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PUSTICAMICA LAKE MAP-AREA, ABITIBI DISTRICT

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PROVINCE OF QUEBEC, CANADA

BUREAU OF MINES

Honourable J. E. PERRAULT, Minister of Mines

J. L. BOULANGER, Deputy-Minister — A. O. DUFRESNE, Director

ANNUAL REPORT

OF THE

QUEBEC BUREAU OF MINES

FOR THE CALENDAR YEAR

1934

JOHN A. DRESSER, Directing Geologist

PART C

QUEBEC

PRINTED BY R. PARADIS

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by G. S. MacKenzie

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PUSTICAMICA LAKE MAP-AREA

ABITIBI DISTRICT

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INTRODUCTION

General Statement

Much geological work has been done in the Abitibi district, both by the Quebec Bureau of Mines and the Geological Survey of Canada. The more detailed studies have naturally been confined to those parts of the district in which mineral deposits have been discovered, *viz.*, to the wide area in the southwest part of the district lying south of the Quebec-Cochrane branch of the Canadian National railways and extending eastward from the Quebec-Ontario boundary to the Bell river; and to the Chibougamau region in the northeast part of the district, north of the railway. In the intervening large stretch of country, the geological work has been almost entirely of a reconnaissance character, along the main water routes. The writer spent the greater part of the 1934 field season in examining the geology of an area in the vicinity of Pusticamica lake, in this lesser known part of the Abitibi district. It was known that here, as in other parts of the general region, Keewatin rocks were prominently developed, and choice fell upon this particular area because a base-map, prepared from aerial photographs, was already available.

This and adjacent areas have been the scene of a limited amount of prospecting from time to time over a period of years, and latterly they have received further attention because of new discoveries in the Senneterre area to the southwest and in the Chibougamau and Opemisca areas to the northeast. Up to 1934, no important mineral deposits had been discovered. However, in the fall of 1934, an interesting gold discovery was made at Madeleine, or Rose, lake, just a few miles northwest of the map-area. A description of this occurrence is given in Part *A* of the Bureau of mines report for 1934, page 125.

Location and Access

Pusticamica lake is 75 miles north of the main line of the Canadian National railway and 30 miles east of the Bell river. It is about 100 miles west, and somewhat south, of Chibougamau lake, and 10 miles south of Waswanipi lake. An area of approximately 450 square miles was examined and mapped. Its west boundary is some three miles west of longitude 76°30′, and the east boundary a similar distance east of longitude 76°00′. The north boundary extends from a point about six miles south of latitude 49°30′ at the west end of the area to a point one mile north of it at the east end. The south boundary is a few miles south of latitude 49°15′ at the west side of the area and a few miles north of it on the east side.

The area is best reached by canoe from the town of Senneterre, on the Canadian National railway, by way of the Bell and Wedding rivers and Otter creek. The Wedding river enters the Bell from the east at a point about 55 miles in a straight line north of Senneterre. Near the headwaters of the Wedding river there is a portage across a height-of-land to Otter creek, a tributary of the O'Sullivan river, which drains Pusticamica lake. Along the Bell River portion of this route there are ten portages, or fewer when the water level is high. The longest is half a mile; but instead of making five successive short portages just south of the mouth of the Taschereau river, an alternative single portage of three miles may be taken. There are nine portages on the Wedding river, two of which are half a mile in length, two a quarter of a mile, and the remainder only a few chains each. The rapids at several of these portages, even some of the longer ones, can be 'run' going downstream provided the water is not too low. The height-of-land portage between the Wedding river and Otter creek is two miles long, and is flat and well cleared. There is one portage of a quarter of a mile on Otter creek and three shorter ones. An outboard motor can be used over the whole route, except for a short distance on the upper part of Otter creek. Travelling light, the trip from Senneterre to Pusticamica lake can be made in a week, or even less.

A somewhat longer route to the mouth of the Wedding river, but one requiring less portaging, is down the Laflamme river, starting from the end of the Morandière road, which runs for 17 miles north

from the town of Barraute. The Laflamme enters the Bell about 11 miles by water north of the mouth of the Wedding river, with no intervening rapids.

