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DEPARTMENT OF MINES

HON. W. A. GORDON, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

GEOLOGICAL SURVEY

W. H. COLLINS, DIRECTOR

Summary Report 1932, Part C

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OTTAWA
J. O. PATENAUDE, ACTING KING'S PRINTER
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GREAT BEAR LAKE AREA, NORTHWEST TERRITORIES

By D. F. Kidd

CONTENTS

Illustrations

INTRODUCTION

During the past year (1932) Great Bear Lake area has continued to attract attention, due to further discoveries of silver mineralization and to the discovery of gold. Prospecting and development have been actively carried on; during part of the summer between 200 and 300 men were in the area and between 2,500 and 3,000 claims have now been staked. With one exception, the copper deposits here, and in Coppermine River area to the north, received little attention in 1932. Active development has been undertaken at several pitchblende or silver discoveries in Echo Bay district. At the Eldorado mine, the original discovery, a small Diesel engine-driven mining plant has been installed and underground work commenced.

The field party under charge of the writer was in the area from early in March until September. Transportation and flying assistance were rendered by the Royal Canadian Air Force. The writer wishes here to acknowledge gratefully the many courtesies extended by the officials of the various mining and flying organizations. Particular thanks are due J. Drybrough, H. S. Robinson, W. G. Jewitt, J. Barrington, and other engineers for directing the writer's attention to points of geological interest noted by them in their traverses. F. T. Jolliffe, G. M. Furnival, N. R. Jennejohn, and K. Lowther acted ably as field assistants, the first two having charge of temporary sub-parties.

CLIMATE

The general character of the climate has been described in a previous report (1).[1] Data for the past season are as follows. Last aircraft from Great Bear Lake to McMurray on skis, April 18. Last aircraft from Great Bear Lake to Resolution on skis, first week in May. First aircraft on floats to reach Great Bear Lake, June 18. First boat from Bear River to reach east side of lake, July 17. Last plane on floats to leave Great Bear Lake, September 23.[2] In the spring snow-shoes were discarded May 10 and the ice in Great Bear Lake became generally unsafe near shore early in June.

TRANSPORTATION

During the past season 300 to 400 tons of supplies were brought to Great Bear Lake by boat via Norman and approximately 50 tons of ore was shipped out. Fuel oil to operate the Diesel engines at the Eldorado mine was brought from the wells below Norman. During the summer a motor tug and 100-ton barge were brought up Bear River through the rapids and were operated on the lake. So far as known all freight brought up Bear River, with the exception of a small amount carried by aircraft, was taken through the rapids, and only one minor accident occurred. The boat freight rate to and from Great Bear Lake and Waterways remains at 16 cents a pound. Much lower rates on large shipments coming out have been mentioned, but confirmation cannot be obtained from the office of the largest boat transportation company. Concessions on special shipments have been offered for the 1933 season.

All passengers and freight from the south during the spring, and most passengers during the summer, were brought in by aircraft, several companies operating services to Great Bear Lake.

GAME AND FUR

In the spring of 1932 game and fur were rather scarce. Moose and bear are the commonest game animals in the timbered parts of the district and some caribou are present in the treeless parts. Indications of otter, mink, wolves, marten, fox, wolverine, and muskrat were seen. Ducks were moderately abundant but no geese were seen; ptarmigan are numerous.

PHYSICAL FEATURES

The general physical features are described in a previous report (1). Exploration south and east of the area examined in 1931 shows that an upland extends at least as far east as Benoit Lake and probably to the valley of Coppermine River. This upland slopes to the south in its southwestern part, and in the inner part of Conjuror Bay the higher summits are only a few hundred feet above Great Bear Lake. The high hills along the shore of Great Bear Lake south of Echo Bay and on Richardson Island are a definite range a few miles wide paralleling the lake shore. These hills at some places reach an altitude of 1,500 feet (1,100 feet above the lake) or perhaps more. The height of the upland east of Great Bear Lake is not very well known. In a transit survey east of Echo Bay in 1931, elevations up to 1,750 feet above sea-level were measured (1). In 1932,

[1] Numbers such as this will enable the reader to find the complete bibliographic reference in the list of papers at the end of this report.

[2] Date supplied by C. H. Dickins, Canadian Airways.

simultaneous aneroid barometer readings were made at Great Bear Lake and at several lakes on the upland. Aneroid observations were also made of differences in elevations of lakes at portages and in this way rough elevations were carried inland. Elevations of some lakes were roughly determined by aircraft altimeter. Some elevations of lakes obtained by these methods are given below, but it should be appreciated that they are rough approximations given only for their possible use, and that they may be as much as 100 feet in error. The datum is Great Bear Lake.

	Feet
King Lake	110
Moody Lake	25
Eaglenest Lake	320
Lake 6 miles northeast of Eaglenest Lake	470
Uhlman Lake	530
Lake 6 miles west of Uhlman Lake	520
Torrie Lake	520
Narrow lake 5 miles east of Smat	200
Small lake 9 miles east of Smat	300
Augustus Lake	630
Junius Lake	600
Benoit Lake	800

The height of land between the Great Bear Lake and Coppermine River drainage lies 30 to 70 miles east of Great Bear Lake and 15 to 30 miles west of Coppermine River. A large number of small streams, nearly all flowing southwest, drain the western slope. The largest of these is Sloan River, which in its upper part has two main branches that flow north, unite, and then flow southwest to Hunter Bay. The east branch drains Benoit, Dumas, and Gagné Lakes and the western one drains Junius Lake; a third smaller branch from the northeast drains McLaren Lake. The second largest stream is Tilchuse River, which probably has its source near Adam Lake (on edge of map-area) and flows southwest through Cruickshanks Lake to Conjuror Bay.

The relief is greatest along the shore of Great Bear Lake where the upland has been most deeply dissected. Here it reaches in Echo Bay region as much as 1,100 feet, and in the range of hills to the south it may be greater. Inland the relief decreases as the elevations of the lakes increase. In the vicinity of Augustus, Junius, and Gagné Lakes no hills over 400 feet high were seen, and larger areas of drift and tundra are present than occur to the west. As noted, in Conjuror Bay, due to the lower upland surface, the relief is much less than farther north. A generalization of some value to prospectors is that areas of low relief and even skyline are frequently underlain by granitic rocks and that where the skyline is irregular the rocks are likely to be of the Old Complex.[1] There are exceptions such as Richardson Island and the shore to the north, but for the area north of Conjuror Bay to McLaren Lake the observation may prove useful.

GENERAL GEOLOGY

During the 1931 season a limited amount of field work was done in the vicinity of Hunter Bay and on the islands and mainland south to Echo Bay. The solid rocks found were provisionally divided into three main groups and two sub-groups. During the past season more widespread

[1] First suggested by J. Drybrough.

geological exploration, and more intensive field work in some areas, has made further subdivision possible. In Echo Bay district several small stocks of a rock varying from quartz-mica diorite to granodiorite occur. They are older than the granitic rocks in that vicinity and have been given a separate place in the table. They have not been differentiated from granite outside this district. Also in this district the rocks of the Old Complex have been provisionally subdivided. The table of formations as revised is as follows.

Table of Formations

Quaternary	Silt, clay, gravel, morainal material
(Unconformity)	
Precambrian(?)	Basic dykes and sills; large quartz veins
(Intrusive contact)	
Precambrian(?)	Little disturbed sandstone, quartzite, and conglomerate
(Unconformity?)	
Precambrian	Granite and other acid plutonic rocks
(Intrusive contact)	
Precambrian	Quartz-mica diorite and granodiorite (only differentiated in Echo Bay)
(Intrusive contact?)	
Precambrian	Sedimentary and volcanic complex Subdivision in Echo Bay district into: *(a)* Cameron Bay group—conglomerate, tuff, argillite, etc. *(b)* Echo Bay group—porphyritic volcanics, tuff, argillite quartzite, conglomerate, etc.

SEDIMENTARY AND VOLCANIC COMPLEX

The distribution of these rocks is shown on the accompanying map. For mapping purposes all rocks that have been intruded by granite are placed in this group. Only in Echo Bay district has any attempt at subdivision been made. Here the complex has been divided, as shown on Figure 1, into the Cameron Bay and the Echo Bay groups.

The Cameron Bay group occurs at the settlement of Cameron Bay, over most of the peninsula to the northeast between there and Lindsley Bay, and along the southwest side of Lindsley Bay. The most prominent member (*See* Plate I A) is a massive, unbedded, brown cobble conglomerate

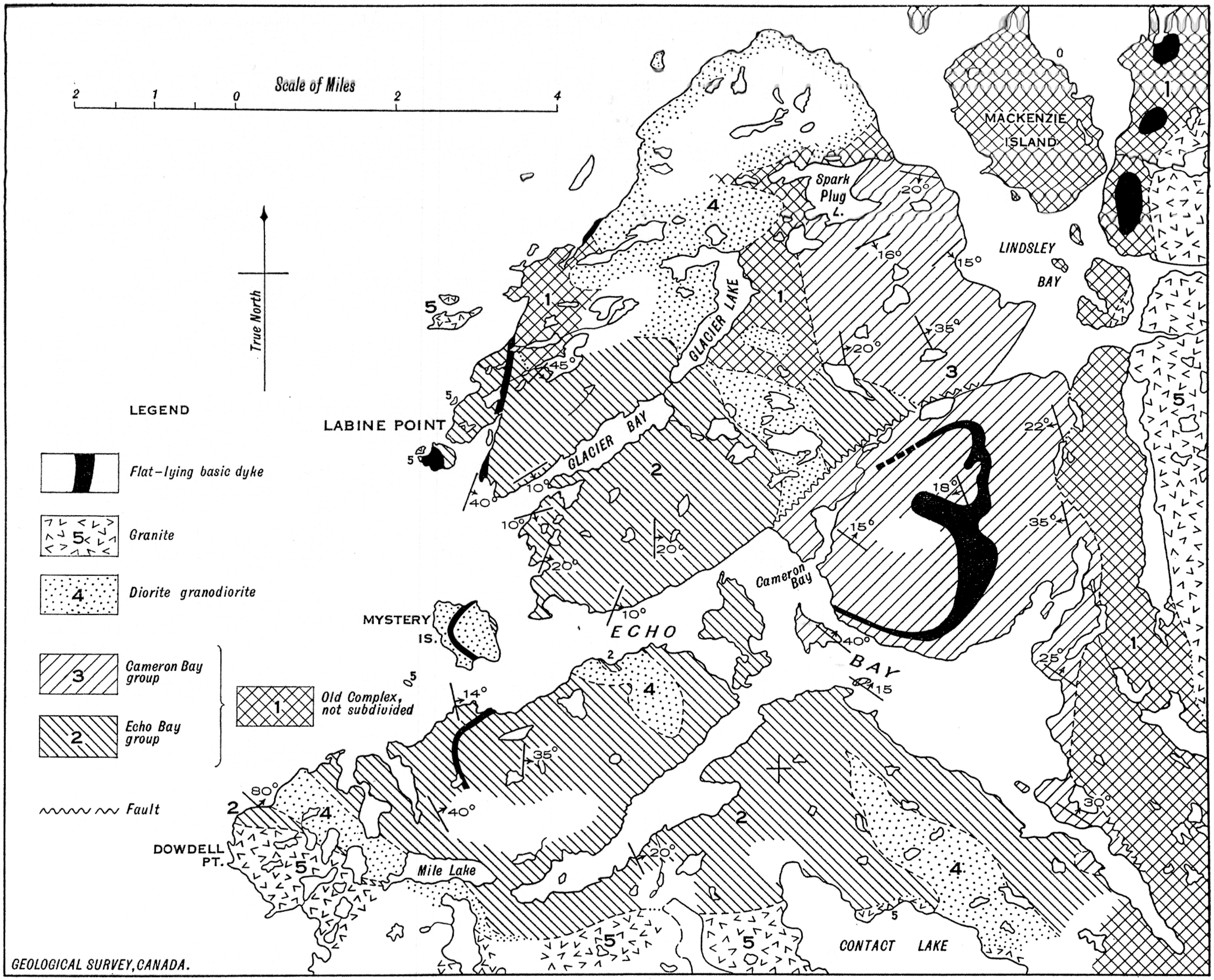

Figure 1. Echo Bay district, Great Bear Lake.

with a ferruginous cement from which the pebbles weather out readily. The pebbles are well rounded and usually well sized, and consist of brown, grey, pink, and chocolate-coloured feldspar and quartz feldspar porphyries, grey to brown, fine-grained quartzite, argillite, fine-grained, dark-coloured rocks, possibly volcanics, and occasional pebbles of vein quartz and bright red jasper. On the southwest side of Lindsley Bay a thickness of 300 to 500 feet occurs. At this place the conglomerate is underlain by cross-bedded, crumbly weathering, pebbliferous, brown sandstone of which a thickness of 300 to 500 feet is exposed. On the low islands in Echo Bay south of Cameron Bay are exposures of massive, reddish brown rocks showing at many places vari-coloured, fine-grained, angular fragments up to one-half inch across. At a few places in this rock beds of greywacke, conglomerate, and argillite occur. The unbedded fragmental rocks are probably tuffs. These rocks dip at a moderate angle to the north, apparently under the conglomerate on the hill east of Cameron Bay. On the southwest shore of Lindsley Bay in a bluff opposite Mackenzie Island, a thickness of several hundred feet of chocolate-coloured, ferruginous argillites with some lean iron formation is exposed. Argillites are also found south of the head of Lindsley Bay. At both places, from the structural relations, they appear to underlie the conglomerate and sandstone, but their relation to the red tuffs is not clear. Overlying the conglomerate on the hill northeast of Cameron Bay are tuffaceous rocks similar to those described. No boundary has been seen between them and the conglomerate, the contact as far as seen being transitional. As they have no bedding their thickness is unknown, though it cannot be great.

On the hill northeast of Cameron Bay and the one east of Spark Plug Lake, are small areas of a massive, grey feldspar porphyry with well-formed feldspar phenocrysts up to one-eighth inch long. At both places it is, so far as can be seen, a somewhat tabular body, possibly an irregular sill in the Cameron Bay group rocks. The contacts have not been seen.

On Mackenzie Island in Lindsley Bay are outcrops of massive, brown conglomerate underlain by reddish, tuffaceous rocks. On the south and north sides of Vance Peninsula ferruginous conglomerate and sandstone, similar to the Cameron Bay rocks, occur dipping to the north on the south side of the peninsula and to the southeast on the north side. These rocks outcrop again on the islands in the bay southeast of Stevens Island and on the northern part of Stevens Island itself. At all these places the dip is usually less than 45 degrees. Along the south shore of Cornwall Island, and in the southeast part of Achook Island, both in the island group southwest of Hunter Bay, similar brown conglomerates with ferruginous cement occur. On the south side of Cornwall Island they are much disturbed, sheared, crushed, and somewhat baked and dip steeply. This is thought to have been caused by granite which outcrops a few hundred feet south on Hogarth Island. Ferruginous conglomerate also outcrops along the west side of Achook Island and on a long, narrow island nearby in the western channel.[1] On the east side of Doghead Point brown sandstone and some conglomerate outcrop, dipping at a low angle northwest. This conglomerate differs, however, in containing abundant granite pebbles. The granite is a red, medium-grained, biotitic variety with an unusually small amount of plagioclase.

[1] This island is the "Rocher Rouge" of Mackintosh Bell.

The Echo Bay group of rocks was only differentiated in Echo Bay. In their upper part they consist mainly of porphyries, at some places extrusives, but at others possibly intrusives, with minor amounts of argillite and tuff. In the lower part of the group argillites, in some places very siliceous, tuffs, quartzites, conglomerates, and a little limestone form an important part of the section. The base of the section has not been seen. The rocks have moderate to steep dips and structurally appear to underlie the Cameron Bay group, though the contact has not been seen. The presence in the Cameron Bay conglomerate of abundant pebbles of rocks similar to those in the Echo Bay group, suggests that there is an unconformity.

Good sections of the upper members of this group are exposed along the northwest side of Echo Bay from Mystery Island to Cameron Bay, and along the crest of the high ridge west of the southwest arm of Echo Bay. In both these sections the rocks are commonly massive, brown to brownish grey to greenish grey, porphyritic rocks with scattered, well-formed phenocrysts of feldspar that is white or pink, at some places lustreless with a greenish tinge, and they occur as squares and laths up to one-eighth inch long in a fine-grained groundmass. At a number of places amygdules from $\frac{1}{2}$ to 2 inches long occur, many of which are elongated and are often in a rudely parallel arrangement. The usual filling of these is quartz, though some contain in addition epidote, and others are only partly filled. Interbedded with these rocks, where seen apparently conformably, are banded argillites, grey to dull green to purplish in colour. At one place on the northwest side of the entrance to Echo Bay there is a breccia of argillite fragments with an amygdular porphyritic matrix. Amygdular bands and argillites are also present at several places on the hills both east and west of the southwest arm of Echo Bay, and indicate the attitude of the volcanics (*See* Figure 1).

Over large areas, for example northwest of Contact Lake, no structures that would indicate that the rocks were surface flows have been seen, and no interbedded sediments have been found. Such bodies may be, in part anyway, minor intrusives rather than extrusives.

The limited number of thin sections of these porphyries studied are all of andesite, in most cases considerably altered to carbonates, white mica, chlorite, iron ore, etc. Where determinable the feldspar phenocrysts are plagioclase (oligoclase to andesine).

The lower members of the Echo Bay group are best exposed along the north side of Dowdell Point for 2 miles north from the granite contact. They also occur near the mouth of Glacier Bay, and in the vicinity of Labine Point. They consist of sediments with interbedded flows and fragmental rocks. No sharp line can be drawn between them and the feldspar porphyries; going down in the section interbedded sediments become more abundant in the porphyries until they form a large part of the section. The commonest rock is a hard, almost cherty, finely banded argillite of red, green, or grey colour. Also there are fine pebble conglomerates (with pebbles of felsite, chert, grey quartzite, argillite, and feldspar porphyry), massive, light brown chert with some included angular chert fragments, grey quartzites, and a little grey, highly contorted, very impure limestone. The argillites are well shown at the granite contact on

Dowdell Point and on the point one-quarter mile east of Labine Point; they are present, interbedded with volcanics, near the end of the point east of Mystery Island. Tuffs and breccias occur at places on the northwest shore of Glacier Bay, and a little dolomitic limestone is present on the east shore at the mouth of the bay. A thickness of a few feet of impure limestone also is present on the north end of Labine Point Island, and on the shore of Dowdell Point one-quarter mile northeast of the granite contact.

Elsewhere in the area examined the Old Complex has not been differentiated. Feldspar and quartz-feldspar porphyries are the most abundant members of the group of rocks mapped as Old Complex. In some cases volcanic structures can be seen in them at intervals, or they contain bands of recognizably sedimentary rocks and so may be part of a volcanic-sedimentary group, but over large areas, however, these criteria of volcanic origin have not been found, and the rocks are classified only as belonging to a group older than the granite in their vicinity. Some of these bodies of feldspar porphyry may be intrusive, and if so may be related either to the volcanics of the Old Complex or to the granites, though they are intruded by them. Regional metamorphism by the granite may possibly have caused the formation of secondary feldspar crystals in some rocks. Which of these three possible origins should be assigned to any individual body of porphyry, or if more than one origin, which is most important, can only be told after detailed field work.

An attempt was made to separate the feldspar porphyries between Echo and Hunter Bays into groups on lithologic grounds. At many places, however, it could not be stated to which group a particular porphyry belonged.

A brick-red to brown feldspar porphyry occurs along the western margin of the granite mass lying east of Lindsley Bay. East of Smat the granite can be seen cutting it as dykes and holding large fragments of it. It is well exposed in the vicinity of Smat, along the east side of the channel immediately north, over a large area on the peninsula east of Stevens Island, and on the large peninsula on the south side of Domex Bay. It forms the major part of Boadway Island, and small, isolated areas of similar rock occur on the southwest part of Cornwall Island, on south-central Achook Island, and on the north end of Rocher Rouge. At the three last-named places the relations may be intrusive though the contacts were not seen. On the hill northeast of Cameron Bay is an area of reddish brown, medium-grained rock, as far as can be seen intruding the Cameron Bay conglomerate. Some phases of it resemble the mica diorite and granodiorite, but others are like the red feldspar porphyry. It is not yet certain with which group it should be placed.

The red feldspar porphyry is characterized mainly by its colour, which is reddish brown to red. It holds well-formed phenocrysts of plagioclase, and at some places orthoclase, up to one-eighth inch long and usually of about the same colour as the groundmass. The groundmass of quartz and feldspar varies from exceedingly fine grained and cherty in appearance, to, where near the granite, rather fine grained but visibly crystalline. Here flakes of biotite averaging about one-sixteenth inch are common. At one place the rock was determined to be an andesine dacite.

Another porphyry, commonly with a purple to purplish grey groundmass, has been distinguished at some places. East of Lindsley Bay, a sharp contact was seen between it and the red feldspar porphyry, but the age relations were not determinable. Where recognized it lies near the margin of the Lindsley Bay granite and the granite to the north, but usually farther away from the contact than the red feldspar porphyry. It is well exposed in the hills east of Lindsley Bay, 1½ miles south of Smat, on the peninsula 1 mile northeast of Stevens Island, on the east-central part of Cornwall Island, and on the extreme western part of Boadway Island. Its characters at these places are not constant, but there is a lithological similarity between the rocks at these different areas. The rock is a quartz-feldspar porphyry with tabular phenocrysts of yellowish, altered plagioclase and somewhat smaller, glassy quartz grains, set in a fine-grained, purple to purplish grey groundmass that is a felt of tiny, altered feldspar laths in chlorite. At one place the rock was determined to be a quartz andesite porphyry.

A third porphyry is found at intervals near the borders of the Workman Island granite. It borders the granite in the central part of Stevens Island, and in the western part of Achook Island, and occurs on the southwest end of the long, narrow island in Western Channel. Its relations are not known. The rock is a hard, grey to greyish brown, quartz-feldspar porphyry with tiny, well-formed phenocrysts of andesine feldspar and some orthoclase grains, and corroded, glassy quartz grains, in a very fine-grained groundmass of quartz, feldspar, and chlorite. There is some biotite and a little pyroxene. Where determined it is an altered quartz andesite porphyry. A brown feldspar porphyry that bears some resemblance to this rock borders the Workman Island granite on Vance Peninsula.

Feldspar and quartz-feldspar porphyries occur over large areas between Hunter Bay and Hornby Bay, and west of the upper part of Harrison River along the few, widely separated traverses made across these areas. At several places the porphyries hold rock fragments and breccias, and with them are unbedded fragmental rocks, possibly tuffs. The presence of such rocks suggests that some of these porphyries are extrusive. A brown feldspar porphyry forms the majority of the exposures on the east and west sides of Doghead Point, but in addition on the east side are some outcrops of sandstone and conglomerate (*See* page 5), and on the west side some exposures are of coarse conglomerate, quartzite, brown tuff, argillite, and buff and distinctive olive-green chert. These rocks have a rather constant strike, and where seen in contact with the porphyry they and the porphyry are apparently conformable.

In 1931 a limited amount of work was done near McLaren Lake, on upper Sloan River. The rocks mapped here as Old Complex are all feldspar porphyries except on the main Sloan River south of the lake, where a little bedded arkose was found. The porphyries are variegated with feldspar phenocrysts, and at some places quartz grains, in a fine-grained, reddish brown to purplish groundmass. At some places unbedded fragmental rocks occur with them.

The rocks mapped as Old Complex between Hunter Bay and Junius Lake and extending from Sloan River south along the east border of the Lindsley Bay granite as far as Eaglenest Lake, are nearly all porphyries of rather variegated character, but similar to those previously described.

The groundmass is fine grained and often cherty in appearance, and the porphyritic character is distinct. At only a very few places was any evidence of the origin of these rocks found. At a place one mile east of Gilleran Lake, on the creek entering the middle of the east side of the lake, a few feet of bedded arkosic material, possibly tuff, is present, overlain and underlain by reddish brown feldspar porphyry. At the west end of the lake 2 miles southeast of Gilleran Lake, finely and lenticularly banded, fine-grained, dark green rock outcrops, the banding being brought out by slight colour differences on the weathered surface. At some places in these porphyries, over areas of a few square feet, faint, fine, regular banding is visible on the weathered surface of fine-grained phases, and at other places scattered small fragments of felsitic rock were found in them. These structures, a faint streakiness due to rude alinement of feldspars, the generally fine-grained character of the groundmass, and the frequent rapid variations, suggest that the porphyries may be largely volcanics with some minor intrusives. They are intruded and often considerably altered by the surrounding granites.

