the magma of the dyke. If this is so, it is quite probable that there may be rich copper concentrations in the other rocks in the vicinity of the dyke. Sample No. 11 from this dyke assayed 0.005 oz. gold and 0.099 oz. silver per ton, and 0.53 per cent copper. While such values, of themselves are not of commercial interest, the occurrence appears to merit further prospecting.

In general, the zones of contact between the several intrusives and the greenstones may be considered as the most favourable places for prospecting. Unfortunately, exposures are rare in the vicinity of such contacts, except in the case of the Dunlop intrusive. South and west of MacIvor hill there are considerable areas of greenstone exposed near the intrusive bodies which occur there, and west of the mouth of Imbeault river there are several exposures of favourable looking greenstone that are near the margin of the Kitchigama granite.

In prospecting in the vicinity of the Dunlop intrusive, it might be well to bear in mind the fact, noted on an earlier page, that the more extensive zones of sulphide mineralization associated with this intrusive body occur in shear-zones which trend in a northeasterly direction, and more particularly where these shear-zones cross belts of fragmental lava. Just north of

Mount Laurier there is a zone of strong local magnetic attraction which may be of some significance.

The most persistent zone of shearing in the area is that along the southern shore of Mattagami lake, and this shearing is most evident in the belts of tuff. It is the opinion of the writer that this shearing was a major factor in controlling the general alignment of the southern shore of the lake. In many places along the exposed portions of this zone, extensive carbonatization, and some silicification and pyritization, of the tuffs, has taken place. If, as the writer believes, the boulder, mineralized with chalcopyrite, found on the island north of Indian Cemetery island is from this zone, there are at least local zones of chalcopyrite mineralization along this main shear-zone. The greater part of the zone is under the lake, so that any programme of investigating would possibly have to be carried out largely by geophysical methods.

No zone of mineralization of definite commercial interest has yet been discovered in the area. However, the southern half of the area, which bears some resemblance to the Chibougamau district, offers definite possibilities. Due to the sparsity of outcrop, prospecting will of necessity be largely limited to the series of ridges and hills extending as a belt south of Mattagami and MacIvor lakes. Both gold and copper mineralization may be expected.

It is possible that there is nickel and chromium mineralization along or adjacent to the margin of the large gabbro body in the southeastern part of the area. This should be borne in mind in any prospecting in the vicinity of this body.

Assay Results

Sample Number	Gold oz./ton	Silver oz./ton	Copper %
1	none	none	
2	trace	trace	
3	0.002	none	
4	0.002	trace	
5	none	none	
6	none	none	0.12
7	trace	trace	
8	0.002	trace	
9	trace	trace	
10	trace	0.025	
11	0.005	0.099	0.53
12	0.007	0.097	0.38
13	0.005	0.020	
14	0.008	trace	
15	0.016	none	

Assay Results (Continued)

Sample Number	Gold oz./ton	Silver oz./ton	Copper %
16	0.002	trace	
17	0.003	none	
18	0.344	0.876	
19	trace	0.020	
20	none	trace	
21	trace	0.070	
22	0.006	0.025	
23	none	none	
24	0.030	0.100	
25	0.008	trace	
26	0.010	trace	
27	0.015	trace	
28	0.004	0.055	2.64
29	0.007	-	
30	0.010	-	
31	0.006	0.346	
32	0.008	0.094	
33	0.004	0.046	
34	0.010	trace	
35	trace	0.022	
36	0.009	0.141	
37	0.006	0.032	
38	trace	0.035	
39	0.045	0.060	
40	0.008	trace	
41	0.004	0.022	
42	0.008	trace	
43	0.007	0.038	
44	0.008	0.028	
45	0.022	0.042	
46	0.162	-	
47	0.016	-	
48	0.002	-	
49	0.003	-	

All samples were taken by the writer and assayed in the Quebec Laboratories of the Bureau of Mines.

Copper determinations were made only on samples where percentage of copper is shown.