Another route into the area, with more portaging than the last, is by ascending the Megiscane river from the point where it is first crossed by the railway west of Doucet. About 25 miles northeast of the railway the route turns north, and by way of several creeks and lakes and a height-of-land portage, Wetetnagami lake may be reached. From there, either the river of that name may be followed into the southeast corner of the area, or a portage may be made to the O'Sullivan river, which flows into Pusticamica lake.

Canoe routes also extend northward from the area to Waswanipi lake and eastward to the Chibougamau region. The Hudson's Bay Company maintain a post at the north end of Waswanipi lake.

Within the area, there is a good canoe route from Pusticamica lake to Lichen lake, by way of Maloin creek and lake. Several other creeks in the area are navigable for some miles. The rapids and portages on these are indicated on the map which accompanies the report. Both the O'Sullivan river south of Pusticamica lake and the Nicobi river between Nicobi and Lichen lakes are difficult to ascend because of long boulder rapids.

Topography and Drainage

The area is east of the clay belt, which extends from the general vicinity of the Bell river westward to and beyond the Quebec-Ontario boundary. Consequently, it has more lakes and a somewhat more rugged topography than is characteristic of the region immediately to the west. Much of it is covered by a heavy mantle of unstratified glacial deposits.

There are three lakes in the area with dimensions of several miles. These are Pusticamica, the largest, in the western part of the area, and Nicobi and Lichen in the eastern part. In addition, there are a number of smaller lakes. The lakes are all shallow and for the most part do not occupy pronounced depressions, and the same may be said of the rivers and creeks. Exceptions to this are the western parts of the two westerly bays of Pusticamica lake.

These bays, and the two creeks which flow from the southwest into the extremities of each of them, lie in quite marked valleys. Pusticamica lake has an elevation of 744 feet, and Lichen lake 841 feet (1).

The land portion of the area has a generally hummocky surface, with occasional ridges rising to 100 feet or so above its general level, and a few higher hills. The most prominent of these hills is just south of the middle part of Pusticamica lake. It rises sharply to a height of between 500 and 600 feet above the level of the lake. Other hills, less prominent but nearly as high, are southwest of the west end of Lichen lake, north of the southwest end of Nicobi lake, and west of the south end of Opawica lake. The relation of these hills, and of the topography in general, to the geology of the area is considered in a later section of the report.

The map-area is in the basin of the Nottaway river and is drained northward by two subsidiary tributaries of that river, the Wetetnagami and the O'Sullivan, each of which has its source not far south of the area. The Wetetnagami passes through the eastern part of the area and joins, through Nicobi lake and river, with the Opawica river from the east at Lichen lake. Lichen lake is continuous with Opawica lake to the north, which empties into the Waswanipi river. The O'Sullivan river is in the western part of the area and it, also, discharges into the Waswanipi river, by way of Pusticamica and Waswanipi lakes. Wetetnagami lake, to the south of the area, has an elevation of 1,055 feet, and Waswanipi lake, to the north, an elevation of 680 feet. The difference between these elevations will serve to indicate the rather steep gradient of the rivers flowing through the area. The Waswanipi river drains into the Nottaway by way of Gull, Olga, and Mattagami lakes.

Soil, Timber, and Game

Most of the area is not suitable for cultivation. However, there are occasional stretches, occupied by unstratified clay containing only a few boulders, which are fairly level and well-drained. In 1896, some successful experiments in growing grain and vegetables were made at the Hudson's Bay Company's Waswanipi post at the instigation of Robert Bell, of the Geological Survey of Canada (2).

(1) Geol. Surv. Can., Nottaway Sheet, 1927.

(2) Geol. Surv. Can., Ann. Rept., Vol. IX, Pt. A, 1896, pp. 70-71.

The timber over the greater part of the area is a regrowth after one or more forest fires, none of which have been very recent. It consists of small poplar, spruce, jack pine, and birch. Many of the swampy areas that were swept by the fires are thickly grown with alder. In places near the lakes, creeks, and larger rivers, and in the muskegs not burned over in earlier years, the timber is of good size. The best growth of spruce seen is along Otter creek, many of the trees being six to eight inches in diameter. There is a good deal of cedar around the shore of Pusticamica lake, and small tamarac are fairly numerous along Mountain creek.