Farther east on Dumas, Gagné, and Benoit Lakes the rocks mapped as Old Complex include definite sedimentary types. Finely banded, fine-grained, green rocks, possibly tuffs, grey schist, and a light green rhyolitic quartz feldspar porphyry, as well as the more common types of porphyry, occur northwest of Dumas Lake for several miles towards Jaciar Lake. On the east side of the lake immediately north of Dumas Lake, a steeply dipping coarse conglomerate occurs. It is little sorted and contains boulders up to 2 feet across. The pebbles are of fine-grained, grey, light or dark green, banded or unbanded rocks, light and dark brown feldspar porphyry, with occasional pebbles of granite, quartz, and red jasper. Many are schistose or flattened and the matrix is schistose. On the west side of the small lake between Dumas and Gagné Lakes, are scattered exposures of an unusual feldspar porphyry not seen elsewhere. It has rounded phenocrysts of pink feldspar up to 3 inches across in a fine-grained, reddish brown groundmass which has scattered, small, glassy quartz grains. The relations of this rock are not known, but it may be associated with the granites. At many places on the west side of Gagné Lake sedimentary rocks are exposed. The most abundant is a banded argillite, in some places schistose, but also there is fine-grained, ripple-marked, grey quartzite, and banded chert. Brown feldspar porphyry and a rhyolitic quartz-feldspar porphyry with a greenish grey groundmass are present at places. All these rocks are steeply dipping. At several places near the granites they are cut by aplitic or granitic dykes, or occur as altered inclusions in granite.

The Old Complex rocks mapped north of Camsell River and east of Richardson Island include sedimentary types and greenstones, as well as feldspar porphyries. In the limited examination so far made, the greenstones and sedimentary rocks have been found on the southern islands in Conjuror Bay, and for 9 miles up Camsell River from its mouth. In the northeast part of Conjuror Bay and the long northeast arm, the rocks mapped as Old Complex are largely the feldspar and quartz-feldspar porphyries, at some places showing volcanic structures, e.g. amygdules or breccias. The sedimentary rocks are boulder conglomerate, with felsite and feldspar porphyry boulders up to 3 feet across, reddish brown, ferruginous conglomerate and ripple-marked sandstone in alternate beds, abundant, vari-coloured, finely banded argillite, cherty argillite, and massive to thinly bedded limestone and argillite. Volcanics are interbedded with these rocks on the Conjuror Bay islands, and on Camsell River form most of the section. They are usually greenstones, in the hand specimen like andesite. Fragmental rocks (agglomerates) are common, and scoriaceous, vesicular, and amygdular structures have been seen. Where seen so far, these rocks usually dip at less than 45 degrees. The relation of the greenstone volcanics to the feldspar porphyries is not known. North of Camsell River granite and aplite dykes intrude feldspar porphyry. The Richardson Island granite has not been seen intruding the rocks (mapped as Old Complex) on the islands of Conjuror Bay, but may do so.

QUARTZ-MICA DIORITE AND GRANODIORITE

These rocks have been separated from the granites for mapping purposes only in Echo Bay district. Here they are distinctive lithologically, and at some places have caused distinctive contact metamorphic effects. At two places they have been seen cut by granite dykes. Small granite dykes cut a rather fine-grained phase of the Dowdell Point dioritic mass at a place on the north shore of the point, one-half mile northeast of the granite contact. Granite dykes have also been seen cutting it one-quarter mile west of the west end of Mile Lake.

Four rather elongated bodies trending in a general east-west direction, and one irregular body, are shown on the map and on Figure 1. These rocks are variable in texture and colour, particularly near their borders where they are distinguishable with difficulty from the rocks they intrude. In the less variegated, central parts of the masses, they are massive, medium-grained, granitic-textured, reddish brown to greenish brown coloured rocks. In the hand specimen they show pink and greenish brown feldspars, the latter usually being more abundant and in larger grains, and small amounts of quartz, biotite, or pyroxene. Five thin sections studied had plagioclase (oligoclase to andesine), orthoclase, quartz, a colourless altered pyroxene, probably augite, biotite, and iron oxides. At some places in the field the rock has the appearance of a syenite, but in the few sections examined plagioclase is much in excess of orthoclase. In the central parts of the masses the rock varies considerably in colour due to variations in proportions of the two kinds of feldspar, and in the amount of dark minerals. Near the borders the rock becomes irregularly finer grained, and somewhat heterogeneous in appearance. The contact with the intruded rocks, usually feldspar porphyries, can only rarely be located, due to its transitional nature at most places.

These rocks have caused an unusually great amount of metamorphism round their borders. At many places for a width of one-quarter mile or more, the intruded rocks are rusty weathering, due to disseminated pyrite, and they have developed chlorite, magnetite, biotite, epidote, actinolite, etc. At other places, particularly near the borders of the mass west of the southwest arm of Echo Bay, the intruded rocks for as much as one-quarter mile from the contact are fine grained, rather heterogeneous, irregularly brick-red, and are apparently very largely composed of feldspar. The large, rusty, pyritic gossans which are prominent in Echo Bay area occur in very many cases near the borders of these stocks.

GRANITIC INTRUSIVES

These rocks are widespread, and individual bodies are of large size. Their distribution and size are shown on the accompanying map (No. 2328). Though the outline of some masses is not known sufficient work has been done to indicate three bodies of batholithic dimensions. These are: (1) The Contact Lake-Richardson Island granite, the north boundary of which runs east from Dowdell Point to east of the east end of Contact Lake. This body extends south to Richardson Island, outcrops round its shores, and has been traced 5 miles south of the south end. It has an explored length of 35 miles and a width, south of Contact Lake, of 14 miles. (2) The Lindsley Bay granite lying east of Lindsley Bay. This has a length from a point 8 miles southwest of Eaglenest Lake to a point south of Gilleran Lake of 20 miles, and its greatest known width east of Lindsley Bay is 15 miles. (3) The Workman Island granite, which outcrops on Achook, Hogarth, Workman, and Stevens Islands. The exposed length of this mass from north to south is 12 miles and the maximum width about 6 miles. Other large areas of granite, as shown on Map 2328, lie east of Hunter Bay and south of Augustus Lake, but their boundaries have not been traced.

The granitic rocks vary markedly from body to body and in the same body. Some of the masses mentioned above may be composite rather than simple intrusives. Most of the granites within 20 miles of Great Bear Lake north of Richardson Island are fresh-looking, massive rocks. Gneissic granite occurs, however, at the south end of Richardson Island, and southwest of Benoit Lake to Tilchuse River.

The granitic intrusives are grouped because they intrude rocks of the Old Complex, and have not been seen cutting the Hornby Bay series. They are not, however, necessarily of one age. It is possible that the gneissic granites are very much older than the massive, fresh-looking granites of the Contact Lake-Richardson Island, Lindsley Bay, and Workman Island masses. The presence of a single pebble of medium-grained, brown granite in rocks of the Cameron Bay group, abundant granite pebbles in moderately tilted conglomerates on the east side of Doghead Point, and numerous pebbles of white, probably vein, quartz in the Cameron Bay group rocks, all suggest the possibility of granites of widely different ages occurring. One of the writer's assistants reports that on the west side of Benoit Lake a gneissose, medium-grained, grey granite is cut by dykes of entirely massive, pink to buff, coarse-grained granite, which also contains inclusions of gneiss and schist. Specimens of the younger granite resemble in appearance the Contact Lake-Richardson Island granite.

The Contact Lake-Richardson Island granite is typically coarse grained, porphyritic, with white to buff feldspar phenocrysts up to 2 inches long in a groundmass of feldspar, with quartz and biotite, often chloritized. The rock is pink to buff weathering and massive, except at the southeast corner of Richardson Island where it is porphyritic and somewhat gneissic. In the southwest part of the island basic inclusions are common in the granite, phenocrysts are usually absent, and the rock is medium grained. East of the island near the east edge of the mass, the granite in places holds fine-grained inclusions and is more variegated.

The Lindsley Bay granite is massive, medium grained, rather uniform in appearance, with light brown to buff to white to pink feldspars, quartz, biotite, and, in some places, also hornblende. It is occasionally slightly porphyritic near the borders. A few thin sections from widely scattered localities were all biotite granite grading towards granodiorite. Oligoclase feldspar is present, but is usually less in amount than orthoclase. Biotite is present in all the sections and there is hornblende, also, in one. Iron oxides, titanite, apatite, and zircon are the accessory minerals.

The Workman Island granite is fairly uniform except near the borders where at places it holds scattered, altered inclusions and is more variegated. Typically the rock is massive, medium to moderately coarse grained, with pink to brown, in some places red, feldspar, quartz, hornblende often altered to chlorite, and, frequently, biotite. Near the borders it is at places slightly porphyritic with feldspar phenocrysts. A single thin section examined had considerable plagioclase (oligoclase) and had the composition of a biotite granodiorite.

The mass of granite occurring at Hunter Bay and extending southeast to Storm Lake is typically a massive, medium-grained rock commonly pink to light brown in colour, but with red, grey, and nearly white phases. The ferromagnesian minerals are often altered to chlorite, but in some cases can be recognized as hornblende and biotite. A few thin sections studied proved to be oligoclase granite or granodiorite with biotite and, in one section, hornblende.

The granite mass that extends east and south from Torrie Lake to Copp and Uhlman Lakes, and may extend north to Drybrough Lake, is typically massive, medium to rather fine grained, light brown to buff to pink in colour, with light brown, pink, white, or grey feldspar, and quartz. The ferromagnesian minerals are usually partly altered to chlorite, but appear to have been chiefly hornblende, with relatively minor amounts of biotite. A single thin section from north of Torrie Lake was an oligoclase-hornblende-biotite granite. In the eastern part of Uhlman Lake a rather different granite occurs. It is porphyritic, with well-formed pink feldspar phenocrysts averaging three-quarters inch and milky quartz grains of three-eighths inch in a greyish pink, aplitic groundmass, in some places holding abundant biotite. East of Copp Lake the granitic rocks are rather variegated, and in places fine-grained granitic gneisses and porphyritic granites occur.

The granite west of Junius and Augustus Lakes and extending nearly to Drybrough Lake, is a uniform, massive, fresh-looking, coarse-grained granite, pink to light brown weathering, with light brown to salmon pink feldspar, glassy quartz, biotite, and possibly, in places, altered hornblende. At some localities it is porphyritic with feldspar phenocrysts.

East of Junius Lake to Gagné Lake and southwest of Benoit Lake is a granite of different appearance. It is medium grained, light brown, white or red weathering, with brown, white, or grey feldspar, quartz, and usually both biotite and hornblende. At many places it is gneissic and southwest of Benoit Lake it is often a mica gneiss with black biotite flakes segregated in laminæ. It is this granite that is reported to be intruded near Benoit Lake by coarse, pink, massive granite (*See* page 11).

HORNBY BAY SERIES

These rocks have been briefly described in a previous report (1, page 53C). They cover large areas west and north of Hornby Bay, and west of Fault River. They outcrop on many of the islands in the bay, and there are two, small, isolated areas on the east shore. Similar rocks are reported to occur on low islands lying about 12 miles southwest of Dowdell Point, and they are present on the south shore of the lake 5 miles southwest of Richardson Island. Rocks, which from the air have a similar appearance, outcrop along the north shore of McTavish Arm for several miles west of Hornby Bay, as far as a prominent rock bluff several hundred feet high.

The base of the series can be seen at a point 10 miles up Fault River at a place where a tributary stream enters from the west. The basal beds dip 20 degrees northwest and the bottom 50 to 100 feet are of coarse, brown, crumbly weathering conglomerate with closely packed, moderately well-sorted, usually well-rounded pebbles, up to 10 inches across. These are largely of massive, reddish brown feldspar porphyries of various types. There are occasional more competent sandy interbeds up to 2 feet thick. On the tributary stream at the junction, the base appears to rest unconformably on a white quartz vein with an exposed width of 50 to 100 feet. The vein cuts intensely sheared and slickensided, fine-grained greenstone. The basal part of the coarse conglomerate for a thickness of 8 feet holds numerous angular fragments of vein quartz that lie in a brown, sandy matrix. Above this the rock changes rather abruptly to the dark brown conglomerate described. Higher in the section to the northwest, 400 feet $\pm$ of conglomerate, sandstone and quartzite, and pebbliferous sandstone and quartzite occur. The sandstone and quartzite are buff, pink, mauve, white, and dove-grey. The pebbles in the conglomerate are largely vein quartz and quartzite, with some of purplish shale and chert.

Several miles southwest, in the steep-walled gorge of the easternmost river on the north shore of Hornby Bay, similar sandstones and quartzites with conglomerate interbeds are well exposed in a section several hundred feet thick. On the eastern islands in Hornby Bay the sandstones and quartzites are overlain by the conglomerate. The top of the Hornby Bay series has not been seen. These rocks may extend north nearly to the south branch of Dease River.

BASIC DYKES AND SILLS

Basic dykes cut rocks of all four groups previously described and are of widespread occurrence. At places they cut the large quartz veins that will be described below, but at one place a large basic dyke is clearly intruded by a typical large quartz vein. This dyke and some others differ lithologically from the more common type in having some red feldspar, and are provisionally separated as a type probably older than the common dykes. A narrow, flat-lying dyke, or dykes, of wide areal extent will be described separately.

The common type of basic dyke is widespread, generally steeply dipping, and up to 100 feet in width. The trend is variable. They commonly show fine-grained margins, and at some places columnar jointing. In the hand specimen they are medium to fine grained, and greenish grey to greenish black. In some instances the medium-grained parts have a diabasic texture.

The basic dykes with red feldspar are not so common. One of these, 50 to 100 feet wide, lies $2\frac{1}{2}$ miles northeast of Smat and is earlier than a large quartz vein at that place. The dyke strikes across the vein at an acute angle, but can be seen to be intruded by the vein, which lies on each side of it. A thin section from this dyke, and one from another dyke on the east side of Stevens Island, show a rock with a medium even grain, with subhedral plagioclase grains (oligoclase to andesine), a little orthoclase, quartz, pyroxene probably augite, and iron ore.

A flat-lying dyke, or perhaps more than one, outcrops at many places between Echo Bay and the head of Hornby Bay. It is found as a series of isolated occurrences that may have been one continuous body. It cuts the Old Complex, diorite, granites, and Hornby Bay series indiscriminately, and often with little regard for any bedding present. The thickness is commonly 50 to 100 feet, at some places greater, and it shows good columnar jointing.

The southernmost exposures are on Mystery Island, through which it cuts dipping northeast (*See* Figure 1). On the mainland immediately to the east it outcrops again with a similar attitude. As previously described (1, page 54C) it outcrops on the island at Labine Point, and on the east side of Labine Point Bay. It also outcrops on an unmapped reef at the entrance to Glacier Bay, and is found again at two places on the shore 1 mile and 3 miles, respectively, north of Labine Point. What may be the same body outcrops over an irregularly shaped area nearly encircling the hill northeast of Cameron Bay (*See* Figure 1). Here it cuts conglomerates of the Cameron Bay group and dips at a low angle to the west. It outcrops again capping two hills on the east shore of Lindsley Bay, and dipping west at a low angle. What is probably the same body is exposed on the east side of Vance Peninsula, and caps two hills on the north part of that peninsula. Here it is nearly flat lying. What may be part of the same mass has a ringlike outcrop round the base of the hill on the peninsula just south of Stevens Island, and occurs also on the southern part of the island at several places. The mass outcrops also along the southeast shores of the group of small islands southwest of Stevens Island. A similar sheet dipping west at a low angle was described and shown on the map of 1932 (1, page 50C), on Workman Island and extending north through Hogarth, Cornwall, and Boadway Islands to the large peninsula west of Hunter Bay. A low dome in the body is exposed for one-half mile along the middle of the west side of Achook Island. On the peninsula west of Hunter Bay this body is almost flat-lying and has a wide areal extent and complicated outline, due to the topographical relief. It is possible that two rudely parallel bodies are present here. A similar, probably the same, body occurs near the mouth of the creek draining Fourmile Lake, and a flat-lying mass caps a hill west of this lake. The sheet outcrops again on the north part of the ridge between the two arms at the head of Hornby Bay. On the west shore of the bay 10 miles from the head, one, possibly two, sheets of this rock outcrop, and as far as can be seen have been intruded along the bedding planes of the Hornby Bay series. A prominent hill 25 miles farther southwest on the shore is reported to be of similar rock.

The wide extent and small thickness of this body, or bodies, are unusual. It has commonly been called a sill, but at many places is more correctly termed a flat-lying dyke.

Thin sections of it from several widely spaced localities have been studied. They show well-formed plagioclase laths (andesine to labradorite); fairly well-formed grains of at least two kinds of pyroxene, one of which is orthorhombic probably enstatite, a little quartz, interstitial micrographic quartz-feldspar intergrowth, brown biotite, and iron ore. Orthorhombic pyroxene is not always present. Of two sections, from the same locality east of Cameron Bay, studied, one from near the upper edge of the dyke had the interstitial quartz-feldspar intergrowth, whereas the other from near the lower edge did not have it.

LARGE QUARTZ VEINS

The large quartz veins previously described (1, page 54C) are shown on Map 2328 (in pocket). It has been necessary in some cases to exaggerate their width for mapping purposes. The thirty-six veins mapped are from 50 to 500 feet in width, in some places more if adjoining stockworks are included. It is not implied that in the areas coloured all the large veins are mapped.

The discovery in 1932 of veins at many widely spaced localities has shown that they are not confined to the described belt (1, page 54C), in which they are numerous. They have been found as far southeast as Tilchuse River, that is as far southeast as explorations have extended. Stockwell described (2, page 63C) a similar vein as occurring in a northeast-trending fault near the north shore of Redrock Lake, 90 miles southeast of Tilchuse River; a quartz vein stockwork cuts the Hornby Bay series southwest of Richardson Island, and what is probably one of these veins is visible from the air about 7 miles southeast of the outlet of Hottah Lake.

Without exception the strike of the veins seen is in the northeast quadrant, and the majority strike about northeast. Their large size makes dip determinations difficult, but in most cases the dip appears to be steep. One prominent vein visible on the south face of a hill 4 miles north of Smat, appears to dip southeast at an angle of 40 degrees to 70 degrees. In three cases these veins have been found to occur in faults of considerable magnitude, and such a relation is suspected in several other instances. In the large fault bordering the west side of the valley between Cameron and Lindsley Bays a vein 50 to 100 feet wide occurs. It is bordered on the east by conglomerate and on the west by feldspar porphyry, both rocks being sheared and slickensided. Branches from the main vein have cut and altered both walls. The vein is evidently in the fault and later than the main faulting. The vein mentioned as occurring 4 miles north of Smat probably also lies in or near a fault. A fault of considerable length lies in the valley of Fault River. Ten miles from the mouth a quartz vein 50 to 100 feet wide outcrops along the northwest bank of the stream for a distance of at least a mile. It lies in the fault and intrudes the sheared rocks. Different rocks on opposite sides of the Sloan vein at Hunter Bay suggest that it, too, lies in a fault, and the presence of a fault near the vein shown 5 miles west of Torrie Lake is suspected.

The large quartz veins have been considered younger than the Hornby Bay series as two of them have been found cutting those rocks, one on an island in Hornby Bay and the other southwest of Richardson Island. The basal beds of the Hornby Bay series, however, appear to rest unconformably on one large vein (page 13). At this place no other explanation of the relations, except possibly a fault breccia, appears possible, and this is regarded as unlikely. Most of the large veins show at least two generations of quartz of distinct properties. The main vein filling is usually massive white quartz, sometimes stained buff or pink, but this quartz is crossed by a maze of later quartz veins a few inches wide, the quartz of which frequently shows crystal outlines, with the crystal faces coated with minute hematite crystals. A special feature of this quartz at some places is the presence of fine, alternate, rhythmic banding of milky and glassy quartz, the bands paralleling the pyramid faces of the crystals and often being only one-thirty-second inch thick. The two veins that cut the Hornby Bay series are both stockworks and the quartz of the veins has the peculiar characters of the second generation just described. On the other hand, the vein on which the Hornby Bay series appears to rest unconformably is massive white quartz, and lacks in the exposures seen the distinctive, later quartz vein network. This suggests the possibility that the quartz of many of the large veins is of two very different ages, the earlier of which is older than the Hornby Bay series, and the later younger than these rocks. It is probably not wise, however, to make a positive statement based on the interpretation of a single exposure. Confirmatory evidence should be sought.[1]

Discoveries of copper minerals in the large quartz veins near Hunter Bay were described in 1931 (1, page 55C). Small amounts of bornite, chalcopyrite, and covellite have been found in some of the veins at other places.

QUATERNARY GEOLOGY

This has been described in a previous report. West of Hornby Bay along the north shore of McTavish Arm, as far as can be seen from an aircraft, the bedrock is almost completely concealed, as far as Cape McDonnel, by large areas of muskeg and sand-plain with, at places, boulder beaches on the shore.

On the west side of Great Bear Lake, on the west shore of Douglas Bay, an indentation on the north side of Etacho Point, boulder clay largely conceals bedrock. The lake shore is here in places lined with large boulders washed from shore cliffs. These boulders are of buff and white quartzite (abundant), various granites and gneisses, and unfossiliferous limestones. They are all types known to occur on the east side of Great Bear Lake.

STRUCTURAL GEOLOGY

Throughout the area the regional trend of the rocks of the Old Complex is, with some exceptions, in the northwest quadrant, usually between west-northwest and north-northwest. Over large areas the dips are less than 45 degrees, but they range up to vertical. The Hornby Bay series is only gently tilted, with dips usually less than 10 degrees. Along the east edge of the area of these rocks northwest of Hornby Bay the prevailing strike is northeast and the dip northwest. Southwest of Richardson Island the attitude of these rocks is similar.

[1] This exposure was brought to the writer's attention by J. Drybrough. He is believed to concur in the writer's interpretation of the unconformable relations at this place.

In Echo Bay district the rocks of the Old Complex usually strike northwest except west of Cameron Bay to Labine Point where the strike is generally north or a little east of north, and along the south side of Lindsley Bay where the strike is variable. Except near Labine and Dowdell Points the majority of the dips are less than 45 degrees. East of Cameron Bay, the Cameron Bay group of rocks appears to lie in a shallow, northwesterly trending syncline, the dips east of Cameron Bay being at low angles northeast, and those south of Lindsley Bay being southwest. Southwest from Cameron Bay successively older rocks dipping at increasingly steep angles northeast are exposed to Dowdell Point. West from Cameron Bay the relations are similar. The argillites and other sediments at Labine Point and on the point southeast of Glacier Bay dip under the porphyries east and west of the inner part of Glacier Bay. Northeast of Glacier Lake the Cameron Bay group rocks dip in general east and northeast, though the structure is not simple.

Farther north the structures are little known. On the large island in Lindsley Bay (Mackenzie Island), and on the south part of Vance Peninsula, the usual strike is northwest with moderate dips, mostly southwest. On the north end of Vance Peninsula, Stevens Island, and the southwest part of the peninsula northeast of Stevens Island, the strike is northwest and the dip usually northeast at an angle of less than 45 degrees. On the south part of Cornwall and Achook Islands the strike is about east-west and the rocks dip moderately to steeply north. The sediments described from the base of Doghead Point Peninsula (*See* page 8) and some on the point between Hunter and Norrie Bays, and on the island 1 mile southwest of there, strike northwest and dip northeast.

In Conjuror Bay-Camsell River district, from the limited work done it appears that the general strike is northwest and the dips are up to vertical.

Near Dumas, Gagné, and Benoit Lakes the sediments and gneisses described from there, as far as seen, have a rather constant northwest strike, with steep dips in both directions.

Faulting is widespread in the area explored. The great majority of the faults seen, both large and small, strike in the northeast quadrant, usually about northeast. In nearly all cases where the direction of the horizontal movement could be determined the northwest block is displaced northeast relative to the other block. In only three places were indications of the direction of vertical movement seen; in two of these the northwest block appeared to have subsided relative to the other, and in the third the opposite appears to have taken place. Large quartz veins occur in several large faults mapped (*See* page 15), and the coincidence in direction between the system of quartz veins and the major faulting suggests that many of them may be fault veins. The southwest course of many of the streams entering the east side of McTavish Arm, and of some lake shores, shows structural control of part of the drainage, and emphasizes the northeast trend of many structures.