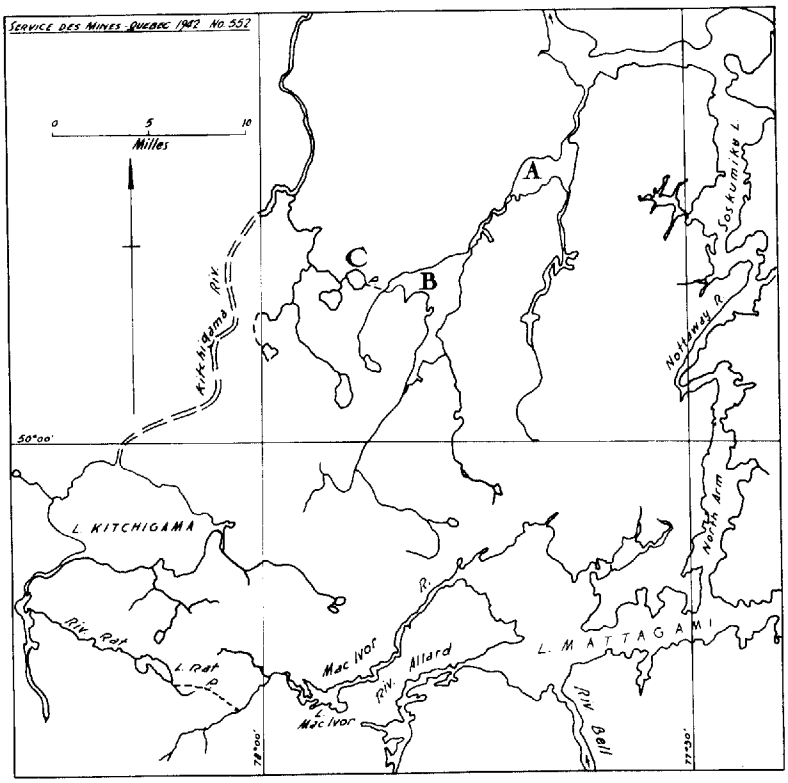

Figure 1.- Map showing routes, Mattagami lake to Kitchigama lake.

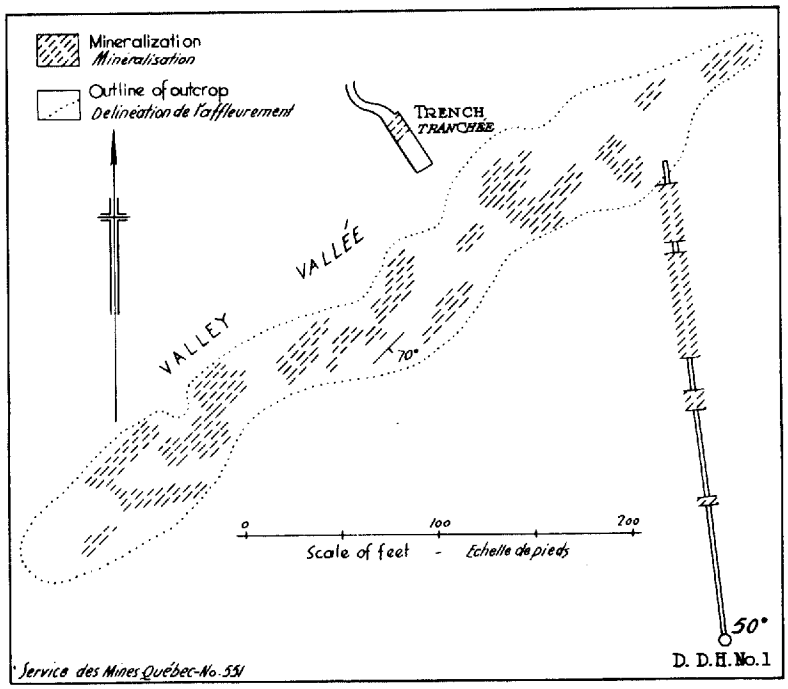

Figure 2.- Plan of exposed mineralization, Dunlop prospect.

ALPHABETICAL INDEX