A number of moose were seen during the summer, but no deer. Trapping of fur-bearing animals is carried on in the area in the winter time. Fish do not appear to be plentiful. A few pike and pickerel were caught in the larger lakes, but no trout.

Previous Work

The first geological work in the area was done by R. W. Brock, in 1896. In that year, acting as assistant to Robert Bell, of the Geological Survey of Canada, he passed through the area in the course of a trip from Parent lake to Waswanipi lake by the Migiscan and O'Sullivan rivers, Pusticamica lake and river. No special mention of the area is made in Bell's reports on *the Basin of the Nottaway River* (1), but the results of Brock's observations are shown on the map which accompanies his 1900 report. The area is also included in the *Nottaway sheet* compiled by H. C. Cooke, of the Geological Survey of Canada, in 1927. More recently, the shore geology of Pusticamica lake and the outcrops on the Pusticamica river north of the lake were examined by A. H. Lang (2), of the Geological Survey of Canada, whose work covered a wide stretch of country north and west of the lake.

Nature and Scope of Work

Though the work done during the summer of 1934 was in more detail than the earlier explorations in the area, it was still little

(1) Geol. Surv. Can., Ann. Rept., Vol. IX, Pt. A, 1896, pp. 64-74; Vol. XIII, Pt. K, 1900.

(2) Geol. Surv. Can., Summ. Rept., Pt. D, 1932, pp. 36-43.

more than a reconnaissance survey. Land traverses were run at half-mile intervals over most of the area. Towards the latter part of the season, the writer was obliged to go to the Chibougamau region. In consequence, only a hasty examination was possible of the eastern part of the map-area, and it was necessary to abandon a projected exploration of the country south and southeast of Waswanipi lake.

The base-map on which the geology is shown was plotted by the Topographical Survey of Canada from aerial photographs made by the Royal Canadian Air Force, the ground survey work having been already done by the Department of Lands and Forests of Quebec. Micrometer surveys were made by the writer and party in a small part of the area not covered by the photographs.

The aerial photographs and a stereoscope were used in the field and proved of great assistance in locating outcrops and estimating the navigability of creeks.

Acknowledgments

The writer is indebted to Mr. G. R. Burge and Mr. W. L. Rochester, of Prospectors' Airways, Limited, for information and many courtesies received during the season. Thanks are also due to Messrs. F. W. Bone and J. H. Lymburner, pilots for Canadian Airways, who brought supplies and mail to the party during the summer. Some of the aerial photographs used were kindly loaned by the Topographical Survey of Canada. The writer is also indebted to Professor F. F. Osborne, of the Department of Geological Sciences, McGill University, for assistance in examining some of the thin sections of rocks from the area. Very helpful assistance in the field was rendered by Paul Auger, École de Chimie, Quebec, senior assistant; and by Paul Descoteaux and Paul Normandeau, École Polytechnique, Montreal, and Alexandre Labrèque, junior assistants. M. L. Laviolette, of Otter Creek, Quebec, satisfactorily discharged his duties as cook, and Laurent Chiasson, of Senneterre, was a capable canoeman.

GENERAL GEOLOGY

The consolidated rocks of the region are all of Precambrian age. A major belt of Keewatin rocks, mostly altered volcanics, extends

in a northeast-southwest direction across the area, and beyond its limits in both directions. In the northeastern part of the area, some sediments of apparently Temiscamian age are infolded into the volcanics. This major belt of volcanics and infolded sediments is bordered to the north and south by batholithic areas of granite and allied rocks. Minor bands of volcanics occur within the areas of granite, and stock-like and irregular intrusions of granite and older gabbro and diorite occur within the areas of Keewatin rocks. The granitic and older rocks are intruded by quartz diabase, and also more acidic, dykes.

The Precambrian rocks are overlain by unconsolidated deposits of Pleistocene and Recent age.