The large northeast-trending faults cut the rocks of the Old Complex, so are younger than them. As some of the large quartz veins cut the granites the faulting may also post-date the granites. As previously described (page 13) a vein in one fault appears to be unconformably overlain by the Hornby Bay series, in which case part of the faulting preceded the deposition of these rocks. However, at this place the basal beds of the Hornby Bay series outcrop on one side of a straight river canyon, and older feldspar porphyries outcrop in the other wall, showing the stream is in a fault and that part of the faulting post-dates the Hornby Bay rocks.

A large and readily visible, northeast-trending fault lies along the west side of the valley joining Cameron and Lindsley Bays. At the base of the 800-foot hill west of Cameron Bay, the conglomerates of the Cameron Bay group, striking northwest and dipping at a moderate angle northeast, can clearly be seen to strike directly into the hill which is composed of feldspar porphyry with diorite or granodiorite to the north. At intervals along the slope of the hill, and near the shore farther southwest, a zone up to hundreds of feet wide of considerably altered rock, sheared, crushed, and slickensided at places, is present, and is intersected by a network of quartz veins. These are offshoots from a large vein which can be seen along the contact of the two rock groups for half a mile near Cameron Bay. The extension of the fault northeast in Lindsley Bay is not known. Looking southwest along the fault, it appears to lie close to the north shore of Echo Bay and to pass just south of Mystery Island. As few signs of it have been seen on the south shore, on Mystery Island, or on Dowdell Point, if it extends this far west it must lie in the channel, and curve to the west. The available evidence shows that along this fault contacts may have been displaced as much as 3 miles, the northwest side going northeast, but until more detailed work is done this cannot be proved. This displacement may be partly accounted for by a smaller vertical movement of the southeast block down relative to the northwest block.

A probable fault is shown on the map 3 miles north of Smat. The amount of movement is not known, but the northwest side is down dropped and displaced northeast relative to the northeast block. A third fault, already described, lies in the valley of Fault River. The length of the fault is not known, but the linear topographic depression in which it lies can be followed in aerial photographs as a narrow trench or single scarp, in a straight line for 80 miles, to within 30 miles of the junction of Kendall and Coppermine Rivers.

In addition to northeast structures, are some that trend north and south. These are shown at places by the topography, and also by north-south dykes of considerable length. Two of these, known as Notman and Rogers dykes, lie northwest of the area examined, and can be readily traced from the air or aerial photographs for many miles as pronounced ridges; the Notman dyke can be traced from East River (south branch of Dease River) for 40 miles to north of the western Dismal Lake. In the area explored this structural trend is best shown in a north-south valley in granite 4½ miles east of Smat, and is easily followed for 12 miles. These structures may represent jointing and fracturing rather than faulting.

ECONOMIC GEOLOGY

The mineral deposits so far discovered are classified as follows:

(1) Copper deposits—
  (a) In large quartz veins.
  (b) In volcanics of the Coppermine River series.
(2) Silver and pitchblende deposits—
  (a) Pitchblende deposits with silver.
  (b) Silver deposits.
(3) Gold deposits.

With one exception little work was done in 1932 on the copper deposits. At the B group claims at Bornite Lake, 20 miles north of Dismal Lakes (1, page 59C), some diamond drilling was done in the spring and summer of 1932. So far as known no work was done on the copper deposits at Hunter Bay or on the disseminated copper occurrences of Coppermine River area.

Considerable development of previous discoveries and intensive prospecting was done in Echo Bay district. Further work was done on the Echo Bay group of the Consolidated Mining and Smelting Company, on the Eldorado mine at Labine Point, Bonanza group at Dowdell Point, and on the M group on the north shore of Contact Lake. At Camsell River, 35 miles south of Labine Point, silver was discovered in the summer of 1932 at two places one-half mile apart. The discovery of gold values in assayed samples from Camsell River and from two places north of Labine Point is reported.

SILVER AND PITCHBLENDE DEPOSITS

Eldorado Mine, Labine Point

This property has previously been described (1, page 61C to 66C) under the names Cobalt, Cobalt Extension, and Ray groups. Since 1931 development work and mining operations have been confined to the Cobalt group.

Three mineralized zones a few hundred feet apart, and trending east-northeast, occur at the end of Labine Point (1, page 62C, Figure 6). The southernmost (No. 1) zone lies partly under water along the shore of Great Bear Lake; the middle (No. 2) zone has been traced from the lake shore for 1,400 feet to a pond under which it disappears; the third zone, still farther north, has been traced for several hundred feet from the lake shore. Pitchblende has been found in all three zones, and silver in addition in No. 2 zone, particularly in the northeast part.

The major part of the recent work has been done on No. 2 zone. In April, 1932, before surface water from the spring thaw caused a temporary stoppage of work, some work was done on No. 1 zone. In August a large part of the crew of about twenty men were busy arranging for the arrival and setting up of a small mining plant. This consists of Junkers Diesel engines operating a compressor and lighting plant. They will run on oil brought from the wells drilled in 1920-22 below Norman, on Mackenzie River. In September a crosscut adit to intersect the east end of No. 2 zone at a depth of 80 to 90 feet below the surface was started. It was reported to have reached the zone in January, 1933. Tunnelling is stated to have been entirely in frozen ground. Hot water had to be used in the drills, but apart from this no unusual difficulties were encountered.[1]

During the spring and summer of 1932 approximately 35 tons of pitchblende ore and 11 tons of silver ore were mined, hand-cobbed, and shipped by boat via Norman. The pitchblende ore was shipped to a refinery being erected by the company at Port Hope, Ontario, and the silver ore was shipped to Trail, B.C. All the ore was obtained from surface pits, the greater part from a group of pits at the northeast end of No. 2

[1] Personal communication from G. A. LaBine.

zone. Stoping here was carried to 20 feet below the surface, to where caving stopped further work. Some pitchblende was also mined from a pit at the middle of No. 2 zone, and from one near the southwest end. Some pitchblende was also mined in the early spring from No. 1 zone. No work was done in 1932 on No. 3 zone, nor, so far as known, at places on the property other than those mentioned. Sufficient development work has not yet been done to warrant estimating the reserves or grade of the pitchblende ores. The following statements indicate what was visible in August, 1932, or was reported to be present.

No. 1 Zone

Pit No. 1 was flooded. This pit has been sunk at the lake shore and is 22 feet long and 13 feet deep. A little pitchblende can be seen at the east end of the pit. As stated in the 1931 report, it has been said that 11 inches of solid pitchblende extends along the bottom of the pit over most of its length.

Pit No. 2 is at the lake shore 350 feet northeast of No. 1 pit, and was flooded. A lens of pitchblende several inches wide and 40 feet long is said to be present.

No. 2 Zone. (The distances to the various pits were measured from the lake shore at the southwest end of the zone.)

At 80 feet, a pit. No work was done here in 1932. In 1931 a small amount of pitchblende was visible in one wall for 12 feet. It was reported that in 1931, 3,200 pounds of pitchblende had been cobbed from material mined from this pit.

150 to 520 feet, drift-covered.

At 520 feet, a large pit in the face of a hill. A width up to 6 inches of pitchblende is visible at one place. Pitchblende, and uranium stains occur up the 30-foot face of the pit to the surface.

At 570 feet, a shallow pit. There is a lens of pitchblende with a length of 15 feet and a maximum width of 6 inches. (It was from across the wider upward extension of this lens that sample No. 538 mentioned in the 1931 report was taken.)

570 to 650, the zone is continuously stripped.

At 650 feet, a shallow pit. Uranium stains are plentiful and there is a seam of low-grade pitchblende 1 to 2 inches wide.

650 to 730 feet, the zone is continuously stripped.

At 730 feet, a shallow pit. There are uranium stains and a little pitchblende.

At 750 feet, a shallow pit. There are uranium stains and a lens, 7 inches by 4 feet exposed size, containing some low-grade pitchblende.

750 to 800 feet, the zone is largely exposed.

At 800 feet, a large pit. (It was from this pit that samples 1, 2, and 3, mentioned in the 1931 report, were taken.) Along the north wall of the pit there is a 20-inch lens of pitchblende narrowing rapidly to 8 inches, and at the north end of the pit forking into two 2-inch seams. The total length is 40 feet.

800 to 950 feet. For about half this distance the zone is exposed.

At 950 feet, a small pit. There are uranium stains and several irregular, closely spaced pitchblende seams about one-eighth inch wide.

950 to 1,100 feet. Over about two-thirds of this distance the zone is exposed.

1,100 to 1,200 feet. The zone is continuously exposed and there is a large pit 75 feet long and up to 20 feet deep. Part of the bottom of the pit is flooded. (This large pit covers the sites of pits Nos. 3, 4, 5, and 6 of the 1931 report, page 66C.) In the hanging-wall of the pit there are a number of pitchblende seams ½ inch wide, in a few places 2 to 3 inches wide. The greater part of the 35 tons of pitchblende mined in 1932 came from this pit.

At 1,235 feet, a pit (this is pit No. 2 of the 1931 description). No pitchblende was seen.

At 1,285 feet, a pit (this is pit No. 1 of the 1931 description). One seam of pitchblende one-eighth-inch wide was seen.

1,285 feet to pond at 1,350 feet, no exposures.

No. 3 Zone

As mentioned in 1931, in one pit there is a single, persistent, ½-inch pitchblende seam, and in a second pit 40 feet east, there is a lens up to 9 inches wide of siliceous pitchblende.

It is apparent that a considerable amount of pitchblende is present, but that due to its scattered distribution a large amount of mining will be necessary to recover it.

In these three zones silver has only so far been found in No. 2. It is most abundant at the northeast end, in the 1,100- to 1,300-foot section. The silver mineralization visible in 1931 in this section has been described (1, page 66C). In the course of mining pitchblende from the large pit made here in 1932, 10·6 tons of high-grade silver ore was cobbed and bagged. Mr. Charles LaBine, president of the company, states that the shipment of 10·6075 dry tons assayed 3,623·2 ounces silver, and 0·02 ounce gold, a dry ton. This represents a high-grade product hand cobbed from the richest mineralized area (pits 3, 4, 5, and 6 of 1931 description) on the property seen by the writer. In August, 1932, part of the bottom of the pit from which this material was mined was flooded and could not be examined, but in the remainder of this pit, native silver was scant when compared with the spectacular surface showings. Silver may, however, be here present in other silver minerals. Argentite has been identified in polished surfaces and has occasionally been seen in hand specimens. It has been suggested that the native silver mineralization may be of supergene origin. This has been based generally on the appearance of the silver in hand specimens, rather than on microscopic observation. Studies of these ores so far made by M. H. Haycock of the Mines Branch and the writer, although only partly completed, indicate that the question whether the native silver is hypogene (primary) or supergene (secondary) will be exceedingly difficult to solve, or if both forms are present in what proportion the two exist will be hard to determine.

Echo Bay Group, Labine Point

These claims adjoin the Eldorado property on the northeast. A brief description of the mineral occurrences has been given in the 1931 report (1, page 66C). During 1932, a number of test pits and diamond drill holes were put down to prospect and explore mineralization found in 1931 in shear zones on Echo Bay No. 1 mineral claim.

The rocks in the vicinity of these shear zones have been described (1, page 66C). They belong to the Echo Bay group of volcanics and interbedded sediments, and consist of massive, fine-grained, grey rocks showing in places traces of bedding. In addition, there is on the east slope of the hill a massive, fine-grained, grey rock with scattered, well-formed feldspar phenocrysts up to one-eighth inch long. Many of the massive grey rocks can be seen, in fresh specimens from diamond drill cores, to be definitely fragmental. They are probably tuffs, as bedding is not common, and the fragments are angular and fine-grained, brown and reddish brown, felsitic rock. At places where they are fractured, chlorite is abundant; finely disseminated pyrite is widespread in them, and magnetite is common.

In addition to the shear zone on the north slope of the hill (100 zone—Figure 2) and the one near the crest (200 zone—Figure 2) mentioned in the 1931 report, several others were found in 1932. These have been called the 300 zone, 400 zone, 500 zone, and A 15 zone (*See* Figure 2). All these shear zones, as exposed in surface pits, are belts of intense fracturing that, except in the case of the A 15 zone, strike northeast and dip steeply. There is frequently in the middle of each belt a well-defined zone up to 1 foot wide of soft, gouge-like material that commonly is composed in part of supergene manganese, copper, iron, and cobalt minerals. The fracturing dies out away from the central zone of shearing. The fractures are nearly always coated with supergene manganese minerals, and the rock adjacent to them contains at many places disseminated chalcopyrite or galena.

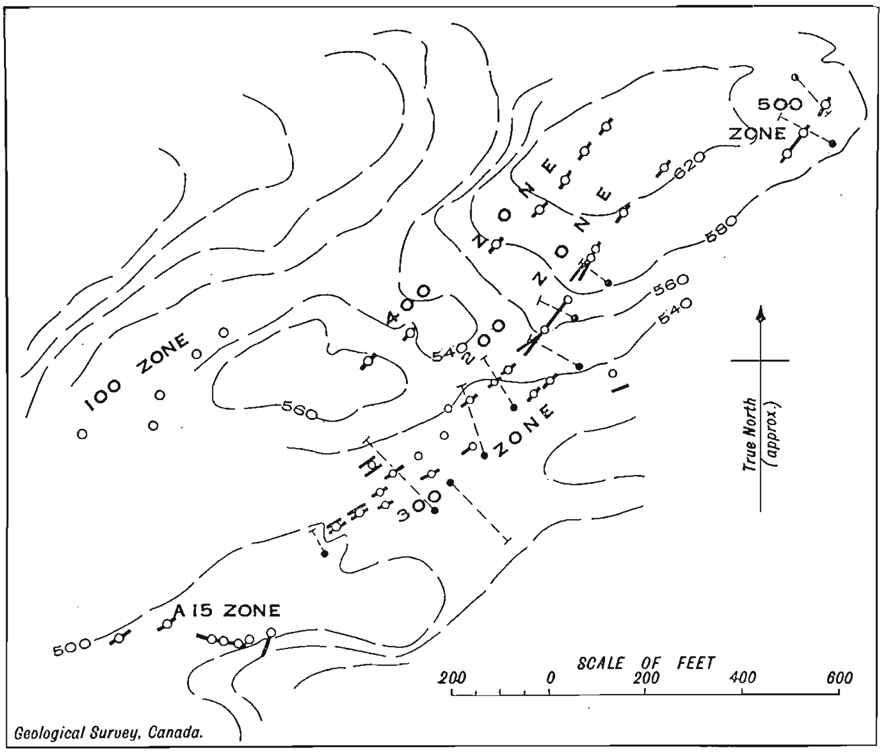

Figure 2. Plan of part of Echo Bay group, Labine Point, Great Bear Lake. Prospect pits are shown by open circles, shear zones by heavy lines, and diamond drill holes by solid black circles.

The 500 zone has been traced 150 feet by three pits. It dips vertically to steeply northwest. In the central, sheared band present in two of the pits, there are cobalt, copper, iron and manganese stains, and galena, chalcopyrite, a cobalt-nickel group mineral,[1] and pitchblende in small amounts, have been seen. In the adjacent rock disseminated chalcopyrite and bornite occur. Some silver is reported present but was not seen. Argentite has been identified in one polished section.

[1] The term "cobalt-nickel group mineral" is used as an inclusive one for all the hard, white cobalt-nickel-iron arsenides and sulph-arsenides and comprises arsenopyrite, cobaltite, gersdorffite, glaucodot, plessite, arsenoferrite, smaltite-chloanthite and chloanthite-smaltite, lollingite safflorite, rammelsbergite, skutterudite, and maucherite. Due to the isomorphism between many members, and their similar properties, minerals of the group can often only be approximately determined.

The 400 zone (*See* Figure 2) crosses the crest of the hill, and its probable extension has been found at intervals for 700 feet. At many places it is a belt of fracturing rather than a shear zone. The previously described supergene mineral stains, and disseminated chalcopyrite in wall-rock, are often present. Small carbonate veins and tiny, irregular stringers are common, and in some pits the carbonate holds numerous, tiny, rounded grains of niccolite. In polished surfaces these show as spherules with a radiating structure, surrounded by shells of a cobalt-nickel group mineral. Silver is reported present in two pits, but in a rapid examination was not seen. In addition, in polished sections, sphalerite, pyrite, and several cobalt-nickel group minerals were seen. At what is thought to be the southwest extension of this zone, carbonate veinlets hold bornite, chalcopyrite, and galena, and sphalerite and pyrite have also been identified in polished surfaces.

The 200 zone (*See* Figure 2), near the crest of the hill, dips vertically to steeply northwest and has been traced for 700 feet. At most places where it has been exposed it exhibits one or two well-defined zones of shearing. These have been stripped continuously for several hundred feet at one place. There is fracturing outside and between the sheared bands, and the fractures are coated with supergene manganese minerals. At the southwest end the sheared bands hold up to 6 inches of chalcopyrite that is much crushed, showing there was some movement after its formation. At the northeast end there are lenses up to 1 foot wide of soft, yellowish white materials, in part carbonate, that is stained with erythrite (cobalt bloom), malachite, and azurite. When broken this shows on the fresh surface rectangular patterns of fern-like shape. Except for these the material resembles the surface alteration product of the carbonate with niccolite described from the 400 zone. In the field, galena, native silver, and argentite (?)have also been found in this material. In addition, the following minerals have been found in polished sections: chalcopyrite, pyrite (as relict grains in chalcopyrite), niccolite (in spherules), sphalerite, isotropic and anisotropic cobalt-nickel group minerals, and stromeyerite ($(Cu, Ag)_2S$), the last at several places. The material tentatively identified in the field as argentite may be stromeyerite.

On the southeast slope of the hill, southwest of the 200 zone, a number of pits have been sunk and several small zones of fractured or sheared rocks have been exposed. This belt has been called the 300 zone (*See* Figure 2). The usual secondary manganese and copper minerals are present. In one pit a vein of white quartz up to 2 feet wide, with chalcopyrite, bornite, and covellite in fractures, is present. This vein is of interest chiefly because some narrow shear planes cross it, showing some movement has taken place since its formation. The A 15 zone (*See* Figure 2) differs from all the others as it strikes east-west. The dip is steeply north. A distinct vein of chalcopyrite, up to several inches wide, has been traced for 50 feet by three pits and some stripping. On the north side it is bordered and cut by a later vein of white to yellowish to pink carbonate. In this there is niccolite and scattered lenses up to 2 inches long of copper-bearing argentite (probably stromeyerite). The earlier chalcopyrite vein contains still earlier pyrite and arsenopyrite, and has a scant quartz gangue.

The very limited study so far made, suggests for further consideration the idea that there may have been in these zones an earlier period of mineralization of pyrite, arsenopyrite, chalcopyrite, and possibly bornite, galena, and sphalerite, with a quartz gangue, and that this was followed later by disturbance, and the formation of carbonate veins with cobalt-nickel minerals, niccolite, chalcopyrite, galena, and silver minerals.

Silver mineralization has been found at some places in many of the zones explored on this claim. As the silver is present in part in other minerals than native silver, it is almost impossible to estimate the amount of silver mineralization present. So far as can be seen, at some places it is fairly abundant, but, as may be expected in deposits of this type, the distribution is irregular.

M Group, Contact Lake

These claims were staked in the summer of 1931 for Northern Aerial Minerals Exploration, Limited, by T. Creighton and others. Development is being carried out by Bear Exploration and Radium, Limited. The claims are close to the north shore of Contact Lake, south of the inner part of Echo Bay. The workings are on a hill ¼ mile north of a point on the lake shore 2¾ miles from the west end of the lake. A portage trail connects Contact Lake with a cove on the east shore of the southwest arm of Echo Bay. Supplies have been brought to the lake by this route, and by aircraft.

The rock at the pits is a massive, medium-grained, quartz diorite or granodiorite (*See* page 10), part of a mass that extends northwest for 3 miles and east for 1½ to 2 miles. On the lake shore south of the workings, the rock is a massive, medium-grained granite which, as far as can be seen in the field, grades across several hundred feet into the diorite-granodiorite rock.

Present development has all been done on a fracture and shear zone that has an average strike about north 75 degrees east and dips commonly 70 to 85 degrees south. This zone extends diagonally up a hill whose lower part has a slope as high as 40 degrees. It has been traced continuously for 350 feet to a drift-filled depression 350 feet across, beyond which its probable extension has been found and traced some distance farther. At its southwest end at the base of the hill it is covered by an area of drift and muskeg, beyond which it has not been located.

In August, 1932, a deep open-pit had been made on the zone at the base of the hill, the face being 20 feet high. Sufficient stripping had been done to expose the zone continuously for 200 feet to the crest of the hill and here a second pit had been sunk.

In the pit at the base of the hill, the diorite is fractured for a width of 1½ to 3 feet and has numerous slickensided surfaces, and the adjacent rock is considerably altered apparently to chlorite (*See* Plate I B). The foot-wall is usually marked by a seam of brown gouge with secondary manganese minerals, malachite, and azurite, but on the other side the fracturing gradually dies away. A persistent vein or veins 2 to 6 inches wide of brownish pink, manganiferous carbonate with bornite and chalcopyrite is present and there are also veinlets (branching out along cracks from the main seam), of massive bornite with covellite. In the floor of the pit the carbonate is nearly white, occurs more irregularly, and at places holds numerous wires of native silver. A lens of white, coarsely crystalline quartz, with vugs lined with quartz crystals and specular hematite, lies near the foot-wall and has carbonate on each side, but the relations to the carbonate were not seen. In August, 1932, numerous silver wires were visible in the carbonate for 5 inches on the south side and for 2 inches on the north side of the quartz lens and at intervals for a distance of 8 feet along the zone.

The zone can readily be traced by the sheared rock and secondary manganese and copper minerals to pit No. 2 at the top of the hill. Fifty feet east of pit No. 1, the zone branches and just at the west end of pit No. 2 it again branches, the branches going off on the north side and lying at distances of 10 to 25 feet from the main zone.

In pit No. 2, as in pit No. 1, the zone dips steeply south, the foot-wall is well defined by a seam of secondary minerals, and the fracturing dies out in the hanging-wall. Near the foot-wall is a persistent quartz vein a few inches wide with white to glassy and rather dark grey quartz, with crystals grown out from the walls. This vein east of this pit is sparingly mineralized in places with chalcopyrite and bornite. In the bottom of the pit low-grade pitchblende can be seen at intervals and appears to be in the form of a lens about 13 feet long with a maximum observed width of 4½ inches. Native silver occurs with the pitchblende and also along fractures in altered country rock and irregularly through it. The silver is visible at intervals in the bottom of the pit over a length of 22 feet. At one spot across a width of 12 inches scattered silver wires are visible and are rather abundant across one-quarter of this width. A channel sample taken across the greatest visible width of the pitchblende lens (4½ inches) assayed as follows:

Sample S2667[1].

Gold	None
Silver (Troy oz. per ton 2,000 lbs.)	666·53
Uranium oxide (U_3O_8)	4·31 per cent

Near the west end of the pit is a lens up to 6 inches wide, of brownish pink carbonate and vein quartz. The carbonate contains perfect, fern-like growths of dark minerals in rectangular patterns, and seams of pinkish red erythrite (cobalt bloom) and possibly nickel bloom. This association resembles some of the mineralization on the Echo Bay group.

Bornite, chalcopyrite, covellite, azurite, malachite, manganiferous carbonate and secondary manganese minerals, pitchblende and its alteration products, native silver, and specular hematite were recognized in this deposit in the field. The following minerals have been seen in polished surfaces on specimens examined in the laboratory. From pit No. 1: argentite. From pit No. 2: magnetite, pyrite (?), tetrahedrite, stromeyerite ($(CuAg)_2S$), and hessite (Ag_2Te). From a point 200 feet east of pit No. 2: a cobalt-nickel group mineral, possibly rammelsbergite, and chalcocite. Not enough specimens have been studied to determine the age relations. Pitchblende occurs, where seen, as broken spherules and chains of spherules often with hollow cores, as at Labine Point. The gangue is quartz or in some cases the cores and radial cracks are filled with carbonate carrying, in some examples, some native silver along cracks. In a single specimen from pit No. 1, argentite occurs as blebs in native silver. In a specimen from pit No. 2, native silver veined stromeyerite. In the only specimen from pit No. 1, the carbonate is later than the quartz.

[1] Laboratories of Mines Branch, Dept. of Mines, Ottawa.

Thompson Group, Bow Lake

These claims were staked by Wight and McKee in 1932. The discovery is on an east-facing slope to the west of, and overlooking, a small lake lying between the east end of Bow Lake and the south side of Contact Lake. A little surface stripping had been done in August, 1932. The rock in the vicinity, where seen, is massive, medium-grained granite. It is cut by a basic dyke that strikes approximately east-west, and whose width is estimated as 75 feet. The dyke rock is dark brownish grey, rather fine grained and crystalline with very fine-grained edges against the granite. Near the centre of the dyke and about parallel with the walls is a zone of fracturing with quartz stringers. The zone can be traced 50 feet and is up to 1 foot wide. The quartz carries considerable pyrite, chalcopyrite, and bornite, smaller amounts of brown carbonate, and pink calcite, and a little erythrite (cobalt bloom). The quartz shows combs, and vugs which may contain hematite. In a small fracture that crosses this vein about at right angles, and that can be traced a few feet, is a seam up to 1 inch wide showing bright yellow stains thought to be uranium minerals. An assay [1] of a selected sample of this material gave:

Gold (oz. Troy per ton 2,000 lbs.)	0·20
Silver (oz. Troy per ton 2,000 lbs.)	3·92
Uranium oxide (as U_3O_8)	14·15 per cent

The chief present interest in this occurrence is that it apparently shows that this pitchblende mineralization took place considerably later than the emplacement of this granite. The amount of mineralization seen was small.

Bonanza Group, Dowdell Point

These claims have been briefly described in a previous report (1, page 67C). Since the previous examination some further stripping has been done and additional mineralization discovered. The discoveries are at two distinct localities, one-half mile apart, at the base of Dowdell Point.

At the western occurrence a band, up to 300 feet wide but widening westward, of nearly vertical sedimentary rocks trending west-northwest, is bounded by the main Dowdell Point granite mass on the south and by a massive, medium-grained, reddish brown, somewhat altered, dioritic rock on the north (*See* Figure 1). The dioritic rock is a border phase of a comparatively large body of diorite and granodiorite that extends east to Mile Lake. The sediments border a drift-filled depression. They are, in large part, well-banded, hard, fine-grained, grey and pink rocks, now largely recrystallized. Some bands, particularly in the mineralized zone, are much softer, weather differentially, and contain a large amount of chlorite, and at some places much hematite and magnetite. They are probably altered calcareous beds. The alteration is characteristic of that caused at other places by the diorite.

[1] Laboratories of Mines Branch, Dept. of Mines, Ottawa.

A belt of fracturing up to 30 feet wide strikes northwest along the north side of the depression and can be traced for 300 feet. In the fractures at some places are veinlets of light brown to dirty white to greenish carbonate, frequently showing numerous wires of native silver. In the carbonate, on a single polished surface, small specks of chalcopyrite, either niccolite or bornite, and at least two, soft grey minerals were found to accompany the silver.

Development consists of two strippings, respectively, 30 feet by 12 feet and 54 feet by 16 feet, situated 70 feet apart, and one pit. In the stripped areas silver is visible on the weathered surface at a number of places. The weathered surface still remains and no systematic sampling has been done. In the case of the smaller stripping, eight, fairly evenly distributed, areas varying in size from 1 inch by 12 inches to, in one instance, 8 inches by 30 inches, contain silver wires in carbonate, and are estimated to carry 5 per cent up to perhaps 50 per cent silver. In addition, occasional wires were seen at other places. In the larger stripping there are, also, eight areas of similar size where silver wires are numerous and there are also patches of lower-grade mineralization.

At the eastern occurrence a low, drift-filled depression extends west from the west end of Mile Lake to a small lake 1,500 feet west (locally called Silver Lake). A rock knob in the valley, and the rocks south of the valley, belong to the Dowdell Point granite mass, this being its north boundary. On the north side of the valley in a low bluff, and over a hill behind, that rises 170 feet, are outcrops of much altered rocks intruded by irregular masses, up to many feet across, of rather fine-grained, dioritic rock resembling that lying north of the western occurrence, and like it probably being the south edge of the diorite body on the point. The least altered rocks are hard, dark grey to reddish brown, finely banded, siliceous argillite, in part almost a chert, and dark greenish grey, fine-grained rock. These rocks and diorite are in places white weathering due to silicification by the granite to the south. The diorite-sediment contact is very irregular; traced to the west over the crest of the hill it bends south and can be followed across the face of a slope overlooking Silver Lake. Here dykes of granite cut the diorite. The diorite contact appears to dip at a low angle south under the deposit and this may account for the extensive alteration of the intruded rocks.

Several veins or fractures have been found in the altered rocks on the slope of the hill, but only a little surface stripping has been done on them. Two sets of fractures exist, one trending west-northwest along the face of the hill, and a second a little east of north, or nearly at right angles. In one north-south fracture a barren quartz vein or belt of stringers up to 1 foot wide is present. In the west-northwest fractures tiny quartz stringers are common. In addition, some fractures contain coarsely crystalline, white to pale grey calcite with, in places, native silver in rectangular dendritic patterns on the cleavage faces of the carbonate. Purple fluorite was seen in the calcite at two places. In a west-northwest fracture (A,

Figure 3) along the bluff and in another (B, Figure 3) on the same strike 400 feet east, a little bornite and other minerals occur: chalcopyrite, bornite, covellite, sphalerite, and tetrahedrite have been seen in polished surfaces of specimens from these places. In one surface a little definitely supergene native silver associated with malachite was seen. In two fractures erythrite (cobalt bloom) has been found.

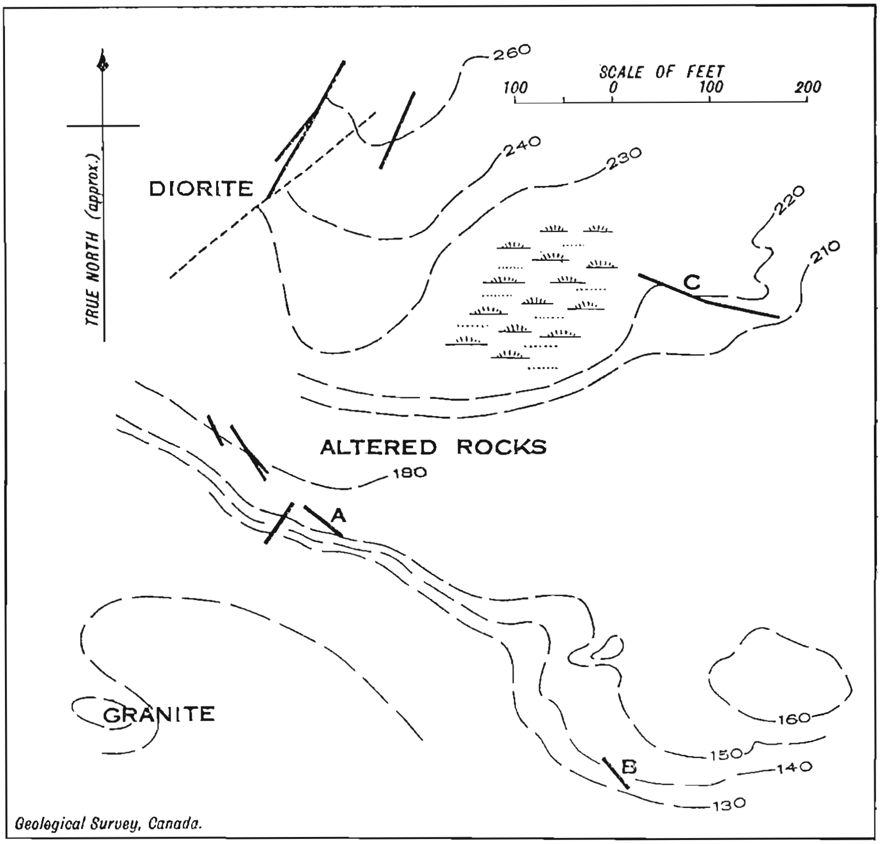

Figure 3. Plan of eastern development on the Bonanza group, Dowdell Point, Great Bear Lake. Fractures or veins are shown by heavy lines; datum is level of small lake 3,500 feet west.

Silver is abundant in the coarsely crystalline calcite at some places. In the west-northwest vein (C, Figure 3) near the crest of the hill, at one place for a length of 16 feet and an average width of 1 inch, the vein has very abundant silver, possibly 35 per cent. In the nearly parallel fractures (A, Figure 2) 400 feet south, there are several places where silver is abundant over areas up to 2 inches by 3 feet, and scattered wires can be seen over somewhat larger areas.

Otter Group, Camsell River

These claims are situated on the north bank of Camsell River, 9 miles east of the mouth of the river, in Conjuror Bay. The discovery is on a smooth ledge rising from the river bank three-quarters mile west of the first considerable rapid. Native silver was found here in a small fracture zone by W. J. Workman and E. B. McLellan in the summer of 1932, and several test pits were sunk to explore the occurrence and nearby similar fracture zones. A brief examination was made in August, 1932.

The rocks on this part of Camsell River are classed with the Old Complex. For one-quarter mile along the north shore, and in exposures on a point opposite on the south shore, the rocks are massive, fine-grained, grey in colour but greenish weathering, and hold at many places vesicles, and at others fragments up to 1 foot across, of a similar rock. There are also massive, fine-grained, grey rocks with tiny quartz phenocrysts and occasional vesicles. All these rocks are probably volcanics. Their attitude was not determined. Similar rocks with interbedded sediments are fairly widely distributed to the north and northwest in Conjuror Bay. Granitic intrusives occur about 1¼ miles east, and also 2 miles south. The mass to the south is reported to extend to Hottah lake (*See* Map 2328).

The pits are on a smooth rock ledge which slopes steeply up from the water's edge to a height of 70 feet at 200 feet from the shore. Farther inland is a cover of soil and vegetation. Silver has been found in a narrow fracture zone that has been traced for 250 feet. The strike is slightly curved (the outcrop is considerably curved due to the slope of the hill), averaging a little south of west (magnetic), and the dip is 70 degrees to 75 degrees north. In the discovery pit, 160 feet from the shore, two quartz veins a few inches wide, with rhythmically banded, milky and glassy comb quartz, converge from a distance of 15 inches apart. Between the veins and outside is a network of white carbonate veinlets holding coarse galena, chalcopyrite, arsenopyrite(?), a cobalt-nickel group mineral, and niccolite with native silver intimately intergrown. Silver is also present in the quartz veins, but where seen was in white carbonate interstitial to quartz crystals. A number of specimens with abundant niccolite and silver have been mined from this pit. Some similar material was visible in the floor at one place. Eighty feet east on this fracture there is a second pit. Here, there is a zone of quartz stringers up to one-quarter inch wide, bounded by fractures and with other parallel fractures for 2 feet outside. For a width of 1 foot at one place, galena and chalcopyrite are disseminated through the rock. In addition, sphalerite and arsenopyrite (?) can be seen in polished surfaces. Here also a little white carbonate, holding chalcopyrite and a few specks of silver, is present. In a third pit 20 feet from the shore, veinlets of white quartz, or of carbonate, are present, with some galena, chalcopyrite, erythrite (cobalt bloom), arsenopyrite (?), and a cobalt-nickel group mineral (?).

Three hundred feet north along the shore a nearly parallel vein occurs crossing a similar ledge on the river bank. It dips 65 degrees north and lies in a fault of which the northwest side is displaced 3 feet northeast. The vein is pink quartz with a breccia of rock fragments and a little erythrite and chalcopyrite. No carbonate minerals or silver were seen.

How Group, Camsell River

These claims adjoin the Otter group on the east. Silver has been discovered a few hundred feet back from the shore on a small point on the north bank of Camsell River, one-quarter mile west of the first large rapid. The claims were staked in the summer of 1932 by J. Borthwick. A brief examination was made in August, 1932.

The rock near the pits is tough, hard, and grey. It is for the most part fine grained, but at some places feldspar phenocrysts up to one-eighth inch long are present. A few hundred yards northeast it is more crystalline, grey, greyish pink, or white in colour, and at one place shows several feet of faint, wavy banding, that strikes northwest and dips 45 degrees southwest. Sparsely disseminated pyrite is widespread. The rocks may be volcanics, though no positive evidence of this was found.

Small pits have been sunk on several fracture zones that in some places are crossed by veins. The fractures appear to occur in two sets, one striking northeast nearly parallel to those described on the adjoining Otter claims, and the other striking north and south. In one northeast-trending zone that has been stripped for 110 feet, silver has been found at one place. The zone consists of 3 to 6 feet of fractured rocks with veins of white calcite up to 6 inches wide in the fractures. The calcite in places holds small amounts of galena, chalcopyrite, native bismuth, and a soft, steely grey mineral, probably bismuthinite. At one place, in calcite-free fractures on the northwest side of the zone, flakes of silver averaging one-sixteenth inch across are sparsely scattered over an area 3 feet wide and 10 feet long. In this vicinity are several other fracture zones on which a little work has been done. No more silver, however, was seen.

Three hundred feet west, two small fractures, trending, respectively, northwest and north, cross massive, fine-grained feldspar porphyry, and intersect each other. The north-south fracture contains a one-quarter inch seam of massive pyrite, and in the adjacent rock there are irregular blebs up to 2 inches across of pyrite in some cases and chalcopyrite in others. Polished surfaces show chalcopyrite replacing pyrite and country rock, and also reveal two grey minerals, one of which may be sphalerite. The pyrite is reported by Borthwick, the discoverer, to assay $4 in gold, and it is stated gold can be panned from this place. The amount of pyrite mineralization exposed here is small.

Other Mineralization, Camsell River

In August, 1932, no other occurrences of visible silver had been reported in Camsell River area. Some work had been done on several fracture zones on the Elite and Oxo claims on the south bank of Camsell River opposite the Otter and How groups. One mile south of the rapid on Camsell River a quartz vein 1 to 2 feet wide strikes east-northeast. Chalcopyrite, galena, a cobalt-nickel-group mineral, erythrite, and yellow carbonate are present in varying amounts, nowhere very abundant. At one place a little native bismuth and boulangerite(?) ($5PbS.2Sb_2S_3$) are present in the carbonate. On the point nearly opposite the discovery pit on the Otter claims, a 1-foot vein of pale grey carbonate with included rock fragments can be traced 50 feet in a west-northwest direction. It contains at places a cobalt-nickel group mineral possibly cobaltite, with galena and sphalerite in cracks in it.

Silver discoveries are reported to have been made in the autumn of 1932 on the south bank of Camsell River but have not been confirmed.

GOLD DEPOSITS

Oro Group, Labine Point

These claims are situated on and near the shore of Great Bear Lake 3 miles north of Labine Point. In the late summer of 1932 visible gold was reported to have been discovered by prospectors of Great Bear Lake Mines, Limited. The occurrence was briefly examined at the end of August.

The discovery lies approximately 1,000 feet inland from a point on the mainland shore southeast of the south end of a prominent, narrow island formed of a vein of quartz. It is west of a narrow, northeast-trending lake locally called Explorer's Lake. The place is close to the contact of quartz-mica diorite with older rocks of the complex to the south. On the edges of a drift-filled gully the borders of a band a few feet wide, of pinkish brown, fine-grained rock with scattered pink feldspar and glassy quartz grains up to one-quarter inch across, are exposed. On each side of the band is massive, medium-grained, brown and grey diorite or granodiorite. On the northwest side a 1 to 2-inch quartz vein cuts the diorite and can be traced 75 feet to where the fissure narrows to a tight crack. It is stated grains of gold as large as a grain of wheat were found in this vein. The quartz is milky, white to brown in colour, and contains pyrite and chalcopyrite. No gold was seen. In the northeast-trending gully three other veins, the largest one foot wide, are visible. It is stated gold can be panned from one of them.

Other Reported Gold Discoveries

As already stated in the description of the How group on Camsell River, pyrite forming a one-quarter inch seam in a small fracture and occurring in blebs of the wall-rock of this seam on the How claim, is reported by the discoverer to assay $4 in gold.

Gold is reported to have been found in the late summer or autumn of 1932 at two places in Echo Bay area: (1) south of Spark Plug Lake; and (2) on the mainland east of Mystery Island. These places have not been seen.

The gold discoveries examined are, as at present known, of very small size.

ADVICE TO PROSPECTORS

Prospectors at Great Bear Lake at the present time are seeking pitchblende, silver, and gold. Copper is receiving little attention.

The major pitchblende discoveries so far made are in well-defined shear zones. That at Contact Lake is evidently younger than the diorite in which it occurs, but its relations to the granites are not known. The occurrence on the Thompson group, Bow Lake, shows apparently that some pitchblende mineralization is later than some of the granite. At Labine Point on the Eldorado property, the No. 2 zone at its south end definitely cuts through a pink aplitic dyke that is an offshoot from the granite on the west side of the point. As has been explained in the section on general geology, the granite masses may be of widely different ages and whereas the mineralization may be later than some granites it may be related to others. In the rocks of the Old Complex and the granites, where cut by shear zones, no definitely unfavourable rocks for the occurrence of pitchblende deposits can be named. However, the granites, the red feldspar porphyries, and the conglomerate of the Cameron Bay group contain comparatively few important shear zones, and in this respect are unfavourable.

The local indications of pitchblende are the brilliant orange and yellow or dull greenish yellow surface stains near the mineral. At Labine Point at places the pitchblende has been leached out of outcrops to a depth of 1 or more feet, but yellowish stains have usually remained. Iron stains are usually brown, but other minerals may give stains similar in appearance to pitchblende, so confirmatory tests for radioactivity are desirable. For this a scintilloscope is useful. (For description and other tests for radioactivity, *See* 3, page 62.)

Silver occurs in fracture zones and, at nearly all the discoveries so far made, is associated with carbonate minerals rather than quartz. On the Echo Bay and Eldorado claims at Labine Point, and the M group at Contact Lake, the carbonate is manganiferous, and pink to pale brown. The bluish black, secondary manganese minerals formed from it are readily recognizable. On the Bonanza claims on Dowdell Point, and the discoveries at Camsell River, the silver occurs in white, light brown, or pale green calcite. At Camsell River, the island zone of the Eldorado claims, Labine Point (*See* 1, page 62C, Figure 6), and some occurrences on the Echo Bay group, the silver is associated with cobalt-nickel minerals, particularly niccolite. In No. 2 zone at the Eldorado, and on the M group at Contact Lake, this association is not apparent. Where quartz, and carbonates with silver, occur in the same zone, the carbonates are in most cases later than the main generation of quartz. This may be the reason why fracture zones filled with quartz and not refractured, though lying near zones with silver, contain little or none; examples are the No. 1 and No. 3 zones of the Eldorado property, and a small quartz vein at the eastern occurrence on the Bonanza claims. The remarks made under pitchblende regarding favourable and unfavourable rocks are equally applicable to silver.

Little can be said about prospecting for gold, as little is as yet known of its mode of occurrence. At the reported gold discoveries seen, the quartz is usually brownish and milky, and is accompanied by pyrite and chalcopyrite. So far as known, gold has not yet been found as more than traces in the large quartz veins and comb-quartz veins, and the gold and silver values in the copper minerals there are low.

NON-METALLIC MINERALS

Coal Deposits, Etacho Point, Great Bear Lake

The presence of coal seams on the west side of Great Bear Lake near Etacho Point has been known since 1912. Between January and March, 1932, coal claims were staked by several parties, and in the summer of 1932 some stripping and sampling of the seams were done. Two and one-half days in August, 1932, were spent in an examination of the occurrences.

Etacho Point lies between Keith and Smith Arms on the west side of the lake, and is formed by the east end of Scented Grass Hills. Coal has been found on the west side of Douglas Bay, a shallow indentation on the north side of the point 9 miles from the end. At this place the shoreline is regular and trends north and south. Inland a series of rolling slopes, timbered in their lower parts, rises to an altitude of 1,700 feet above the lake 5 miles inland. They are largely, if not entirely, covered with glacial drift. Along the shore there are bluffs up to 60 feet high, fringed with a beach of large boulders derived from the drift. Two miles south of the coal outcrops, in the bottom of Douglas Bay, there is a good gravel and sand beach, and in the mouth of the western of two small creeks there is excellent shelter for two aircraft or for small boats.

The coal seams outcrop in the bluffs along the shore at intervals for $1\frac{1}{2}$ miles, and also for $\frac{1}{2}$ mile inland along a small creek (*See* Figure 4). They strike somewhat west of north, nearly parallel to the shore, and dip 25 degrees to 50 degrees west, or inland. Exposures are scarce as most of the bluffs along the shore are masked by slumped boulder clay from the overlying glacial drift, or by vegetation (*See* Plate II A). The more important exposures are indicated on Figure 4 by numbers.

At locality 1, a coal seam outcrops dipping inland. The section consists of:

17 ft. 6 in., woody, dark brown lignite, rusty on fractures.
4 ft. +, yellow clay, in places rusty.

At localities 2 and 3 several coal seams outcrop, the largest of which can be traced between these places. At locality 3 the section is:

6 ft. 0 in., surface soil and sandy yellow clay.
3 ft. 3 in., brown lignite.
10 ft. (?) fine, yellow sand with some clay bands.
0 ft. 6 in., unbedded, dove-grey clay.
5 ft. 6 in., coal: 2 ft. brown lignite with woody cleavage.
3 ft. 6 in., darker lignite with angular fracture.
27 ft. 6 in., yellow, unbanded clay with some dove-grey bands.
16 ft. 3 in., coal: 5 ft. 6 in., brown, lustreless lignite.
8 ft. 6 in., blacker, more compact lignite.
0 ft. 3 in. ±, brown clay.
2 ft. 0 in., brown, clayey lignite.
2 ft. +, yellow clay.

At locality 2 the lower 12 feet of the large 16-foot 3-inch seam is visible and the section is:

12 ft. +, lignite.
9 ft. 0 in., yellow-grey, unbedded clay.
3 ft. 6 in., woody, brown lignite.
2 ft. 0 in., yellow-grey, unbedded clay.
1 ft. 6 in., woody, brown lignite with below it several feet of clay.

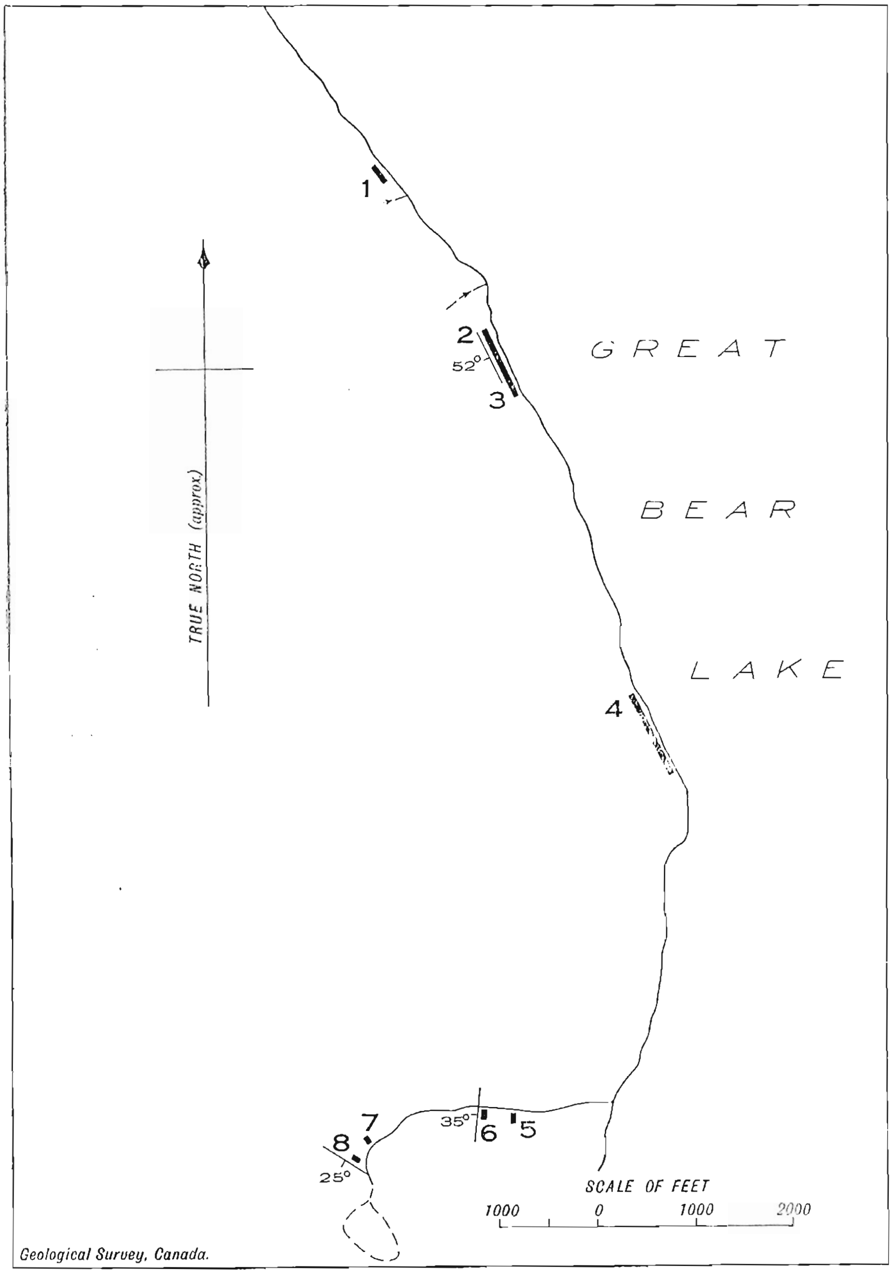

Figure 4. Plan of coal outcrops, Etacho Point, Great Bear Lake. Coal outcrops are indicated by heavy lines and are numbered as in text.