TABLE OF FORMATIONS

RECENT AND PLEISTOCENE	Boulder clay, gravel, sand
Great Unconformity	
KEWEENAWAN(?)	Bostonite, quartz diorite porphyry Quartz diabase
Intrusive Contact	
UPPER TEMISCAMIAN (ALGOMAN)	Aplite, pegmatite, granite, granite gneiss, granodiorite Diorite, gabbro
Intrusive Contact	
LOWER TEMISCAMIAN	Conglomerate, arkose, greywacke
Unconformity	
LOWER LAURENTIAN (KEEWATIN)	Diorite, rhyolite, trachyte, andesite, tuffaceous sediments, amphibolite, mica schist

NOTE:—The above Table of Formations is based on the nomenclature suggested by the National Committee on Stratigraphical Nomenclature (Trans. Roy. Soc. Can. 1934, Section IV, page 119).

KEEWATIN

The major belt of Keewatin rocks has a northeast-southwest trend and varies in width from 5 to 10 miles. It is narrowest in the central part of the area and widens towards the southwest and probably also to the northeast. In the southwestern part of the belt, the continuity of the volcanics is much interrupted by intrusions of granite and older diorite and gabbro, some of which have dimensions of several miles. Exploration in the eastern part of the area did not extend to the northern contact of the volcanics, but the belt would appear to widen to the northeast, as Keewatin rocks occur on Opawica lake in that direction. A smaller band of Keewatin rocks and intrusive diorite between Lichen and Nicobi lakes was traced westward from the Nicobi river for five miles, within which distance it has a maximum width of two miles. The country eastward from the river was not explored.

The Keewatin in this area is represented by fine-grained, greyish, and light to dark green, sericitic and chloritic rocks, which exhibit various degrees of schistosity. They would appear to be, in large part, altered volcanics of intermediate composition, as trachytes and andesites, though the metamorphic equivalents of rhyolites and basalts are also present. Interbedded flows of diverse composition were observed in places. Pillow structure was rarely seen, the best preserved examples being in the southwestern part of the area. A porphyritic texture in the andesite was noted in two places, in one of which the phenocrysts of feldspar are two inches in length. Brecciated structure was frequently seen. A few outcrops of banded, siliceous tuff were noted on the islands and mainland around the northeast end of Pusticamica lake.

North of this lake and eastward, the volcanics in many of the outcrops are highly carbonatized. At several places in the area, amphibolite has been developed in the volcanics along their contact with the granite. Occurrences of similar rock, associated with biotite schist within the areas of granite, would appear to be altered remnants of the volcanics.

In addition to the larger masses of diorite and gabbro intruding the volcanics, there are sills and dykes of similar composition. Some of these were intruded, as were the larger bodies, after the major

folding of the Keewatin rocks, but others are as highly deformed and altered as the volcanics and probably represent a late phase of the Keewatin igneous activity (see Plate I-B).

Temiscamian

Several outcrops of sedimentary rocks occur north of Auger lake and creek, in the northeastern part of the area. These were found towards the end of the season, when little time was available for their close examination. The sediments have the characteristics and geological relationships of rocks elsewhere in the Precambrian which are considered to be of Temiscamian age. They would appear to be a southwesterly extension of a band of sediments which are reported to outcrop on the central part of Opawica lake, to the northeast.

Volcanics outcrop on the south of the west part of Auger lake and creek. Just north of Auger creek, at its discharge from the lake, is an outcrop of a rock which resembles an agglomerate, except that some of the fragments of volcanic material appear water-worn. About half a mile west of this outcrop is another, in which conglomerate is exposed over a width of twenty feet. Pebbles form more than 50 per cent of the rock. They are mostly of acid to basic volcanic material, but there are some of massive, grey hornblende granite and others of grey and white quartz. The granite pebbles are well rounded and up to one foot in diameter. Those of volcanic material are somewhat flattened. The matrix is a fine-grained greywacke. A few hundred feet northeast of this outcrop, two bands of similar conglomerate, each about two feet wide, are interbedded with a coarse-grained arkose. The bedding planes strike N.42°E. and dip 70° to the northwest. Other outcrops of the sediments were seen farther northeast. Highly foliated talcose and chloritic schists occur between these outcrops and the granite around the east end and north of Auger lake. The origin of these schists is doubtful, and some part of them may be altered sedimentaries.

Post-Temiscamian Intrusives

The post-Temiscamian intrusives may be conveniently divided into three groups according to their age: the older diorite and gabbro,

the granites and associated rocks, and the younger (post-granite) dyke-rocks.

OLDER DIORITE AND GABBRO:

The older diorite and gabbro occur as sill-like and irregular bodies, some of them of considerable size, within the areas of Keewatin rocks. Smaller masses also occur within the areas of granite.

The bodies of diorite and gabbro within the greenstone areas are commonly elongated in a direction parallel to the trend of the older formation. The largest, apparently continuous, body of such rocks is south of Mountain creek and the southwest bay of Pusticamica lake. It extends for ten miles southwestward from the O'Sullivan river, within which distance it has a maximum width of two miles, or possibly more. Most of this body is medium to fine-grained gabbro, dark green in colour, quite massive in some places and markedly foliated in others. Under the microscope, the chief constituents are seen to be secondary yellowish-green hornblende with a few of the original augite grains still recognizable, and lime-soda plagioclase. The latter is highly saussuritized. In places, secondary albite and quartz, in micrographic intergrowth, are present. Magnetite and ilmenite, the latter partly altered to leucoxene, are common accessories. In some outcrops, the rock has a dioritic composition and contains dark brown biotite in addition to hornblende; in others, particularly near the margins of the body, a few grains of bluish opalescent quartz may be seen in the hand specimen. Across some isolated outcrops, there appears to be a gradation from the gabbro and diorite, through quartz diorite, to granodiorite and granite. In other places, granite definitely intrudes the gabbro, and where such is the case, the quartz diorite, if present, may be only a contact facies of the granite. However, it is possible that the gabbro, diorite, and quartz diorite are earlier differentiates of the magma which later gave rise to the granite.

Smaller, less continuous masses, mostly of dioritic composition, were observed between the northwesterly bays of Pusticamica lake and Mountain creek, and in the band of Keewatin rocks between Lichen and Nicobi lakes. In these two localities, the rock is generally fine-grained and is difficult to distinguish from the volcanics. At some

points, it has a porphyritic texture, with phenocrysts of feldspar up to two inches in length.

The gabbro was not observed to cut the Temiscamian sediments, but north of Auger lake an outcrop of gabbro was found directly in the strike of the sediments.

The smaller masses of diorite and gabbro within the areas of granite are in places difficult to distinguish from amphibolite developed by regional metamorphism of the volcanics. Under the microscope, the amphibolites are characterized by a high proportion of bright-green hornblende and comparatively fresh plagioclase, in contrast to the paler, uralitic hornblende and altered feldspar of the diorite and gabbro.

Granite and Associated Rocks:

The granitic rocks of the area range in composition from granodiorite to aplite and pegmatite. It was not possible in the limited time available to study all the occurrences of these rocks in sufficient detail, either in the field or microscopically, to permit of the precise differentiation or classification of the several types represented, and, as a consequence, they are not everywhere separately delineated on the accompanying map.

Granite gneiss, in general not very markedly foliated, occurs along, and south of, the south contact of the major belt of Keewatin rocks. The gneiss is mostly grey in colour, but there are pink varieties along the Nicobi river and at the north end of Nicobi lake. Hornblende is the most common ferromagnesian constituent of the rock, though many facies have biotite as well, or alone. Muscovite is present to the exclusion of both these minerals in some of the gneiss around Auger lake and the south end of Opawica lake. Thin sections of the granite gneiss from several localities show albite to be the predominant feldspar, though with some orthoclase. Quartz is usually quite abundant. In places, notably on the high hill southwest of Lichen lake, there are rocks having the composition of granodiorite; and north of Auger lake, the granite gneiss is low in ferromagnesian minerals but contains abundant quartz and a considerable amount of soda-lime feldspar. In both these localities, and particularly in the latter, the rocks have been sheared and appear to have been subjected to hydrothermal alteration.

In the larger, stock-like, intrusions of granite within the major belt of greenstones, the rock is pink in colour and massive in texture. The only place where granite was seen north of the greenstone belt was along Otter creek, where, also, the granite is pink and massive, but has a porphyritic texture. These masses seem to be more acidic than the granite gneisses, since the rock contains a higher proportion of quartz, and albite, though present, is less abundant than orthoclase and microcline. However, in other, smaller intrusions of grey, massive granite within the greenstone area, albite is the chief feldspar, as in the gneisses.