At locality 4 a large coal seam outcrops and can be followed south for 1,000 feet along the shore. The seam strikes slightly inland, and dips fairly steeply inland. This is probably the same seam as the 16-foot 3-inch seam at localities 3 and 2, and the seam at locality 1. The section is as follows:

Several feet—fine yellowish silt or sand.
3 ft. 0 in., woody lignite.
0 ft. 9 in., brown clay.
13 ft. 0 in., lignite.
4 ft. 0 in., lignite with some clay.
2 ft. +, pale grey clay.

Along the banks of the creek (*See* Figure 4) there are exposures in landslide slopes. At locality 5 a coal seam outcrops dipping up the creek. The seam is 7 feet 6 inches thick and is overlain and underlain by a few inches of brown clay. The coal is a dark brown, fairly competent lignite with a parting parallel to the bedding. At locality 6 the section is as follows:

20 ft. ±, grey to yellow banded silt with one 2-inch coal seam.
1 ft. 2 in., lignite.
8 ft. 0 in., silt, like above, grading down into
15 ft. 0 in., poorly bedded, light grey sand, almost entirely unconsolidated, with scattered, rusty clay nodules.

At locality 7 a small coal seam not over 2 feet thick is present, but the attitude could not be seen. At locality 8, near the top of a bluff, a seam of very woody, brown lignite with clayey bands outcrops. A thickness of 7 feet 6 inches of coal overlain by 6 inches of brown clay is visible; the base of the seam is concealed.

The coal in some of the seams on the lake shore was sampled. Channel samples were taken and no material was discarded. The analyses were made in the Fuel Testing Laboratories, Mines Branch, Department of Mines, Ottawa. Results are as follows:

—		1	2	3	4	5	6
Moisture, per cent	R	44·6	45·5	48·0	37·8	50·4	49·1
	D	–	–	–	–	–	–
Ash, per cent	R	16·3	5·6	4·6	22·6	4·7	8·3
	D	29·3	10·4	8·9	36·4	9·5	16·2
Volatile matter, per cent	R	20·2	24·1	22·8	20·7	21·6	21·2
	D	36·5	44·2	43·9	33·2	43·6	41·6
Fixed carbon (by difference), per cent	R	18·9	24·8	24·6	18·9	23·3	21·4
	D	34·2	45·4	47·2	30·4	46·9	42·2
Sulphur, per cent	R	0·4	0·2	0·2	0·4	0·2	0·4
	D	0·8	0·3	0·3	0·7	0·3	0·8
Calories per gramme gross	R	2,430	3,010	2,890	2,340	2,965	2,890
	D	4,380	5,520	5,560	3,760	5,970	5,675
B.T.U. per lb. gross	R	4,370	5,410	5,200	4,210	5,330	5,200
	D	7,890	9,930	10,010	6,770	10,750	10,220
Fuel ratio		0·93	1·25	1·10	0·92	1·10	1·00

R = coal as received; D = dried.

All samples were non-coking.
Sample 1: 5 ft. 6 in. seam overlying 16 ft. 3 in. seam at locality 3.
Sample 2: upper 5 ft. 6 in. of big seam at locality 3.
Sample 3: middle 8 ft. 6 in. of big seam at locality 3.
Sample 4: 2 ft. clayey coal at base of big seam at locality 3.
Sample 5: 13 ft. coal from middle of seam at locality 4.
Sample 6: 4 ft. lignite and clay from base of seam at locality 4.

These analyses indicate that the best coal sampled is in the large seam outcropping on the lake shore. Here at two places 13 feet of good quality lignite was sampled (samples 2, 3, and 5). The ash content of this coal is exceptionally low, but the moisture is high. The samples as taken included some ice from ice veins in the coal. The analyst reports that:

"Special tests showed that the true inherent moisture, that is, the moisture content when exposed to an atmosphere of 100 per cent relative humidity at room temperature, is approximately 40 per cent. Therefore, the moisture results reported represent total moisture in the samples as received in the laboratory and include both inherent and superficial moisture."

This coal has the chemical character and physical appearance of the Saskatchewan or Ontario lignites and ranks with them. The age of the coal is not known, as no determinable fossils were found. It is probably Cretaceous or Tertiary.

In August, at a depth of 2 feet below the surface, the coal was solidly frozen and contained ice veins up to an inch wide. Data are lacking, but it seems likely that the coal may be frozen to a depth of one, perhaps several, hundred feet. On the east side of Great Bear Lake, solidly frozen ground was penetrated to a vertical depth of 160 feet without its lower limit being reached, and in the Yukon the frozen ground extends as much as 300 feet below the surface. In Spitzbergen and west Greenland frozen coal is successfully mined. The disadvantages in the breaking down of the coal may be offset by the increased strength of the sand and clay above and below the seams.

Clay

Clay occurs interbedded with the post-glacial silts that occupy the lower valley of Sloan and Harrison Rivers. It is frozen with ice seams in it, but due to slumping of the banks is not readily seen except at the water's edge in the spring. A 3-foot bed on the west bank of Harrison River, just above the first rapid, was sampled. The sample was reported by the Ceramics Division of the Mines Branch, Ottawa, to be a very silty clay unsuitable for use in the clay products industry. Other clay beds in these silts may be of better grade.

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GREAT SLAVE LAKE-COPPERMINE RIVER AREA, NORTHWEST TERRITORIES

By C. H. Stockwell

CONTENTS

Illustrations

INTRODUCTION

Great Slave Lake-Coppermine River area (*See* Figure 5) includes the lower part of Taltson River, the country around the east arm and part of the north arm of Great Slave Lake as far west as Yellowknife River, and thence northward to Coppermine River. The extreme limits of the area are latitudes 61 and 65½ degrees and longitudes 109 and 114½ degrees and it measures about 325 miles long, north and south, and about 175 miles wide, east and west. Large parts of the area remain unexplored.

This preliminary report is based on geological field work carried on during the summers of 1929 to 1932. In 1929-30-31 the country around the east arm of Great Slave Lake and the north shore of the north arm as far west as Yellowknife River was investigated. In 1932 a reconnaissance trip was made along Yellowknife River to Coppermine River and thence easterly to Thonokied Lake and southerly back to Great Slave Lake. The writer was ably assisted in geological work by H. W. Fairbairn, Neil Derby, and P. I. Ogilvie in 1929, by A. W. Derby and N. B. Keevil in 1930, by N. B. Keevil and N. S. Beaton in 1931, and by H. S. Hicks in 1932. The work of the summer of 1932 was greatly facilitated by the Royal Canadian Air Force who brought supplies to Winter Lake and Point Lake.

Seven base maps were used in the field work. Three of these, namely, Great Slave Lake (Eastern Sheet), Great Slave Lake (Western Sheet), and Lockhart River Basin, are issued by the Topographical Survey of

Canada and the other four, namely, Yellowknife to Reindeer Lake, Reindeer Lake to Point Lake, Point Lake to Big Bend, and McLeod Bay to MacKay Lake, are issued by the Geographical Section, general staff, Department of National Defence. During the field work minor alterations were made in the topography of these maps, an instrumental survey was made of lakes south of Great Slave Lake, and a track survey was made of Coppermine River from Lake Providence, to the east end of Lac de Gras.

ACCESS AND ROUTES OF TRAVEL

Great Slave Lake may be reached by boat during the summer months and by air the year round except during break-up and freeze-up. Mackenzie River Transport, with offices at Waterways, Alberta, during the season of navigation and at Hudson's Bay House, Winnipeg, Manitoba, operate a regular boat service from railhead at Waterways to Fitzgerald and from Fort Smith to Resolution on Great Slave Lake. The journey from Fitzgerald to Fort Smith, a distance of 16 miles, is made by motor car. Their first boat generally arrives at Resolution about the middle of June and the last one leaves there during the latter part of September. On Great Slave Lake they operate boat services to Rae, on the north arm of the lake, and to Taltson River, Snowdrift, and Reliance, on the east arm. Generally, only one trip a season is made to Snowdrift and Reliance. Freight rates per 100 pounds of general merchandise, as advertised for the summer of 1933, are: from Waterways to Resolution $3.50; Waterways to Rae $4; Waterways to Reliance $6.50. Northern Waterways, Limited, also operates boat services from Waterways to Resolution and to points on Great Slave Lake. Canadian Airways, Limited, Edmonton, Alberta, operates a regular mail, passenger, and express service from McMurray, Alberta, which is near Waterways, to Resolution; other trips will be made by special arrangement. Several other air transportation companies also operate in the district.

The part of the area north of Great Slave Lake can be reached by canoe, by air, or, in winter, by dog team. Trading posts are open the year round at Resolution, Rae, Taltson River, and Snowdrift. Trading posts at Reliance are open only during the winter. Wireless stations are located at Rae and Resolution.

The following account gives descriptions of canoe routes and other pertinent information useful to anyone wishing to enter the district. As a guide to the traveller, the base maps already referred to should be used, in addition to the map, Figure 5.

Around the East Arm of Great Slave Lake

On Great Slave Lake large canoes are preferable to small ones on account of large, open stretches of water on which high waves often develop. At most places, however, numerous islands and bays offer considerable shelter. From the mouth of Jean River, the most easterly distributary of Slave River, to the mouth of Taltson River, the water close to the shore is generally so shallow, except at Stony Island, that it is difficult to land with loaded canoes. Elsewhere on the lake canoes can be landed almost anywhere.

On routes back from Great Slave Lake small canoes are best on account of the many portages that are necessary. Taltson River has been explored by Camsell (1).[1] Thubun river has a swift current for 2 miles from its mouth. This swift water is followed by a rapid past which is a worn portage trail indicating that the river is used as a canoe route. Probably the country to the south of Great Slave Lake is best reached by way of this river. A portage trail also leads past a fall at the mouth of Laloche River. Snowdrift River flows over two rapids between Stark and Great Slave Lakes and is occasionally used for canoe travel for a distance of 7 miles southeasterly from its outlet into Stark Lake. In this stretch are two portages and much swift water. In the next 12 miles the river drops about 500 feet over a series of rapids, cascades, and falls (13, page 20) and is ordinarily not used as a canoe route.

The country east and north of Reliance is ordinarily reached over Pikes Portage (2). Hoarfrost River was traversed by Back (3), but usually is not used as a canoe route.

The country north of McLeod Bay is difficult to reach on account of a steep rise in the land from the north shore of the bay. It is apparently generally reached by way of Mountain River, a route travelled by Anderson and Stewart (4). Pike (5) used a route farther to the west. The only accurately mapped route, described later, is along Barnston River.

The country north of Great Slave Lake between McLeod Bay and Yellowknife River possibly may be reached best by way of Beaulieu River or by way of a river flowing into the east side of Lake Prosperous.

A portage route through a chain of lakes south of Christie Bay is occasionally used by Indians and others and affords a means of reaching Reliance in the early spring before ice has left McLeod and Christie Bays. This route is along Murky Channel to Murky Lake, thence by a small stream to a lake to the east, from the east end of this lake over a portage of about half a mile to Snowdrift River near its outlet into Stark Lake, along Stark Lake to its east end, and thence by way of seven lakes and eight portages, totalling about 2½ miles, to the most southerly bay of Great Slave Lake south of Reliance.

Yellowknife River to Winter Lake

The canoe route, as here described, from the mouth of Yellowknife River to Winter Lake, is essentially the same as that explored and described by Franklin (6). The first portage, a short one on the east side of the river, is about 6 miles from the mouth of the river and leads to Lake Providence. At a point 2 miles up the river from the north end of Lake Providence a portage, about half a mile long on the east side of a succession of falls, leads to a small lake from where the traveller has a choice between ascending two short rapids and making a short portage past a fall or making a portage of 660 yards past both rapids and fall. This leads to a narrow lake 8 miles long. The portages so far are over well-worn trails, but northward to Winter Lake there are generally no worn trails and during the writer's trip it was necessary to cut many of the portages. Northward from the long lake 3 miles of river, interrupted by three falls, necessitating portages, and two difficult rapids, leads to a lake 1½ miles long. At the north end of this

[1] The number, and in some cases, page number, following author's name will enable the reader to find the complete bibliographic reference in the list of papers at the end of this report.

lake a rapid and some swift water lead to the base of a series of falls through a narrow gorge. The canoe route leaves the river at the base of this series of falls and continues northwesterly by way of a chain of three small lakes, Franklin's "Grassy Lakes," and intervening portages to meet the river again. The route then continues up the river for 6 miles to Rocky Lake and is interrupted between small lake expansions in this distance by five rapids and six falls, necessitating six short portages. Between Rocky Lake and Fishing Lake are three rapids and five portages. The second of these portages is a mile long along the northeast bank of the river. At the north end of Fishing Lake another portage leads past the east side of a succession of rapids and falls. Northward from here are two swifts, one short portage and a rapid leading to a narrow western arm of a lake. The river that flows into this lake is a succession of many rapids and falls for a length of 10 miles and, consequently, the canoe route follows a series of eight small lakes and nine portages on the west side of the river. The first of these portages, Franklin's "Icy portage," is nearly a mile long and the remaining six total nearly 2 miles long. Along the river from the ninth portage to Lower Carp Lake, a distance of 3 miles, there are two portages and one rapid.

Between Lower and Upper Carp Lakes is a fairly well-worn portage trail over half a mile long and between Upper Carp Lake and Reindeer Lake is a short portage. Between Reindeer Lake and Grizzle Bear Lake near the headwaters of Yellowknife River and just past the edge of the main woods, are four rapids and nine portages, the longest of which is one-half mile on the west side of the river at the outlet of Hunter Lake. From the northeast end of Grizzle Bear Lake the canoe route is over a short portage into a small lake and thence by a longer portage and a small creek to another lake. From the north end of this lake the route passes, by way of three small lakes and four portages, over the divide between the Yellowknife and Snare River drainage systems and into another lake. This lake drains north by a small creek, where another portage is necessary, into a small lake and thence to Winter Lake along a creek where three more portages must be made. Between the mouth of Yellowknife River and Winter Lake, by the route outlined, are fifty-three portages, aggregating about $13\frac{1}{3}$ miles long, in addition to sixteen rapids which may be surmounted by lining, poling, or wading.

From Grizzle Bear Lake to Winter Lake are large and small, scattered patches of spruce sufficient for fuel, and at several places large enough for cabin construction.

Winter Lake may also be reached, and probably more easily, by way of Snare and Winter Rivers from Rae on the north arm of Great Slave Lake, a route followed and roughly mapped in 1912 by Wheeler (7). That this route is still used by Indians is evidenced by their winter camps at the west end of Winter Lake and by well-worn portage trails on the banks of Winter River between Winter Lake and the next lake to the west.

Winter Lake to Point Lake

The canoe route continues from Winter Lake northward along Winter River to Little Marten Lake, in which distance there are five portages and three rapids. This route was also followed by Wheeler who continued from Little Marten Lake eastward across Lake Providence and beyond.

From Little Marten Lake the mapped route is northeasterly to Point Lake. From the northwest end of Little Marten Lake a portage of 680 yards, ½ mile east of the point where Winter River enters the lake, leads to a small lake. This small lake drains into the river and is fed by a stream coming in from the east which is followed, with one short portage, for 4 miles to the junction of two branches. The northern branch is followed for a very short distance to where it is so thickly strewn with boulders that it is impassable. Here the stream is avoided by making a portage of nearly three-quarters mile into a small lake east of the creek and thence by a portage of 660 yards into a lake expansion of the stream. From here the stream and small lake expansions are followed for 6 miles to Big Lake, which it drains, and in this distance six portages totalling about a mile long must be made past shallow, boulder-strewn parts of the stream bed. The route from Big Lake to Wray Lake, passing over the divide between Mackenzie and Coppermine River systems, is over two small lakes and three portages, the longest of which is nearly a mile. From the east end of Wray Lake a small stream is followed for 12 miles northeasterly to Point Lake. The stream, which has a gentle current most of the way, contains four rapids which are easily run, and six rapids or falls where as many portages were made. Between Winter Lake and Point Lake are twenty-four portages aggregating about 7½ miles long.

Scattered groves of spruce trees occur as far north as the second lake north of Winter Lake. From there to Point Lake are a few widely scattered, small patches of scrub spruce, and in many places small willows and shrubs sufficient to supply a small amount of fuel for the passing traveller.

Point Lake and Vicinity

From the west end of Point Lake, Coppermine River flows with a swift current through a short channel into Redrock Lake. Between Redrock Lake and Rocknest Lake it has a swift current at several places and at one locality forms a difficult rapid.

Odjick Lake is reached from Redrock Lake by way of a small river connecting the two and forming a succession of four, closely spaced shallow rapids, at the lowest of which a short portage must be made. A portage of one-quarter mile along the bank of the same river leads from Odjick Lake to the next lake to the east. The river comes in at the east end of this lake and was not explored farther.

Hicks Lake, according to H. S. Hicks who explored it, is best reached along a river that drains from it into the north arm of Point Lake. Five portages with a total length of over 1½ miles were necessary. Along a chain of lakes and connecting streams north of the east end of Point Lake, also explored by H. S. Hicks, eleven portages, totalling 3 miles long, were made. A lake at the east end of Point Lake is reached after two portages, totalling over one-half mile long. A lake south of Richardson Bay is reached by way of a very small stream along which three portages, totalling 1,230 yards, are necessary. The country to the southwest of Point Lake probably may be reached most easily along a river that flows into Point Lake in a bay south of the largest island in the lake. The country to the southwest of Redrock Lake may be reached by a river that flows into the lake near its west end.

Wood fuel is plentiful in the vicinity of Richardson Bay and on Redrock and Rocknest Lakes and occurs at scattered localities on the west part of Point Lake. The country around Hicks Lake is barren of spruce or other trees and only a few small groves of scrub spruce were seen around the east part of Point Lake.

Point Lake to MacKay Lake

On Coppermine River, between Point Lake and Lake Providence are two rapids at which portages aggregating three-quarters mile long are required. Where Coppermine River enters at the south end of Providence Lake is a rapid where it is advisable to make a portage one-quarter mile long. Another rapid occurs immediately after, then a small lake and another rapid at the outlet of Desteffany Lake. Coppermine River between Desteffany Lake and Lac de Gras is interrupted by about ten rapids in narrow parts between small lake expansions. Portages totalling $1\frac{1}{4}$ miles long were made at six of these rapids. Across a height of land between Lac de Gras and Thonokied Lake the route followed was over four small lakes and five portages totalling nearly 2 miles long. Across a height of land between the southwest arm of Thonokied Lake and MacKay Lake the route followed was over five small lakes. The loaded canoes were dragged through shallow water at two localities and in addition four portages, aggregating nearly three-quarters mile, were made. The portages between Point Lake and MacKay Lake are over prairie country where footing is good.

The country is barren of spruce except for some patches of fair-sized trees around the south part of Lake Providence. Shrubs are scarce and usually very small. For cooking purposes the writer used Optimus stoves. For a two-man party using one of these stoves, about 1 gallon of coal oil and one-third pint of methylated spirits are sufficient fuel for a week.

MacKay Lake to McLeod Bay

Between MacKay Lake and Lake of the Enemy is one small lake and two portages. From the west side of Lake of the Enemy a chain of four small lakes and five portages leads to the first lake southeast of King Lake. This lake drains northwesterly to King Lake by a small river over a rapid. The river probably flows from King Lake northward to MacKay Lake and may afford a better canoe route than through Lake of the Enemy. From the first lake southeast of King Lake the river was followed southward to Fry Lake. Along this stretch of the river, which broadens into three lakes, one difficult rapid was lined up and three short portages were made. Between Fry Lake and the next large lake to the south is a divide on which two small ponds and three portages were crossed. A portage of a mile is necessary between this large lake and Barnston Lake. From the south end of Barnston Lake, Barnston River was followed nearly to its mouth. From Barnston Lake the river flows southwesterly through a chain of three lakes and into a fourth. Four portages are necessary. From the fourth lake the river swings southeasterly through a more constricted channel, but broadening into a fifth, sixth, and seventh lake. In this stretch are some five rapids and several swift parts all of which were run, and seven rapids or falls around which short portages were necessary.

From the seventh lake the river is almost a continuous rapid and fall to its mouth at McLeod Bay and was avoided, the route followed being through a chain of small lakes south of the seventh lake and west of the river. From the south end of the seventh lake two portages and one, intervening, small lake lead to a lake that drains by a small creek to Barnston River. This creek was followed southerly for three-quarters mile, in which distance it was necessary to make seven short portages. The creek was then left and the route followed was over three small lakes and four portages. The first two portages were one-half and one-eighth mile long, with a total drop in elevation of 100 feet; the third, slightly over 1 mile long, was along a high ridge and down a steep slope with a drop of 380 feet; the fourth was about one-half mile long with a drop of 150 feet. Between MacKay Lake and McLeod Bay there are, by the route described, thirty-seven portages aggregating 7 miles long.

Between MacKay Lake and the first lake south of Barnston Lake good firewood can be obtained only in a few places. Wood is plentiful from there southward to McLeod Bay.

GENERAL FEATURES OF THE AREA

Great Slave Lake-Coppermine River area is in part rugged and rocky and in part flat and drift-covered with occasional rocky hills. The area around the east arm of Great Slave Lake is generally rocky. Great Slave Lake is about 495 feet above sea-level and at the west end of the east arm the hills rise from 50 to 100 feet above the lake. Thence northeasterly along and close to the lake the hills become higher until, in the rugged country around the eastern part of the arm, they rise from 800 to 900 feet above the lake. In this rugged country, flat-topped hills rise abruptly from the water or from low, surrounding country and long ridges are broken by steep-walled, transverse valleys. This area of rugged country ends abruptly to the southeast at the edge of a steep escarpment forming the northwest edge of a gently rolling, rocky upland. From the north shore of McLeod Bay, rock hills rise, within distances of from 1 to 4 miles from the shore, to an upland which continues north to Lac de Gras. Between McLeod Bay and the south shore of MacKay Lake this upland is in part of much drift-covered, broad areas with occasional rock hills, but is chiefly of closely spaced rock hills rising from 100 to 250 feet above depressions occupied by lakes. Low, rolling, drift-covered prairie prevails around the northeast arm of MacKay Lake and around Lac de Gras. Only a few rock hills in this area rise to from 100 to 150 feet above the lakes. The tops of the hills at McLeod Bay stand at 900 feet above Great Slave Lake, whereas at MacKay Lake they are about 150 feet higher and probably continue at about the same height to Lac de Gras.