No large areas of syenite were seen, though both the granite and granite gneiss grade into facies deficient in quartz, particularly near contacts with the volcanics.

Pegmatite dykes are of rare occurrence in the area. A few were noted cutting the volcanics. One near the west end of Pusticamica lake contains large crystals of white feldspar enclosed in grey, dull-lustre quartz. The others noted also had white feldspar, but the quartz was white and glassy.

Dykes of fine-grained aplite occur in a number of places. There are several such dykes intruding the granite gneiss around the south end of Opawica lake, in one of which small specks of molybdenite were observed. In these and the similar dykes elsewhere in the area, albite feldspar and quartz are the chief constituents.

Dykes of coarse-grained feldspar porphyry, such as occur in the vicinity of Madeleine lake to the northwest, were not observed in the area, though some of the aplite dykes contain occasional phenocrysts of quartz or feldspar or both.

Intrusive relations were not observed between the several types of granitic rock, except that a basic phase of the granite gneiss on Lichen lake is cut by a dyke of biotite granite. Also, on Nicobi lake, a pegmatite dyke is intersected by a later dyke of aplite. The absence of foliation in the granitic intrusives within the greenstone area would suggest that they are younger than the granite gneiss, though probably the two are genetically related.

Granite was not observed to intrude the Temiscamian sediments. However, the metamorphism of the sediments and their areal and structural relations to the volcanics and granite gneiss around Auger

lake indicate that the granite gneiss is younger than the sediments. The only evidence in the area of a granite older than the Temiscamian is the fact that granite pebbles are found in the conglomerate of this formation. For the present, therefore, all the granites are assigned to the Algoman period of igneous intrusion. A pre-Cobalt age is suggested by the fact that, at a number of places, they are cut by dykes of quartz diabase, and also by reason of their lithological similarity to granites of that age in the southwest part of the Abitibi district.

YOUNGER (POST-GRANITE) DYKE ROCKS:

Dykes of quartz diabase intruding the granite and older rocks were observed at a number of places in the area. Post-granite dykes of more acidic composition were also observed, but only in the northeastern part of the area.

The diabase dykes range in width from less than a foot to 200 feet and more. The larger dykes are medium to fine-grained, with the ophitic character generally apparent. They usually have a chilled edge. The smaller dykes are fine-grained, resembling in texture the chilled edge of the larger dykes. The rocks weather a greenish-brown. Though fresh-looking in hand specimen, they are seen, under the microscope, to be somewhat altered. A little quartz is present in most of the thin sections examined, but in none of them was olivine observed.

The diabase occurs chiefly in the region to the southwest of a high hill south of the middle part of Pusticamica lake. Some of the outcrops are aligned, suggesting that they are parts of one dyke; in other places, smaller dykes can be traced for less than 100 feet. Evidently, there is a zone of diabase intrusion extending northeasterly across this part of the area. The zone may continue farther northeast and east, as other dykes of diabase occur near Auger lake and at the south end of Opawica lake. The strike of the dykes is about northeast-southwest in the southwestern part of the area and east-west or slightly south of east in the northeastern part.

It is possible that this zone of diabase intrusion is continuous with the large dyke, or series of dykes, described by L. V. and A. M. Bell (1), which extends northward through the Senneterre area to

(1) Que. Bur. Mines, Ann. Rept., Part B, 1933, pp. 32-33.

Wigwam island, in Parent lake, for a distance of 35 miles. When going to the field, the writer made a hasty trip to Moose mountain, a high hill in Tonnancour township, north of Parent lake. The central portion of the mountain, and a long ridge to the southwest in line with Wigwam island, are composed of diabase. Thus the zone of diabase extends an additional 15 miles north and northeast of Wigwam island and may well continue across the 30 miles or so between Moose mountain and the southwest part of the area under consideration.

The post-granite dykes of more acidic composition than diabase were observed around the south end of Opawica lake. They are from less than one foot to four feet wide. Lack of outcrop prevented an estimate of their length. Eight of the ten dykes observed occur within a range of 500 feet. Their strikes vary from S.15°E. to S.45°E., and their dips from 60°W. to 80°E. One of the dykes is noticeably sheared along its margins and is crossed by fractures in a direction of S.20°W. The rocks are dark in colour and medium- to fine-grained in texture. Some of them contain small phenocrysts of feldspar. A thin section showed the phenocrysts to be highly altered. In the groundmass are altered albite and possibly more basic plagioclase, uralitic hornblende, and considerable quartz, suggesting that the dykes have the composition of quartz diorite porphyry.

Four miles east of Opawica lake is a prominent ridge with a direction S.35°E. Rock outcrops along it for 2,000 feet and across it for several hundred feet. The ridge was not examined by the writer, but specimens from it were obtained by P. Descoteaux. These specimens and the direction of the ridge suggest that it represents a dyke related to the smaller ones described in the last paragraph, though intrusive contacts with granite or older rocks are not exposed. The specimens vary sufficiently to suggest that there was more than one stage of intrusion. One specimen is like the dykes near Opawica lake, though slightly less altered and containing more orthoclase and less uralitic hornblende; another is fine-grained with occasional phenocrysts of feldspar and, under the microscope, is seen to have the composition and petrological characteristics of a bostonite; and a third is similar, except that it contains a few phenocrysts of quartz.

Pleistocene and Recent

The Pleistocene and Recent deposits were not studied in any detail. Morainic material has been deposited over a large part of the area. It consists of boulder clay. South of Pusticamica lake, patches with boulders up to several feet in diameter, from which the finer-grained material has been washed away, are of frequent occurrence. Several drumlins were observed in different parts of the area. Low esker-like ridges also occur, some of which are persistent for a mile or more. These tend to have an east-west or northeast-southwest direction. Most of the drumlins and eskers are composed of boulder clay, but a few are fairly sandy gravel. Some comparatively flat stretches between the ridges appear to be covered with outwash deposits of clay and sandy clay. Stratified clays were not seen in the area, except some of recent deposition along the creeks. Clean sand was not noted, except in places in the creek bottoms, notably along the upper part of Mountain creek.

The few glacial striations observed in the area vary in direction from S.35°W. to S.45°W., indicating that at least the latest ice-sheet which advanced over the area came from the northeast.

STRUCTURAL GEOLOGY

The general direction of the foliation in the major belt of Keewatin rocks and in the granite gneiss along the south contact tends to be northeast-southwest, parallel to the direction of the belt. Southward from the belt, the direction of the minor bands of volcanics, and their general foliation, as well as that of the associated granite gneisses, is east-west; and still farther south it swings a few degrees south of east. There are, however, many local variations in the strike, particularly around the larger granitic intrusions in the major belt of greenstone.

In no place were the volcanics found sufficiently well exposed or preserved to permit of determination of the attitude of the flows. In the pillow lavas in the southwestern part of the area, the shape of the pillows suggests that the flows concerned face north. The conglomerate and arkose beds near the south edge of the sediments north of Auger creek, dip to the north at 70 degrees. The dip of the

schistosity in the volcanics, and of the somewhat doubtful bedding of the tuffs along the south contact of the Keewatin belt, is generally to the north. These rather scanty data, together with the areal distribution of the Keewatin and Temiscamian, suggest that the two formations were closely folded prior to their invasion by the older diorite and gabbro and the granite. Their present areas represent the remnants of an eroded major synclinal fold, within which there are many minor foldings. Considerable drag-folding was noted around the northeastern end of Pusticamica lake.

No extensive cross-fracturing was observed in the greenstones. The shear-zones, quartz veins, and aplite and pegmatite dykes, all tend to follow the directions of schistosity, though a few exceptions were noted. South of the middle part of Pusticamica lake, a dyke of albite granite which cuts obliquely across the schistosity is faulted for a few inches and is itself crossed by a later vein of quartz. The dyke has a direction N.40°W., the fault N.50°W., and the quartz vein N.75°E. In the granite gneiss around the south end of Opawica lake, and in the sediments north of Auger lake, a rather marked jointing cuts northeasterly or/and northwesterly across the nearly east-west foliation or bedding. The granite gneisses have been noticeably sheared in places, especially around Auger lake and southwest of Lichen lake.