Along Yellowknife River as far north as Lower Carp Lake, rocky country prevails, valleys are narrow and hills have rounded, steep slopes and nearly flat, broad tops (*See* Plate III A). Relief gradually decreases from about 250 feet at the mouth of the river to 150 feet at Lower Carp Lake. Between Lower Carp Lake and Wray Lake the country is less rocky than that farther south, valleys are generally broad, rock hills have more gentle slopes, and some of them are isolated in broad, nearly flat, drift-covered lowlands (*See* Plate III B). Many boulders are scattered over hills and valleys, ridges of sand and boulders are common, and shorelines of lakes are mostly of drift. The maximum relief is about 150 feet. Rocky country again prevails around Point Lake and thence easterly to the west end of Lac de Gras and westerly to the south shore of Redrock Lake. On the south arm of Point Lake, rock hills rise to about 200 feet above the lake. Westerly from here they become higher until at the west end of the lake they are about 400 feet above the lake level. The country around Odjick Lake and south to the north shore of Redrock Lake is low, drift-covered prairie with a few rock hills rising above the general level. The country between Redrock and Rocknest Lakes is low in some places and rugged in others, and is bordered on the east by a high, rocky upland. The tops of the hills at the mouth of Yellowknife River stand about 250 feet above the level of Great Slave Lake, whereas between Lower Carp Lake and the south end of Point Lake (8) they are from 800 to 900 feet, and at the west end of Point Lake 1,050 feet above this level.

The region has been glaciated, as indicated by smoothed and striated rock surfaces and glacial deposits. On Great Slave Lake, most of the striæ strike southwest. North from the mouth of Yellowknife River the striæ gradually change their trend from southwest at the mouth of the river to west at a point 115 miles to the north and to 30 degrees north of west at Big Lake, 50 miles still farther north. North from the mouth of Barnston River the strike of the striæ gradually changes from southwest at the mouth of the river to west at a point 20 miles to the north. Northward from this point for 65 miles they strike west or nearly west. North of here they swing north of west and on Thonokied Lake, 30 miles to the north, they strike 50 degrees north of west. Between Big Lake and Thonokied Lake and about the south arm of Point Lake, a northwesterly striking set of striæ commonly crosses an earlier set striking slightly south of west. On a few outcrops near the entrance to the south arm of Point Lake, striæ vary in strike between the limits of 15 degrees north of west and 25 degrees south of west. On Point Lake west of the south arm striæ generally strike west. North and northwest of Point Lake they strike slightly north of west.

Glacial boulder drift is widespread in the area between Lower Carp Lake and the south arm of Point Lake and also around Lac de Gras and MacKay Lake. Irregular ridges and knobs of an unsorted mixture of boulders, pebbles, and sand were piled up at a few places at the edge of the retreating ice. Such morainic deposits are well developed on the north side of Wray Lake and immediately northwest of Little Marten Lake where knobs and ridges of drift rise as much as 100 feet above surrounding country. Long, winding ridges of boulders and gravel were deposited by streams flowing on, in, or under the ice. These ridges, or eskers, are up to 16 miles long, and trend approximately parallel to the direction of movement of the ice. They generally have narrow, rounded tops and steep side slopes (*See* Plate III B). Along their strike, the eskers are broken in some places and undulate in height from 10 to 80 feet above the surrounding country. The eskers are best developed at Winter Lake, at Little Marten Lake, immediately west of the south arm of Point Lake, and between Lac du Sauvage and Thonokied Lake. No eskers were seen south of the north end of Fishing Lake on Yellowknife River or south of the first lake north of Barnston Lake on Barnston River. The eskers at Point Lake trend parallel to the later, northwesterly striking set of striæ. Hills of sand and gravel occur along the sides of many eskers and elsewhere. A large area of sand and silt is developed along Slave River and east to Taltson River. Deposits of clay were observed on the south shore of Redrock Lake, between Redrock and Rocknest Lakes, at the site of Fort Enterprise, and along a stream that drains Wray Lake. Beach deposits of sand, gravel, or shale now stand high above the present level of some lakes. At a few places on the east arm of Great Slave Lake, such beaches are up to 540 feet above the present lake-level. On the south side of Winter Lake they were observed at 120 feet above the present level of that lake. These beaches may have formed in glacial lakes that were drained with the retreat of the ice-sheet.

The country around the east arm of Great Slave Lake is generally thinly timbered with spruce, birch, pine, tamarack, and poplar. Spruce trees are the most abundant and they are up to 18 inches in diameter, although the majority are much smaller. Along Yellowknife River nearly to Grizzle Bear Lake, 125 miles from the mouth of the river, spruce and birch are plentiful, although in the last 20 miles the timber is confined to valleys. For 70 miles from the mouth of the river, spruce trees are generally from 6 to 12 inches and a few are 18 inches in diameter. Birch is much smaller. To the north, with the exception of a few areas of good-sized trees, spruce is generally only from 1 to 4 inches in diameter and from 10 to 15 feet high. Between Grizzle Bear Lake and the second lake north of Winter Lake, spruce occurs in scattered, large and small groves. The trees are generally small, although in large groves south and east of Winter Lake they are from 6 to 12 inches in diameter. From the second lake north of Winter Lake to the north part of Lake Providence and the east part of Point Lake the country is barren of spruce or other trees, except for a few small, widely scattered stands of scrub trees from 1 to 6 feet high. Fair-sized spruce trees are plentiful about Richardson Bay on the south side of Point Lake. West of Richardson Bay scattered patches of smaller trees occur on the south shore of Point Lake nearly to its west end. Low country around Rocknest Lake and the west part of Redrock Lake is well timbered with spruce. Several stands of good-sized spruce were seen around the south half of Lake Providence. The country between Lake Providence and Thonokied Lake, and thence to the south side of MacKay Lake, is barren of spruce or other trees, although willows and other small shrubs occur in some places. On Lake of the Enemy and on King Lake, just south of MacKay Lake, several groves of tall spruce trees from 6 inches to 18 inches in diameter are present. The country between these lakes and the north end of Barnston Lake is barren except for a few, widely scattered, small patches of scrub spruce. For the next 15 miles south are many patches of small spruce. To the south for 20 miles to Great Slave Lake spruce and birch occur continuously along valleys, although hill tops are generally unforested.

Very few moose were seen along the east arm of Great Slave Lake. They are more common along Yellowknife River for 60 miles from its mouth. Large herds of barren land caribou were seen at Point Lake during the first week in August. Thereafter until the first of September caribou, either alone or in small groups, were seen almost every day southeast along

Coppermine River and its lake expansions and on Thonokied and MacKay Lakes. Lake trout occur in many lakes throughout the area and some of those in Great Slave Lake are large. Whitefish, pike, and other fish also are plentiful in Great Slave Lake. Almost all of the area examined north of Great Slave Lake is within the Yellowknife preserve as outlined on a map issued by the Natural Resources Intelligence Service, Department of the Interior, 1929.

GENERAL GEOLOGY

The bedrock of Great Slave Lake-Coppermine River area may be grouped as follows:

Table of Formations

Late Precambrian:
- Basic intrusives:
  - Sills and dykes of diabase
  - *(Intrusive contact)*
- Et-Then series:
  - Conglomerate, sandstone, and quartzite
  - *(Unconformity)*
- Dioritic intrusives:
  - Diorite, quartz diorite, syenite, quartz syenite
  - *(Intrusive contact)*
- Great Slave group:
  - Conglomerate, arkose, sandstone, quartzite, shale, slate, oölitic iron formation, dolomite, limestone, breccia, basalt, andesite, trachyte, rhyolite porphyry, and tuff
  - *(Unconformity)*

Early ? Precambrian:
- Granitic intrusives:
  - Granite, granodiorite, quartz diorite, pegmatite, and chloritized granite. All the granitic rocks of the area, probably, are not of the same age. Some of the bodies are younger than, and others are probably older than, certain or all the formations listed below
- Point Lake-Wilson Island group:
  - Conglomerate, arkose, quartzite, phyllite, dolomite, specularite iron formation, gneiss, schist, basalt, andesite, trachyte, and rhyolite

EARLY ? PRECAMBRIAN

Point Lake-Wilson Island Group

The oldest rocks recognized, with the probable exception of a body of chloritized granite and possibly other bodies of granitic rock described in a succeeding section of this report, include sediments and volcanics closely folded and intruded by granites. In most sections, sediments are more abundant than volcanics and in many areas the strata are intimately intermixed with granite. The sediments and volcanics, in some places mixed with granite, outcrop extensively at intervals along the north shore of Great Slave Lake for 175 miles east of Yellowknife River; for 70 miles up this river; as five, separate, large areas in a region about 160 miles long extending from northwest of Point Lake southeast to MacKay Lake; east of Taltson River and at Basile Bay on the south shore of Great Slave Lake; and on Wilson Island and other islands at the entrance to the east arm of the lake. The strata at Point Lake and at other localities north of Great

Slave Lake are similar in many of their lithological and structural features, and in general they vary markedly in lithological character and in degree of metamorphism from the strata on the south shore of Great Slave Lake, at Wilson Island, and other islands on the lake. The strata north of Great Slave Lake strike irregularly, but most commonly trend north to northwest, whereas the strata on Wilson Island and other localities on Great Slave Lake generally trend northeast. Because these areas are widely separated from one another, and for other reasons, it is impossible definitely to correlate the strata at the various localities or to determine any differences in age between them, and they may comprise two or more distinct series. The strata of this group are most completely represented at Point Lake and at Wilson Island and these two localities are selected as type areas in the following description.

On *Point Lake* the basal beds are conglomerate and lava flows. The conglomerate is well developed about Richardson Bay on the south shore of Point Lake and also on the north shore of the lake. The pebbles and boulders are chiefly of grey granite with a few of quartz and dark volcanics. The matrix is a green schist carrying shreds of chlorite and small bits of volcanics, quartz, and feldspar. The granite boulders range from 1 inch to 2 feet in diameter. At most localities the majority of granite boulders are well rounded, but at some places they are lens-shaped due to squeezing of the rocks during folding. The conglomerate is generally not bedded, but it contains a few beds of green and grey schists that originally probably were impure sandstone, and these indicate the strike and dip of the conglomerate. One conglomerate body on the north shore of Point Lake is about 3,000 feet wide and at least 3 miles long. It strikes about north 20 degrees west and is bordered on the east by sedimentary schist dipping steeply to the northeast and on the west by volcanics carrying a few narrow bands of conglomerate. Another body of conglomerate, along the strike of the large one just described, occurs just east of Richardson Bay and is 4,000 feet wide, but within 1 mile to the southeast it gradually narrows and ends. The beds here strike north 20 degrees west and dip 65 degrees northeast. This body is followed by volcanics on both its east and west sides. A third body of conglomerate on the first point west of Richardson Bay is nearly a mile long and is bordered on its southeast side by granite. At its east end it strikes east, dips 30 degrees north, and the bedding is crossed by a cleavage striking north 10 degrees west. At its southwest end it strikes north 50 degrees east and dips 70 degrees northwest. Along the strike of this conglomerate body is another one about a mile south of the first bay west of Richardson Bay. It is about 400 feet wide, strikes north 20 degrees east, and is bordered on both sides by lavas. On the second point west of Richardson Bay are lavas carrying thin beds of conglomerate. It is clear that the lavas and conglomerate beds are interbedded and of the same age, although the pebbles of lava in the conglomerate and the character of the matrix suggest that the volcanics were being eroded during intervals between the extrusion of the flows.

The lavas interlayered with the conglomerate on Point Lake are close to, and probably in contact with, the granite that borders the conglomerate. The lavas, which contain narrow bands of conglomerate west of Richardson Bay and west of the conglomerate on the north shore of

Point Lake, form a northerly striking band about 2 miles wide and are bordered on the west by sedimentary schist. This band occurs again to the north on the shores of the bay into which a river from Hicks Lake empties, on the west side of this river, and on the west shore of Hicks Lake. At these localities it ranges from 1 to 3 miles wide, is bordered on both sides by sedimentary gneiss or schist, and contains a narrow interbed of sedimentary schist. The lavas are chiefly basalts. Large bodies of the lava are altered to green chlorite schist with relicts of pillow structure at a few localities. Some of the lava is fine grained, and dark green, and in it pillows are well developed locally. Other bodies of lava are of medium-grained, massive, hornblende-rich types.

Sediments, in places much injected by granite, outcrop extensively over an area 75 miles long extending from Point Lake north to Hicks Lake and southeast to beyond Lake Providence. With the exception of a small amount of schistose lava with remnants of pillows on the first lake south of Lake Providence, no lavas were recognized over wide areas and the sediments form by far the greater part of the strata. The conglomerate and lava flows near Richardson Bay are bordered on the west by a narrow belt of biotite schist and on the east for about 6 miles along the lake by biotite schist containing a few beds of impure quartzite. Elsewhere the strata are chiefly biotite gneiss. The schist is dark green or grey, fine grained, and thinly laminated. The quartzite is dark grey, fine grained, and contains a small amount of mica, giving the rock a faint schistose structure. The biotite gneiss is light to dark grey according to the amount of biotite. The rock is generally coarse grained and, where not intimately mixed with granite, is generally well bedded. The beds are alternating layers from 1 foot or less to 5 feet or more thick and are of various grain sizes and shades of grey. In many outcrops the bedding is straight. At most localities cleavage parallels bedding, but in a few outcrops the cleavage crosses the bedding at a small angle. In addition to biotite, the bedded gneisses carry abundant quartz and generally small amounts of oligoclase and muscovite. In some outcrops, especially on the west shore of Hicks Lake, certain or all of the beds of gneiss carry scattered, eye-shaped masses, from $\frac{1}{4}$ to 2 inches long, forming protuberances on weathered surfaces. A narrow band of conglomerate on a creek flowing from Wray Lake to Point Lake is bordered on the east by sedimentary gneiss and on the west by granite. The conglomerate is of squeezed pebbles of grey granite and quartz in a biotite gneiss matrix. On the south half of Lake Providence the sediments strike northeast. On the north half of this lake and along the south arm of Point Lake, they generally strike north. To the west along Point Lake they strike northwest. They strike irregularly, but generally to the northeast on Hicks Lake and thence to the east end of Point Lake where they trend about east. Dips are as low as 30 degrees, but are commonly between 60 degrees and vertical. The dip of the beds in any one area commonly is in an opposite direction to the dip of the beds in an adjacent area, suggesting that the strata have been folded into a series of anticlines and synclines. Tops and bottoms of beds have not been determined. The narrow band of schists west of Richardson Bay is cut by a few granite dykes. The band is bordered on the west by a zone 2 miles wide of intermixed schist and granite passing to the west into a large body of clean granite. In the mixed zone schist alternates with granite and is much cut by dykes and stringers of granite. On Lake Prosperous and on the south arm and east end of Point Lake, the sediments are generally cut by many granite dykes and sills and a few dykes of pegmatite. The sediments are also much injected along bedding planes by granite stringers and at many such places are permeated with granitic material, partly manifested by scattered, large crystals of feldspar. At such places, evidence of bedding is partly or almost completely obliterated. At some localities, large areas are of gneissic or massive rock composed chiefly of quartz, oligoclase, and biotite, and having the general appearance of a granite but containing remnants of beds suggesting that the whole was originally a sediment.

At Redrock Lake west of Point Lake lavas and a small amount of sediments similar to those on Point Lake are well exposed. Dark green schistose basalt, in places showing pillow structure, outcrops on a broad point on the north shore of the lake and on the south shore opposite this point. Pale green and grey schists outcrop at the west end of the lake. The beds strike northeast and dip 70 degrees southeast.

At Lac de Gras sedimentary gneisses occur along the west half of the north shore and for 30 miles along the south shore. The gneisses are much like the gneisses on Point Lake but are commonly finer grained and at one locality are crossbedded. Like the coarser gneisses at Point Lake they carry small, eye-shaped masses at some localities. Scattered crystals of andalusite were noted in one outcrop. The sediments break into large slabs. The strata strike northwest and dip from 60 to 80 degrees to the northeast at some localities and to the southwest at other places. A narrow band of similar rocks outcrops at the east end of Lac de Gras.

On Thonokied Lake, east of Lac de Gras, sedimentary gneisses strike north to northwest and dip from 30 to 80 degrees east and northeast. On the north arm of the lake, the sediments are injected by many large granite sills. Scattered, eye-shaped masses in the gneiss are of cordierite at one place at least. At one locality garnets are developed in the gneiss at a granite contact.

Along the east arm of MacKay Lake and on lakes to the south, sediments outcrop extensively for 35 miles. The most common types are fine-grained gneisses like the gneisses at Lac de Gras. At one locality fine-grained, crossbedded gneiss is of quartz, mica, and scattered biotite flakes. At another, coarse-grained quartz-muscovite gneiss contains many small, eye-shaped masses of a mixture of quartz and much muscovite. The beds commonly strike north, dip from 40 degrees to vertical, and at one locality crossbedding shows that the strata are overturned.

On the west side of Barnston River for 20 miles from its mouth and along the shore of Great Slave Lake for 8 miles west of the river sedimentary gneiss similar to that on Point Lake is generally well exposed and is well bedded (*See* Plate IV A). The strata strike northerly and dip from 30 degrees to vertical. The sediments are injected by many granite and pegmatite dykes and sills for 8 miles north of the mouth of the river.

At several other localities on the north shore of Great Slave Lake, sedimentary gneiss and small amounts of schist and quartzite, generally similar to those on Point Lake, are well exposed. Much granitized gneiss outcrops at Derby River east of Barnston River. Beds are contorted and generally strike north. Northeast of Blanchet Island, sedimentary gneisses are extensively exposed for 18 miles along the shore. The strata commonly strike north to northwest and dip from 65 to 85 degrees. At the east end of this extensive area, dark grey, sedimentary, hornblende schist is interbedded with a few beds of dark grey quartzite, 1 inch wide, and a few beds of light grey gneiss 2 feet wide. Small areas of sedimentary gneiss occur at the mouths of François and Beaulieu Rivers and in the bay west of Beaulieu River. For 25 miles northwest from a point 6 miles west of this bay sedimentary schists and gneisses outcrop on many small islands and on parts of the shore of the lake. The strata here strike northwest.

Along Yellowknife River sedimentary gneiss, like the gneiss on Point Lake, occurs extensively for 70 miles north of Great Slave Lake and was seen at a few localities for 15 miles farther north. At a few localities, chiastolite crystals up to 3 inches long are scattered through the gneiss. Fine-grained, sedimentary, biotite and chloritic schists are abundant for 10 miles north of the mouth of the river. At one locality biotite schist carries small garnets. A few thin quartzite beds are interlaminated with the schists. Andesite lava, with pillows well developed locally, occurs on the north shore of Duck Lake east of the bay at the mouth of Yellowknife River. Light and dark green, hornblende-rich rocks, possibly lava flows, outcrop on the west side of this bay and were seen at several localities for 25 miles to the north. The strata generally strike northerly and dip from 10 degrees to vertical, dips of 40 degrees and greater being most common. North of Rocky Lake, 35 miles north of the mouth of Yellowknife River, the gneisses are generally much injected by granite dykes and stringers, are much granitized, and are mixed with large and small bodies of granite.

On many large and small islands southwest of the west end of Simpson Island, near the entrance to the east arm of Great Slave Lake, sedimentary gneisses carrying garnets are much granitized and injected by large and small bodies of granite.

On *Wilson Island* and nearby small islands immediately south and northeast, a thick assemblage of sediments and volcanics is well exposed. The lowest members of the assemblage recognized, as developed on a group of small islands south of Wilson Island, include bands of rhyolite up to several hundred feet thick alternating with trachyte bands up to 50 feet thick. The rhyolite and trachyte, which are probably chiefly lava flows, are followed to the north, as exposed on the same group of small islands and in a deep bay on Wilson Island, by probably 2,000 feet of interlayered conglomerate, arkose, sedimentary schist, rhyolite, trachyte, and, probably, andesite. The conglomerate and associated strata are overlain conformably by several thousand feet of quartzite interbedded with small amounts of dolomite and schist, as developed for 14 miles along the west half of Wilson Island. Probably overlying the quartzite, dolomite, and schists are interbedded quartzite, phyllite, and schist, on the islands northeast of Wilson Island.

The rhyolite is a hard, fine-grained, grey to bright red rock. Most of it is finely laminated and carries feldspar phenocrysts. A few amygdules of quartz and chlorite were observed in it. Most of the trachyte is fine grained, dark grey to black, and is faintly schistose. Some of it is a schist carrying abundant biotite. Many outcrops exhibit cavities filled with quartz and undoubtedly are amygdules. The majority of the trachyte flows are non-porphyritic, but phenocrysts of either feldspar or hornblende are present in a few. No pillow structure was observed in either the rhyolite or the trachyte.

The conglomerate is well bedded, layers containing closely spaced boulders and large pebbles alternating with layers containing scattered pebbles. The pebbles and boulders are of pink granite, grey and pink granite-gneiss, red feldspar, quartz, purple and black schists, rhyolite, and trachyte. Those of rhyolite and trachyte are identical in appearance with the lavas described in the foregoing paragraph which underlie and are interbedded with the conglomerate. Some of the granite boulders are similar in appearance to the rock of a granite body on Simpson Island immediately to the southeast. The pebbles and boulders are round except where flattened by pressure. The majority are from 1 inch to 6 inches in diameter, although a few are a foot across. The matrix is of schistose arkose carrying micas and constitutes a large proportion of the rock. The schistose structure of the matrix and the longer dimensions of the flattened pebbles are roughly parallel to the bedding in some places and at other localities cross the bedding at angles up to 45 degrees.

The arkose associated with the conglomerate and lavas varies from a massive pink rock to a schistose grey rock and in some places contains pebbly layers. On some outcrops the arkose is crossbedded.

Thin beds of sedimentary schist associated with the conglomerate, arkose, and lavas, are of dark grey rocks containing mica, quartz, and scattered small grains of red feldspar and lens-shaped pebbles of red rhyolite.

The quartzite on the west half of Wilson Island and overlying the conglomerate and associated strata is in beds, many of which are about a foot thick and separated from one another by thin, micaceous layers. The micaceous layers have weathered more rapidly than the massive quartzite and hence the weathered surfaces present a ribbed appearance. Much of the quartzite is white, light grey, or pink, although some beds are dark grey and others are very pale green. The dark grey quartzite carries biotite, giving the rock a poorly developed cleavage. Many layers are crossbedded and ripple-marks are well preserved on a few beds. Near the underlying conglomerate the quartzite carries a few pebbly layers. In one outcrop, two beds of fine-grained, dark green schist occur in the quartzite.

Bodies of dolomite up to 100 feet thick are interlayered with the quartzite at some localities. This is a grey or red rock, containing, in addition to dolomite, many small quartz grains and a few shreds of muscovite and chlorite. Weathered surfaces are reddish brown and are rough due to protuberances of the small quartz grains.

The rocks on the islands northeast of Wilson Island, and probably overlying the dominantly light-coloured quartzites on Wilson Island, are of light grey and pink quartzite interbedded with much dark grey, faintly schistose quartzite, and thick bodies of dark grey to greenish grey, fine-grained sediments. Some of these fine-grained sediments have fairly good cleavage, and are called phyllites. Others have better cleavage and are called schists.

The strata on Wilson Island and on small islands immediately to the south and northeast generally strike slightly north of east. They dip between 45 degrees and vertical and at many places are overturned.

Rocks generally like those on Wilson Island and nearby small islands are exposed at Iles du Large, Stony Island, Basile Bay, and other localities on Great Slave Lake. On Iles du Large, southwest of Wilson Island, light-coloured quartzites contain a few beds of dolomite, sedimentary gneiss, and specularite iron formation. The gneisses are coarse-grained, quartz-biotite and quartz-muscovite rocks, crossbedded at one locality and carrying red garnets at a few places. The iron formation member forms beds up to 35 feet thick. It is a schistose, quartz-rich sediment carrying flakes of specularite and a few shreds of chlorite. The strike of the strata varies greatly and dips are from 20 to 70 degrees. On Stony Island east of the mouth of Slave River light grey, pebbly quartzite is interbedded with arkose and sheared conglomerate. The quartzite is cut by a dyke of grey porphyry somewhat similar in appearance to the rhyolite on small islands south of Wilson Island. At Basile Bay, 35 miles northeast of Wilson Island, sediments are well exposed over an area 25 miles long. On a peninsula west of the bay is a syncline in which light-coloured quartzites are underlain by dolomite and schist and overlain by dark grey, faintly schistose quartzite and phyllite. Here the strata generally dip from 70 degrees to vertical and at some places are overturned. East of the bay, about 3,000 feet of light-coloured quartzite is bordered on its north side by about 3,000 feet of schistose, dark grey quartzite carrying a few beds of light-coloured quartzite and a few small lenses of specularite iron formation. The schistose, dark grey quartzite and associated strata pass to the north into a great thickness of phyllite and schist. The strata east of the bay strike northeast, dip from 40 to 75 degrees southeast, and may be overturned.