The most extensive series of post-granite fractures are those occupied by the later dyke-rocks. Those in which the diabase occur trend from northeast-southwest in the southwestern part of the area to east-west in the eastern part. Those occupied by the more acidic dykes at the south end of Opawica lake have a consistently northwest-southeast strike. One of these latter dykes was also noted to be sheared and fractured in a direction N.20°E.

The lakes and ridges of the area reflect the underlying geology. Thus the direction of the north shore of Pusticamica lake and of the bays on its western side is northeast, parallel to the direction of the greenstone belt. Lichen lake has a nearly east-west trend, parallel to the general direction of foliation of the surrounding gneisses. Nicobi and Maloin lakes, which are in areas of more massive granite gneiss, have irregular shore-lines. The smaller lakes exhibit similar geological control. The ridges tend to follow the major structural directions of the area, *viz.*, northeast-southwest and east-west. The

high hill south of Pusticamica lake would seem to be due to the fact that it is composed of massive granite with a core of diabase, both unjointed and so resistant to erosion. However, in other places, the diabase and massive granite do not form marked ridges, and other high hills are composed of granodiorite, diorite, and bostonite.

The O'Sullivan, Pusticamica and Nicobi rivers, or at least that part of them within the map-area, do not appear to follow any structural directions. Indeed, these rivers have cut through the glacial covering in only a few places.

ECONOMIC GEOLOGY

As was stated in the introduction, no mineral deposits have as yet been discovered within the limits of the map-area. Veins of barren, white, glassy quartz are of fairly frequent occurrence. Only one of these, intruding the quartz diorite in the southwestern part of the area, was seen to be mineralized. It contained large cubes of pyrite. However, in view of the fact that some of the gold-bearing veins at Madeleine lake, 12 miles to the northwest, are but slightly mineralized with sulphides, any veins in the area should be closely examined. Small shear-zones, mineralized with pyrite and pyrrhotite, were noted at several localities in the volcanics, and also in the older diorite and gabbro and the granodioritic phase of the granite gneiss southwest of Lichen lake. Pyrite and pyrrhotite are fairly freely disseminated, even in the more massive volcanics, particularly where these are carbonatized north and northeast of Pusticamica lake. A small grain of chalcopyrite was noted in a specimen of only slightly sheared gabbro from the northeast end of the large body of that rock south of Pusticamica lake.

The Keewatin volcanics, with the included areas of Temiscamian sediments and intrusive diorite and gabbro, may be considered favourable prospecting ground. These rocks underlie somewhat more than one-third of the area examined, or approximately 150 square miles if the area occupied by Pusticamica lake be excluded. The western portion of the major belt of Keewatin rocks is probably the more inviting part of the area, as the belt is wider in that direction and exposures are more frequent. The country north of Pusticamica lake and eastward also calls for attention because of the

rather extensive carbonatization of the volcanics, with scattered pyrite mineralization. Unfortunately, there are but few outcrops in that part of the area, only one or two per mile being encountered. It was found that the outcrops tend to occur on the north side of the prevailing east-west ridges. Traverses made by the party were across the ridges, and doubtless more outcrops would be found by following along them.

Reconnaissance work by Lang (1) and earlier workers along the Wedding, Florence, and Bell rivers to west of the area indicates that much of that country may be underlain by Keewatin rocks. This possibility is further suggested by the fact that the major belt of Keewatin rocks in the area widens towards the west. Thus the country westward from the map-area to the Bell river, and southward from Madeleine (Rose) lake and the Florence river to Kamshigama lake and even farther south towards Parent lake, appears to be equally as favourable prospecting country as the map-area itself, if not more favourable. Considerations which suggest this latter possibility are, firstly, the apparently wider areas of greenstone and, secondly, the known occurrence of gold at Madeleine lake. Geological conditions comparable to those at the latter locality were not observed in the map-area. These particular conditions are: the intrusive body of quartz-diorite and the dykes of feldspar porphyry; the fracturing, shearing, and hydrothermal alteration of these rocks; the cross-faulting in the intruded volcanics; and the gold (native and telluride), chalcopyrite, and sphalerite mineralization in the quartz veins.

(1) *Loc. cit.*

A.—High hill south of Pusticamica lake.

B.—Faulted dykes of diorite intruding rhyolite breccia, north shore of Pusticamica lake.

ALPHABETICAL INDEX