East of Taltson River, quartzite, quartzose gneiss, and schist are interlayered with laminated grey and reddish porphyritic rhyolite, forming bands up to 400 feet wide. Small amounts of laminated rhyolite, quartzite, and schist were seen on small islands west of Preble Island. A small amount of dolomite like the dolomite west of Basile Bay is exposed in a bay 3 miles west of the southwest end of McDonald Lake.

The assemblage of sediments and volcanics about Wilson Island may be the same age as the Tazin series (1) (9) as developed in several areas to the south between Great Slave Lake and Lake Athabaska.

Granitic Intrusives

Granite is widespread in country both north and south of Great Slave Lake and on islands in the west part of the east arm of the lake. The granite forms small and very large bodies and in some areas, already described, is intimately intermixed with sedimentary gneiss as stringers, dykes, and small bosses. At most localities intrusive relations with the sediments and volcanics already described are apparent. At Point Lake, however, a body of chloritized granite is probably older than adjacent sediments and volcanics which are cut by other granites indicating that granites of probably at least two ages are present. The relations of still other bodies of granite are unknown.

North of Great Slave Lake the several areas of sediments and volcanics already described are separated by large bodies of granite. The chloritized granite at Point Lake is described later. The other granite bodies, as far as observed, intrude the sediments and volcanics. Since these strata occur in widely separated areas and are not known to be of the same age, the intrusive granites may be of different ages. These intrusive granites north of Great Slave Lake are of two main types. One is red and is granodiorite in mineral composition. Its feldspars are oligoclase and microcline in about equal proportions and the rock carries biotite or muscovite and, at many places, feldspar phenocrysts. The red granodiorite carrying biotite is extensively developed around the west part of Point Lake in a large area extending for 120 miles north of Fishing Lake. Red granodiorite carrying muscovite is abundant on the north shore of Great Slave Lake. Within the main areas of these red granodiorites are small areas of gneissic, red, massive, light grey, white, and pink, and slightly gneissic, dark grey granites. At a few localities the grey types of granite are cut by dykes of red granite. Dykes of pink pegmatite up to 30 feet wide cut sediments and grey and red granite. A few of these pegmatites carry black tourmaline. The other main type of granite north of Great Slave Lake is a light grey to white rock varying in mineral composition at different localities. At Fishing Lake and at Thonokied Lake it is a medium-grained biotite-oligoclase-quartz diorite. Between Lake of the Enemy and Barnston Lake it is a fine-grained, yellowish weathering, biotite-oligoclase-quartz diorite cut by pink pegmatites carrying muscovite. At Desteffany Lake and thence along Coppermine River to Lac de Gras it is a microcline-biotite granite. On the north shore of Great Slave Lake east of Barnston River it is a muscovite granite containing microcline, albite, and black tourmaline. Here it is associated with pink tourmaline-bearing granite and grey, granitic gneiss. The gneiss is cut by dykes of pink granite and both the gneiss and the dykes of pink granite are cut by pink pegmatite dykes of microcline, quartz, muscovite, and black tourmaline. On the north shore of Lac de Gras is a light grey to white, pegmatitic, albite-muscovite granite containing a small amount of microcline. Similar-appearing, pegmatitic granite also occurs on the first lake southeast of Hicks Lake. The pegmatitic granites are cut by dykes of pegmatite and within them are irregular-shaped pegmatite segregations of pink and white feldspar, quartz, muscovite, and smaller amounts of black tourmaline, apatite, and garnet.

The quartzite and gneisses on a few of the Iles du Large are cut by a red biotite-microcline granite containing a small amount of oligoclase. On Stony Island pebbly quartzite and conglomerate carrying granite pebbles are cut by dykes of red granite and red pegmatite. The dolomite in a bay 3 miles west of the southwest end of McDonald Lake is cut by white microcline-albite-muscovite granite. Sediments and volcanics near the mouth of Taltson River are cut by pink granite dykes possibly derived from a large mass of porphyritic pink and grey granite lying between Thubun and Taltson Rivers.

Granitic rocks of unknown relations to the sediments and volcanics occur between McDonald Lake and the east end of Great Slave Lake; on Simpson Island; and on Union Island. The granitic rocks between

McDonald Lake and the east end of Great Slave Lake are massive, albite-microcline-muscovite granite and gneissic pink and grey types. On Simpson Island they are massive red microcline granite and gneissic red and grey types. On Union Island they include grey and greenish grey, granitic rocks associated with massive, red muscovite granite containing orthoclase, microcline, and albite.

A dark to pale green rock, probably a chloritized granite, occurs on small islands west of Preble Island and at intervals along the south shore of Great Slave Lake for 35 miles east of Taltson River. The greenish rock is massive to schistose and contains many scattered crystals of red and greenish feldspar. It is cut by red granite dykes and its relations to the sediments and volcanics are unknown.

The body of chloritized granite at Point Lake, and probably older than the nearby assemblage of conglomerate, volcanics, and schist, is a grey to greenish grey, massive or schistose, albite granite whose minerals are strained and broken and in large part altered to chlorite, sericite, and carbonate. This granite carries a few small inclusions of dark green schist considered to be remnants of the country rock which it intruded. That the chloritized granite probably is at least older than large bodies of nearby red granite is indicated by the fact that it is cut by red granite and pegmatite dykes similar to dykes cutting the volcanics and schists, and undoubtedly derived from these large bodies. In the short time available for a study of the locality, positive evidence was not obtained to prove the relations of the chloritized granite to the adjoining strata, but the evidence obtained strongly suggests that the granite is the older. The conglomerate on the point west of Richardson Bay rests against the granite and, at one locality, passes to granite within a zone from a few inches to a foot or more wide and, at another place, the two rocks are separated by a low area partly filled with drift and 20 feet or more wide. The conglomerate beds dip from 30 to 70 degrees away from the granite. Many boulders in the conglomerate are of albite granite identical in appearance with the adjacent chloritized granite. At one locality granite boulders in the conglomerate adjoining the granite are large, but the granite boulders in the conglomerate 100 feet from the granite are small and are associated with many quartz pebbles. The conglomerate adjoining the granite is no more recrystallized than it is away from the granite. The chloritized granite is cut by many irregular bodies and dykes of basic rock similar in appearance to the lavas interbedded with the conglomerate and no dykes of this character were seen in bodies of granite that intrude the volcanics and schists. These basaltic dykes are so like the nearby lavas as to suggest that they represent feeders to the flows of basalt and, if so, indicate that the granite is older than the lavas. Without giving this and other evidence in detail, it is concluded that the schists, now represented by inclusions in the chloritized granite, were intruded by this granite, which was then brought to the surface by erosion. Lava flows and beds of sediments were deposited on this surface. There is evidence of erosion of lavas and granite to form conglomerate beds which, at the locality studied, rest directly on the granite. This assemblage of strata later was penetrated by large bodies of granite and was also closely folded and largely recrystallized.

The age relations of a body of diorite and gabbro about 3 miles east of François River are unknown. The size of this mass is also unknown, but it has been traced from a point ½ mile north of Great Slave Lake to a point 2½ miles north of the lake. It is bordered on the west and south sides by red, granitic rocks. Recently discovered deposits of nickel and cobalt are in this body of diorite and gabbro. Augite diorite is the most continuous type of rock in the mass. It is massive, dark grey, and medium to coarse grained, and is composed of augite, plagioclase, and small amounts of hornblende, biotite, apatite, and magnetite. It is cut by stringers and dykes of quartz diorite, granodiorite, and pink granite. A pyroxene, probably acmite, and an amphibole, probably riebeckite, are present in the quartz diorite and granodiorite. Granodiorite, similar in appearance to the granodiorite cutting the augite diorite, forms small, dyke-like and irregular-shaped bodies in the bordering, red, granitic rocks near the edge of the augite diorite. The augite diorite carries small, angular and rounded masses of anorthosite and hornblende diorite. At one locality in the augite diorite is a rock of alternating layers about one inch thick, of magnetite and of magnetite mixed with silicate minerals. The gabbro is in masses, from 10 to 50 feet or more across, within the augite diorite. Two main types of gabbro were seen, the one a dark grey, augite gabbro and the other a light grey, hornblende gabbro. The augite gabbro locally contains segregations up to 3 feet long of coarsely crystalline augite and is cut by stringers of this mineral. Segregations and stringers of a dark mineral, possibly hornblende, occur in the hornblende gabbro. The augite gabbro and its segregations are cut by stringers of biotite diorite.

LATE PRECAMBRIAN

Great Slave Group

The Great Slave group of sediments and volcanics is developed along the east arm of Great Slave Lake. The strata for the most part occupy a canoe-shaped synclinorium 150 miles long. The synclinorium is narrow at the west end about Caribou and Blanchet Islands and widens to the east to a maximum breadth of 40 miles. The beds on the north limb generally dip only at from 5 to 10 degrees south. The strata on the south limb are on the whole closely folded, dips from 30 to 70 degrees being common. The rocks of the group overlie unconformably the granites described in the preceding section of this report. Two or possibly more series of strata may be present in this group, but no definite evidence of a structural unconformity or of a prolonged erosion interval has been noted within this thick assemblage. For description, the Great Slave group may be divided into two parts; a lower part comprising chiefly conglomerate, arkose, sandstone, quartzite, shale, slate, lavas, oölitic iron formation, limestone, algal limestone, and dolomite; and an upper part of limestone, shale, breccia, sandstone, and lava.

The *Lower Part* of the group is well exposed on the gently dipping north limb of the synclinorium as outcropping on Kahochella and Pethei Peninsulas, on islands in McLeod Bay, and on islands west of Pethei Peninsula, and these places are chosen as type localities for various members of the lower part of the group. A basal bed of arkose from 1 to 2 feet thick overlies red granite on the north shore of McLeod Bay. The arkose is followed by perhaps 3,000 feet of sandstone and quartzite exposed on the islands in McLeod Bay. These rocks are well bedded and in places are crossbedded and ripple-marked. The quartzite beds are pale pink, white, or pale green and carry round pebbles of quartz. Much of the sandstone is red and carries abundant mica flakes along bedding planes. Thin shale partings are present between some of the sandstone beds.

On the north slope of Kahochella Peninsula the quartzite and sandstone are overlain by about 1,000 feet of shale, slate, argillite, oölitic iron formation, and laminated limestone. The shale, slate, and argillite are red rocks with a few beds that are black or green. Some beds carry concretions and rows of small, eye-shaped masses of calcareous material. The laminated limestone carries thin beds of reddish, argillaceous material. On islands west of Pethei Peninsula similar rocks overlie quartzite and sandstone. Here iron formation beds are from 2 inches to 40 feet thick and are associated with volcanics. The iron formation is massive or shaly and carries oölites of hematite in a siliceous and calcareous matrix. The volcanics include amygdaloidal pillow lava, tuff, breccia, and agglomerate carrying fragments of green schist, red granite, jasper, oölitic iron formation, and argillite.

Along the north slope of Pethei Peninsula and to the east, the shales and argillites are overlain by about 1,500 feet of limestone and dolomite. The rocks on the north slope of Pethei Peninsula south of Mountain River are chosen as the type section across this limestone and dolomite. Here a thin bed of laminated limestone at the base is overlain by about 700 feet of dolomite, which is followed above by about 800 feet of limestone. The dolomite typically is dark grey and finely crystalline. It weathers brown and much of it carries wavy, algal-like structures. A bed of limestone about 20 feet thick lying on the dolomite has excellent algal structure. At the east end of Pethei Peninsula and to the east of this peninsula this algal bed and its underlying dolomite are missing and here about 1,000 feet of mottled limestone, to be described next, lies directly on a basal layer of about 100 feet of laminated limestone. In the type section the algal bed is overlain by about 500 feet of mottled limestone. This limestone in the type section and to the east is mottled red and white and carries irregular-shaped and rod-like masses of harder red material. The rod-like masses stand normal to and cross the bedding. They are commonly from 3 inches to 2 feet long and in some places comprise as much as one-third of the rock. In the type section the mottled limestone is overlain by a 50-foot bed of massive, white, cliff-forming limestone and this is followed by about 200 feet of white and grey limestone with wavy structure. Another bed of algal limestone, about 20 feet thick, lies above the wavy limestone. Several types of algal-like structures occur in this bed, most of them resembling piles of inverted bowls such as illustrated by Lausen (10, pages 384-385). This algal bed extends at least 100 miles along its strike. To the east of the type section the algal bed is overlain by wavy and massive white limestones about 100 feet thick.

The succession and character of the strata on the south limb of the synclinorium are generally similar to those on the north limb. On the south limb, however, the limestone and dolomite and the two prominent algal beds are generally missing. East of Murky Lake a basal conglomerate, with quartz pebbles up to 3 inches long, lies on granite. On a group of islands immediately west of Keith Island, quartzite and sandstone carrying a few thin beds of jasper are interbedded with volcanic breccia and andesite lava. Some of the lava has amygdaloidal and pillow structures. The quartzite is cut by andesite dykes. Quartzite, argillite, and oölitic iron formation east of Keith Island are associated with pillow lavas and quartz and feldspar porphyries which probably intrude the sediments.

Conglomerate, quartzite, sandstone, and shale of the Great Slave group and not forming a part of the synclinorium are developed at several localities in the southwest part of the east arm of Great Slave Lake. At some of these places conglomerate or arkose rest on red granite and at one locality interbedded conglomerate and arkose overlies schists probably belonging to the assemblage older than the granite.

The *Upper Part* of the Great Slave group is developed in the central part of the large, canoe-shaped synclinorium. The rocks are extensively exposed on the south shore of Tochatwi Bay, on Pearson Point, and on the north side of Stark Lake. At most localities the basal beds of the upper part of the group lie on the top limestone of the lower part. South of Redcliff Island and at the west end of Stark Lake, however, the basal beds of the upper part lie close to the shale, slate, and laminated limestone formations of the lower assemblage. Here about 1,500 feet of limestone and dolomite are missing. If the limestone and dolomite were deposited in this area they were removed either by erosion before the deposition of the strata of the upper part of the group or by faulting. If they were removed by erosion then the Great Slave group is divisible into at least two series. In some areas the strata of the upper part of the group are nearly flat lying. In other areas the beds dip even more steeply than the members of the lower part on the south limb of the synclinorium.

The basal members of the upper part comprise possibly 1,000 feet chiefly of interbedded dolomite, sandy shale, breccia, and limestone. The dolomite is in beds from 2 inches to 20 feet thick. Some of the beds are white, others are purplish, and many are of various shades of grey and red. The dolomite is very fine grained and it breaks with conchoidal fracture. The sandy shale is fine grained and generally red. Beds are up to 40 feet thick and some beds are ripple-marked. The breccia is of angular blocks of dolomite, shale, limestone, sandstone, and a few of lava and syenite. The blocks are closely packed or lie in a matrix of shale. The limestone is white and fine-grained and its weathered surface exhibits wavy, algal-like structures.

The dolomite and associated strata are overlain by a thick assemblage of sandy shale and sandstone. The shale is very like that interlayered with the dolomite. Along the south shore of Tochatwi Bay the sandstone is interbedded with the shale. Here the sandstone is red, fine grained, and some layers are crossbedded and others are ripple-marked. The sandstone is overlain by about 300 feet of chocolate-coloured argillite, sandy shale, and fine-grained, red sandstone. Many of these beds are ripple-marked, others exhibit mud cracks, and some have cubical cavities which may have been filled with salt crystals. These rocks at one locality are capped by a flat-lying lava flow 70 feet thick and at another place are overlain by steeply dipping flows, up to 150 feet thick, with interbeds of argillite. The lavas are medium-grained, reddish grey, mottled, augite andesite and augite basalt with a few flows of green lava and of light red, albite trachyte. Amygdules filled with calcite and chlorite are common in both the bottoms and tops of flows. Pillow structure was seen only at one locality. In one flow pockets up to 2 feet in diameter are lined with agate and comb quartz and their central part is filled with carbonate. Columnar jointing is developed in most flows.

On *Union Island* and on nearby small islands is a succession of sediments of unknown age relations to the members of the Great Slave group. On Union Island a flat-lying arkose bed about 10 feet thick overlies granite. The arkose is of pebbles of quartz up to one-half inch long and small pieces of quartz, feldspar, and muscovite in an abundant dolomite matrix. Granite blocks up to 3 feet across are embedded in the arkose. Brecciated granite beneath the arkose is cemented with dolomite and veinlets of dolomite cross the granite for at least 20 feet below the arkose. The arkose passes upward into grey, buff-weathering dolomite crossed by a network of quartz threads and holding pockets filled with quartz, black chert, and pyrite. On nearby small islands the grey dolomite is overlain by interbedded buff, grey, and black dolomites, red argillite, and black slate. On these small islands the beds dip both at low and high angles.

On *Redrock, Rocknest, and Odjick Lakes,* about 220 miles north of Great Slave Lake, are sediments and volcanics very like the Great Slave group. The strata no doubt overlie granite unconformably. Beds dip from 5 degrees to vertical. At the east end of Rocknest Lake nearly flat-lying quartzite is overlain by 300 feet of green and grey slate with mica flakes along bedding planes. The slate is capped by about 80 feet of andesite lava. Elsewhere on Rocknest Lake and south to Redrock Lake are massive and laminated grey dolomite, laminated argillaceous limestone, grey and red slate, and sandstone. At Odjick Lake and south to Redrock Lake grey and pink quartzites are locally crossbedded and carry thin layers of arkose and dolomite. About 300 feet of red and green slates appear to underlie the quartzites. The quartzite at Odjick Lake is bordered on the west side by a fault.

Dioritic Intrusives

Dykes, sills, and stock-like bodies of dioritic and syenitic rocks are exposed on Caribou and Blanchet Islands and at several localities to the east along and near the south shore of Great Slave Lake. Some bodies are small, but one is 17 miles long. They intrude almost all members of the Great Slave group, as well as the granite and the sediments older than the granite.

The rocks of these intrusive bodies are massive and fine or medium grained. They vary from light grey to dark grey and from dark red to bright red. The grey rocks grade into the red types and are cut by stringers of the red types, which hold inclusions of the grey rocks. Much of the dark red rock is a hornblende-oligoclase-quartz diorite. Small amounts of it are andesine-quartz diorite, albite-quartz syenite, and granodiorite. The bright red rocks are quartz-syenite and syenite. The grey rocks are chiefly augite diorite, carrying hornblende and carbonate. Some of the grey rock is augite-albite syenite and some of it is albite-quartz syenite.

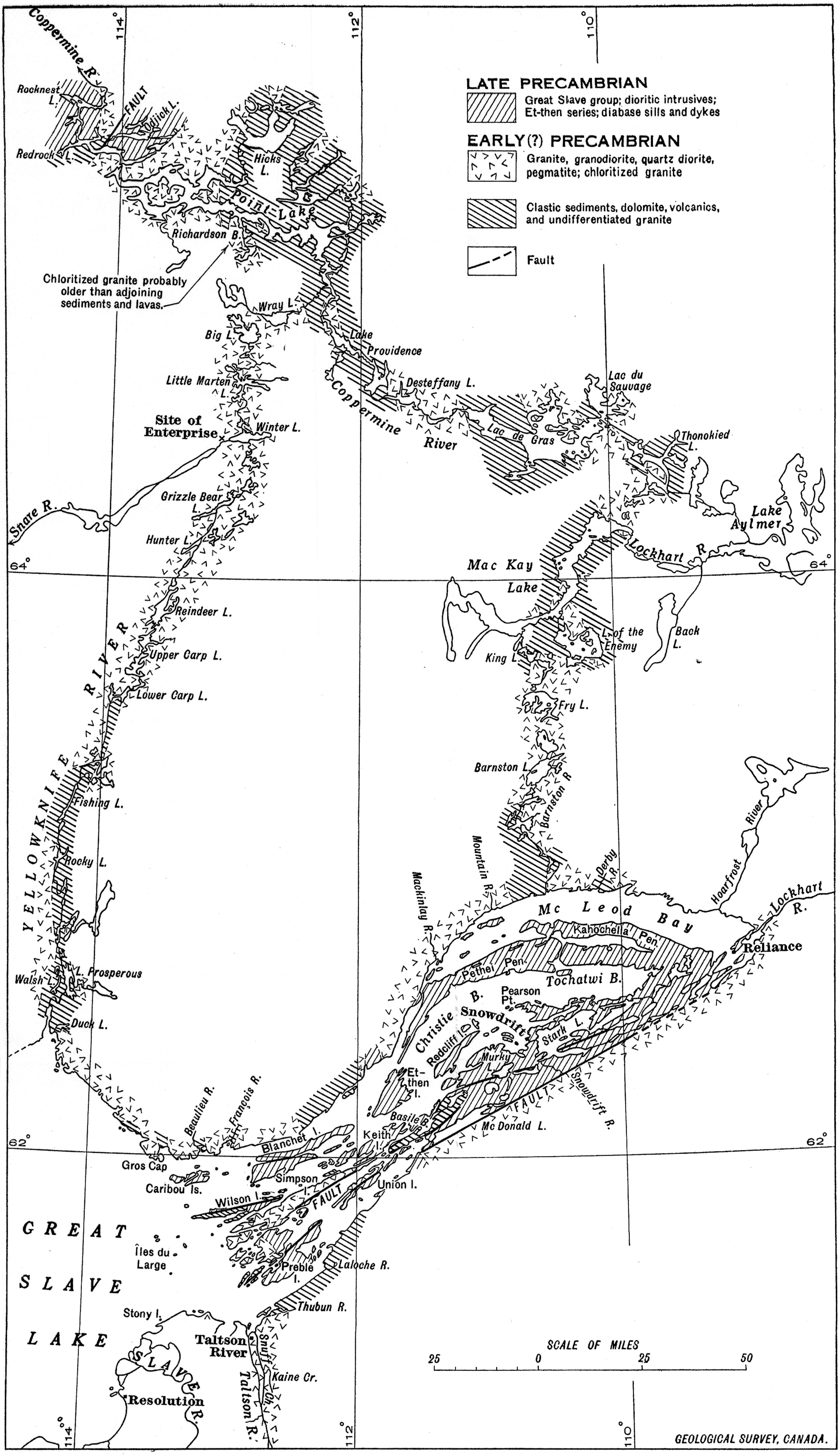

Figure 5. Great Slave Lake-Coppermine River area. NOTE. All the granite, granodiorite, etc., is older than the Great Slave group and by far the greater part is younger than the Early (?) Precambrian sediments and volcanics, but at least one body, at Point Lake, is probably older than part or all of the Early (?) Precambrian sediments and volcanics.

Et-Then Series

The Et-Then series of conglomerate, sandstone, and quartzite lies on an old erosion surface that crosses dioritic intrusives, almost all members of the Great Slave group, granite, and sediments older than the granite. The strata of this series occur in a number of separate areas as follows: on Et-Then Island; on Redcliff Island and south to McDonald Lake; east of McDonald Lake as a narrow band 35 miles long and west of the lake to Preble Island; on Wilson Island; on Pearson Point and southeast to Stark Lake; and in other small areas on and near Great Slave Lake. Some of these areas are crossed and bordered on one or two sides by faults shown in Figure 5. Over wide areas the strata dip at angles of from 5 to 20 degrees. Near faults and at other localities dips are up to 70 degrees.

Conglomerate generally occurs at the base, although at a few localities pebbly sandstone is developed at the bottom of the series. The conglomerate carries thin beds of sandstone or quartzite. At Et-Then Island the conglomerate is 400 feet thick. At McDonald Lake it may be several thousand feet thick. Its boulders are well rounded, closely packed, and commonly range in size from 6 inches to a foot in diameter with a few to 2 feet. Between the boulders are pebbles and fragments ranging in size down to sand. The pebbles and boulders comprise a great variety of rocks and practically every member of the older groups is represented. At most localities boulders of quartzite predominate. Granite boulders are common at many localities, but are lacking or rare in conglomerate that contains important amounts of limestone boulders. In some areas the conglomerate is poorly cemented, in others it is well cemented, and at a few localities the two types are interbedded. The poorly cemented or gravelly conglomerate commonly forms cliffs, whereas the well-cemented rock outcrops as round hills. The cliff and other outcrops are red. At two localities amygdaloidal lava seems to be interbedded with the conglomerate, but the relations are not definitely known.

The conglomerate is followed above by red, mottled red and white, and greenish grey sandstone and quartzite. These are coarse grained, exhibit excellent crossbedding, and are ripple-marked. Grains of feldspar are present in addition to quartz. Pebbles of quartz, quartzite, and red granite are along some bedding planes. Some beds of sandstone and quartzite carry such pebbles widely dispersed.

Probably the Et-Then series is the same age as the Athabaska series (9, page 154) as developed at Lake Athabaska.

Diabase

Sills and dykes of diabase are well developed on the east arm of Great Slave Lake. A few dykes were observed north of the lake to Coppermine River and beyond. They cut the Et-Then series and all older rocks. One sill, on Pethei Peninsula, is at least 500 feet thick and continues for 60 miles along its strike. It dips south at a low angle. Another sill, on Kahochella Peninsula and southwest to Et-Then Island, is from 150 to 200 feet thick and it outcrops discontinuously for 95 miles along its strike. It dips south and east at low angles. A flat-lying sill is exposed on Redcliff

Island. Immediately to the east, on Pearson Point, is an easterly striking dyke. Another dyke east of McDonald Lake trends northeasterly for 60 miles. These dykes dip northwesterly. These sills and dykes form prominent ridges and exhibit excellent columnar jointing (*See* Plate IV B). Some dykes dip steeply or vertically and generally trend slightly west of north. Such dykes occur on Great Slave Lake and north to beyond Coppermine River.

The bulk of the diabase is grey and medium grained. Parts of the bodies are red, coarse-grained diabase and the edges are chilled. The chief minerals are labradorite or bytownite and augite with minor amounts of biotite, hornblende, magnetite, apatite, orthoclase, and quartz. The orthoclase and quartz are graphically intergrown. The diabase cuts the other rocks with sharp contacts and at some localities the intruded rock is baked for 50 feet from the contact.

ECONOMIC GEOLOGY

Much of the Great Slave Lake-Coppermine River area has not been prospected. The country about the east arm of Great Slave Lake and along the lower section of Yellowknife River has been examined in a general way. The areas of sediments and volcanics that may carry ores are large and, in some respects, the geology of these areas is very similar to that of areas elsewhere in the Canadian Shield where valuable ores have been found. The information available about the mineral prospects and possibilities of this large area is summarized in the following paragraphs.

NICKEL AND COBALT AT FRANÇOIS RIVER

In February, 1932, Mr. Paul Beaulieu staked a deposit of nickel and cobalt-bearing minerals at a point about 2 miles north of Great Slave Lake and 3 miles east of François River. The deposit may be reached overland from a point on Great Slave Lake to the south, or perhaps as easily by a canoe route leaving Great Slave Lake just south of François River.

The deposit is in the body of augite diorite about one-quarter of a mile from its contact with red granite. The augite diorite is cut by dykes of granite and the deposit is younger than both these rocks. Two veins lying within a few hundred feet of each other are exposed on the west-facing slope of a hill. The veins strike about east and dip from 70 to 80 degrees south.

One of the veins, on Maple No. 4 mineral claim, cuts both augite diorite and granite cutting the augite diorite. The walls of the vein are sharp, but the augite diorite and the granite for a few inches from the vein are partly altered to carbonate and are cut by stringers of carbonate. The vein is exposed by four trenches for 230 feet along the strike. In the west trench the vein is of carbonate only a few inches wide.

In the second or next trench east, the vein is exposed for 30 feet along its strike. The 20 feet of it from the west end is of buff-coloured ankerite, partly altered to limonite and carrying small quantities of a cobalt and nickel-bearing mineral. The vein for the next 5 feet is 15 inches wide, and here the ankerite carries closely spaced botryoidal masses, up to one-half inch in diameter, chiefly of niccolite. The niccolite forms the centre of these masses and it is veined and surrounded by several cobalt, nickel, and arsenic-bearing minerals including smaltite-chloanthite and a hard, white, anisotropic mineral. All these minerals are partly altered to the nickel and cobalt bloom minerals, annabergite and erythrite. The vein in the east 5 feet of the trench is from 5 to 10 inches wide. Here the outer parts of the vein are of niccolite. The middle part, from 1 to 3 inches wide, is chiefly of smaltite-chloanthite carrying a small amount of niccolite, and both these minerals are veined and mixed with a small amount of carbonate.

The third trench is 24 feet east of the second and in it the vein is exposed for 20 feet along its strike. In this trench the vein is 11 inches wide at the west end, it pinches in the middle, and widens to 6 inches at the east end. Massive niccolite is the chief vein mineral and it is partly weathered to clay-like annabergite. Some of the niccolite is in closely spaced, botryoidal masses lying in a matrix of carbonate. The niccolite of some of these masses is bordered by a narrow band of a cobalt and nickel-bearing mineral. Some of the massive niccolite carries specks of an unknown, soft, bluish grey, anisotropic mineral. A chip sample judged to represent approximately the average of the vein as exposed in the second and third trenches was assayed by Mr. A. Sadler, Mines Branch, Ottawa, whose report follows: gold, a trace; silver, 1·97 ounces, Troy, per ton of 2,000 pounds; platinum, none. The ore was not assayed for cobalt or nickel, for the deposit is rather small to work unless it carries important quantities of precious metals. The fourth or east trench is 150 feet east of the third and here the vein is 6 inches wide. It is of carbonate.

The second and parallel vein is at the north side of the Maple No. 4 mineral claim. The vein is exposed in only one small trench. In it much cobalt bloom is present across one foot. Fresh vein material is poorly exposed but a band of ankerite 2 inches wide on the foot-wall passes into a band of smaltite-chloanthite 1 inch wide.

These veins carrying cobalt and nickel mineral are interesting in that they indicate the presence in this area of a type of mineralization somewhat similar to that at Cobalt, Ontario, and also at Camsell River and Great Bear Lake some 300 miles to the northwest. Cobalt bloom has been noted (11, page 108A) on the north shore of the bay west of the narrows between Christie and McLeod Bays and the occurrence of cobalt and nickel-bearing mineral may be widespread about Great Slave Lake. The country between François River and McLeod Bay should be closely prospected for deposits carrying cobalt, nickel, and silver.

OTHER EVIDENCE OF MINERALIZATION

The widespread bodies of granites of the region are for the most part unmineralized. The body of chloritized granite on Point Lake, which is probably older than nearby granite, sediments, and volcanics, is cut by quartz veins. No gold or sulphides were seen in this quartz. Chloritized granite at the first portage on Thubun River is crossed by quartz stringers carrying carbonate, fluorite, and chalcopyrite. Veins in granite near Taltson River carry quartz, carbonate, galena, sphalerite, and fluorite, but apparently no gold and only a little silver (12, pages 81-82). Granite on a small island near the northeast side of the north arm of Great Slave Lake is cut by a quartz vein carrying abundant sphalerite and some galena and chalcopyrite (12, page 78). Carbonate, specularite, and pyrite were noted in other quartz veins in granite on the north shore of Great Slave Lake. So far as known no body of quartz in the granite carries gold.

The large areas of sediments and lavas older than and bordered by granite are considered to be favourable prospecting territory. At some localities these sediments are intimately intermixed with granite, but over large areas granite is lacking or present in small dykes and bosses. An area of sediments and volcanics 50 miles long on Yellowknife River does not carry much granite and here quartz veins were seen at a few localities. In the southern part of this area some of the quartz bodies carry carbonate, arsenopyrite, sphalerite, and galena with some gold and silver (12, pages 72-74). The several areas of sediments on the north shore of Great Slave Lake east of Yellowknife River are cut by quartz veins. The largest of these areas is northeast of Blanchet Island and is not much cut by granite. On Wilson Island, on other nearby islands, and at Basile Bay, the sediments and lavas older than the granite are cut by quartz veins, lenses, and stringers. Many of these carry specularite and orthoclase. In a few, however, carbonate, chlorite, pyrite, galena, and chalcopyrite were seen and one is known to carry a little gold and silver (12, pages 75-76). Granite cutting these strata was seen only on islands southwest of Wilson Island. Beds of specularite iron formation (12, pages 84-85) in the strata on islands southwest of Wilson Island are too low in iron to be an ore at present. All the areas of sediments and lavas older than the granite about Great Slave Lake should be prospected very carefully for gold-bearing quartz.

Deposits of pyrrhotite and pyrite in sediments and lavas near the mouth of Yellowknife River apparently carry only a trace of silver and no gold (12, pages 73-75).

To the north of Great Slave Lake the formations that are older than granite appear favourable for the occurrence of ores about Redrock, Point, Providence, Thonokied, and MacKay Lakes and at Lac de Gras. These areas are difficult to reach except by aircraft. Bedrock is covered over fairly large areas about Thonokied and MacKay Lakes and Lac de Gras and timber is lacking on these lakes.

The strata of the Great Slave group are younger than the widespread bodies of granite and, therefore, any deposits they may contain are also younger than the main granite bodies of the area. The Great Slave strata, however, are cut by bodies of dioritic rocks, and mineral deposits may have formed in connexion with these intrusives. Parts of some of these bodies of dioritic intrusives are brecciated and the broken blocks are cemented with carbonate. The dioritic rocks are cut by veins of carbonate and quartz. The Great Slave strata also are cut by veins of carbonate and quartz. Micaceous specularite, chlorite, red albite, pyrite, and chalcopyrite were noted in some of these veins (12, pages 76-77). A few veins are largely of barite with some calcite and chalcopyrite. The beds of oölitic iron formation in the Great Slave strata are too low in iron to be of value. Strata, somewhat similar to the beds of the Great Slave group and occurring on Redrock, Rocknest, and Odjick Lakes, are cut by quartz veins. One of these veins, along a fault east of Odjick Lake, is about 50 feet wide. To the southeast this quartz vein passes into a body, up to 700 feet wide, of quartz stringers and country rock. Very little pyrite was seen in the quartz. It is clear that the strata of the Great Slave group may carry ore deposits and, consequently, all areas of these sediments and volcanics should be prospected.

The strata of the Et-Then series also are cut by a few veinlets of carbonate and by quartz stringers. Calcite, barite, chalcopyrite, and sphalerite were seen in some quartz stringers. In the diabase, hexagonal joint planes and parallel joints locally are filled with carbonate and comb quartz carrying small amounts of chlorite and chalcopyrite. The sills and dykes of diabase about Great Slave Lake are remarkably like those of the Cobalt and Thunder Bay areas where valuable deposits of silver have been mined in and near diabase.

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MAGUSE RIVER AND PART OF FERGUSON RIVER BASIN, NORTHWEST TERRITORIES

By L. J. Weeks

CONTENTS

Illustration

INTRODUCTION

In 1932 the writer, continuing work begun in 1929, ascended Maguse River from its mouth to Kingaryualik Lake, close to its headwaters, and, returning, crossed to Kaminak Lake on Ferguson River. A single line of micrometer survey was run from the coast to the most westerly point reached, and to this were connected numerous track surveys made with one canoe and using a boat log to determine distance. On reaching Kaminak Lake no surveys were made, use being made of an excellent map constructed by means of aerial photographs taken the previous summer. Messrs. A. W. Derby and W. C. Gussow were employed as student assistants, the former working separately from the writer on numerous occasions.

The area examined lies almost entirely in the so-called barren lands, a small clump of timber lying immediately west of Kingaryualik Lake, the most westerly point reached. Between this lake and the coast, however, no difficulty should be encountered in building a fire in an emergency, as clumps of bushes 2 and 3 feet in height are frequently met.

Maguse River enters the west side of Hudson Bay near Eskimo Point and not far north of latitude 61 degrees. The river is divided into two parts, the upper and the lower river, separated by Maguse Lake 70 miles in length. Kingaryualik Lake, near the head of the river, is 500 feet above sea-level, this figure being obtained from the reading of an airplane altimeter by Mr. W. J. Buchanan, pilot for Canadian Airways, Limited. Since the upper and lower parts of Maguse River total about 50 miles in length, the average drop of the river parts of the basin is 10 feet a mile. Actually the rate of drop of the upper part is greater and the lower part less than this figure. The height of Maguse Lake is unknown, but might be estimated at 200 feet.

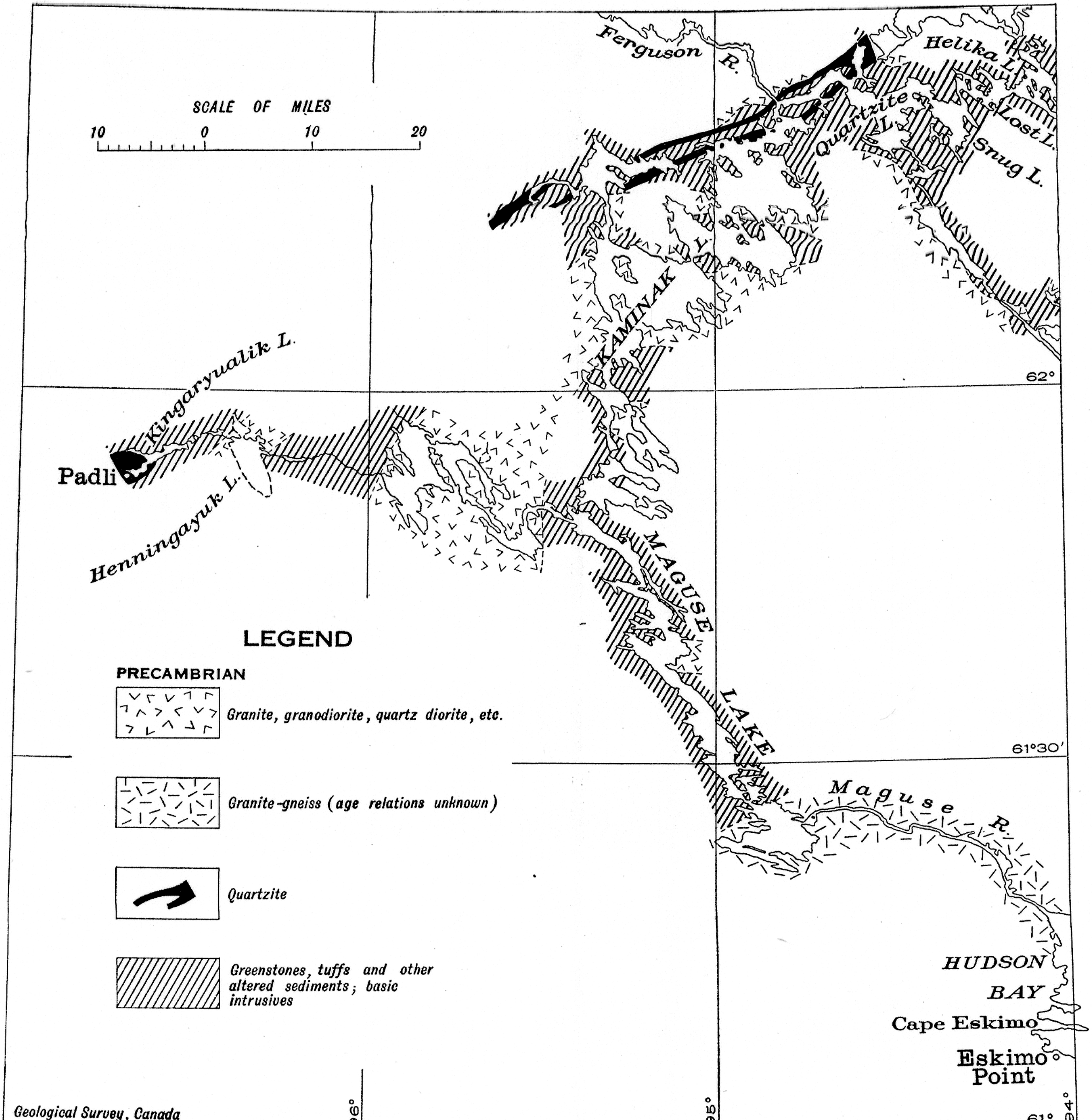

Figure 6. Maguse River-Kaminak Lal e area, Northwest Territories.

Kaminak Lake lies 6 miles north of Maguse Lake, at a point about two-thirds of the way up the lake. It is separated from the latter lake by a small lake 5 miles long and two portages totalling 7,000 feet. Apparently Maguse and Kaminak Lakes have a difference of elevation of less than 20 feet.

Immediately west of the mouth of Maguse River the country is almost completely covered with drift. In general, rock exposures increase in frequency proceeding westward and northward, until on reaching Kingaryualik Lake and the northern parts of Kaminak Lake, rocky bluffs over 100 feet in height are no unusual occurrence.

Ptarmigan and geese are plentiful during the summer. No caribou were seen until August 4, but thereafter were very plentiful, as a rule a small number being in sight at all times.

Two trading posts are located in the explored area, Eskimo Point, a few miles south of Cape Eskimo, and 12 miles south of the main mouth of Maguse River, and Padli at the extreme western end of Kingaryualik Lake. Prior to 1932 goods for the latter post were transported up Maguse River by canoe at large cost and damage to the goods. In this year, however, the experiment of airplane transportation was successfully attempted.

With the exception of traders, missionaries, and about five white trappers, the population is entirely Eskimo, mostly belonging to two tribes, Assiamiut, and so-called Padlimiut. (The Eskimo word Padli was applied to a point at the lower end of Maguse Lake. When a post was established on Kingaryualik Lake, the name Padli was given to it, and the name Padlimiut to those natives dwelling thereabout.)

In 1930, D. F. Kidd, who was assistant to the writer the previous summer, was given independent work on Ferguson River west of the 94th meridian. His work, although very briefly summarized previously by the writer, was not fully reported on until this past winter. A more complete summary of this work is included in this report, and, with the work of the writer on Kaminak Lake this past season, completes the geological examination of Ferguson River to the head of Quartzite and Kaminak Lakes.

Since field work in this region each summer results in the obtaining of more definite relationships between the various rock groups, a full discussion of these relationships will be postponed until such time as work in this region is definitely completed. This report, therefore, will give a description of the geological features that would be observed in travelling the routes examined by the writer.

MAGUSE RIVER AND LAKE

For 12 miles from the seacoast, Maguse River flows over a low, gravelly plain without any well-marked stream valley. Bedrock does not occur in this distance at any place in the banks or river bed, but two outcrops of granite-gneiss were observed some distance north of the river, respectively, at the mouth and 2 miles west thereof. This part of the river is characterized by numerous gravel islands and is extremely shallow. A very shallow lake 8 miles in length ends 4 miles from the coast. At the head of this flat stretch of country, the river divides, a much smaller stream flowing east to another mouth 15 or 20 miles north of the main mouth.

Above this point the river flows through rolling, drift-covered country, and as a rule is bounded by cut banks of glacial till varying in height generally from 10 to 35 feet. In the early spring, no bedrock is to be seen along this section as far as Maguse Lake. In the late autumn, however, numerous exposures of granite-gneiss are visible close to the water's edge. Usually the outcrops mark a fall or steep rapid.

Maguse Lake may be conveniently divided into four parts, each separated by a navigable rapid. The most southeasterly section is roughly rectangular in shape and about 5 miles square. The country surrounding this part of the lake is drift covered and rolling. Only one outcrop of granite-gneiss was observed near the southeast corner of the lake. An esker 4 miles in length parallels the southwestern side, forming an attenuated island.

The second section of Maguse Lake is 36 miles long. The country bordering it is mostly rolling, but much higher than that farther east. Outcrops are very scarce, but are well distributed, thus giving a fair idea of the underlying bedrock. The nature of the surrounding country as observed from the lake would lead one to expect outcrops on the higher parts 2 to 5 miles inland.

While surveying this part of Maguse Lake the compass was found to be affected by strong local attraction. A series of computed variations for consecutive stations, each separated from the last by between 4,000 and 5,000 feet, show the following figures to the nearest degree: −6, −23, +48, +43, −32, +72, +18, +6, +8, +70, −19, +20, +10, −4, +134, +33, +17, −18, −30, +9, −36, +10. Those variations prefixed by a "plus" are east and those prefixed by a "minus" are west. In general it appears that the highest variations do not occur where rock is exposed near the lake shore. It might possibly be assumed that the rock containing most of the magnetic material is of a softer nature than that which protrudes through the drift mantle.

The few outcrops exposed for about 16 miles from the lower end of this section of the lake are of altered sediments and some rocks of doubtful origin. The attitude of the sediments was observed at one point 4 miles north of the rapids in the lake and they were found to strike 230 degrees true, dipping southeast 40 degrees. North of these rocks is an exposure of grey granite porphyry. This rock is exposed at the bottom of a bay for a distance of 2,000 feet; the nearest exposures, some 4 miles on each side, are of greenstone.

A short distance northwest of this outcrop the lake narrows but without a rapid. One mile north of the narrows are outcrops of fine-grained, sheared, and banded sediments or tuffs, and chlorite schists. The former strike 67 degrees true and dip southeast at a high angle. A short distance northeast of this outcrop is the end of an esker extending northwest 5 miles, with a branch 1½ miles long joining it 3 miles from its end.

The esker varies in width from 100 to 600 feet and has a fairly constant height of about 20 feet. It is composed of fine sand and pebbles. A few boulders found on it and many along its edge have probably been left by floating ice in the lake. Steep cliffs cut in the sand by wave action show it to have been wider formerly. Two and 3 miles, respectively, from its northern end are two, small, esker-like islands which possibly are continuations of it, the intervening parts having been washed away.

Two miles northwest of the extremity of this esker are a few outcrops of fine-grained tuffs or sediments and slightly sheared volcanic rocks. The latter, outcropping on a small island, show minute grains of sulphides on a freshly fractured surface.

At the head of this section of Maguse Lake, outcrops become quite plentiful and can be seen extending to the northward away from the lake. The exposures are mostly of chlorite schist, probably of volcanic origin. No sediments were suspected in this locality.

The third section of Maguse Lake is about 8 miles long, and is of the general shape of a new moon, convex to the southward. At the head of the rapids separating this part from the second section and on the south side of the lake, are exposures of much altered schists much cut by veins and masses of granite. On the north side near here are exposures of unaltered granitic rocks. These are part of a belt of granitic intrusives of granodioritic and quartz dioritic composition having a width on Maguse Lake of 16 miles and extending north and northeast to and across Kaminak Lake. Only one other outcrop was observed on the third section of the lake; it also is granitic and occurs near the southernmost extremity of the "moon."

The fourth and last section of Maguse Lake is a series of northwest-southeast trending bays, connected transversely. It is surrounded by rolling, drift-covered hills, some of considerable height. That part adjacent to the third section is practically devoid of rock exposures, one outcrop being observed at the rapid separating the two sections. The western part of the lake, however, is largely devoid of drift in places, and apparently rock exposures increase to the west away from the lake. The contact between granitic rocks and the volcanic-sedimentary complex cuts across the western extensions of four large bays, in one of them contact phases being observed very similar to those seen at the eastern end of the third section of the lake.

Two fairly large streams enter Maguse Lake, the southern being termed upper Maguse River. The northern stream was explored for a distance of about 2 miles from its mouth and was found to flow for this distance among rounded knobs of fine-grained, chloritic rocks showing a faint schistosity in places.

For 12 miles above Maguse Lake, upper Maguse River flows, with many rapids and falls, through sparsely drift-covered country. Rounded, rocky knobs predominate, with very few hills rising to any height above the general level. The intervals between rock exposures are occupied by small lakes or grass-covered till. The rocks vary considerably in appearance, but all are apparently of volcanic or detrital origin. At the first fall above Maguse Lake, green schists are apparently interbedded with a dense, grey, siliceous rock in bands about 1 foot in width, striking 73 degrees true and dipping southeast at a high angle. At a fall 6 miles east of Henningayuk Lake are exposures of agglomerate much deformed. Fragments of volcanic material, in a matrix of fine-grained material, have been given a distinctly lenticular shape, whereas the matrix received a pronounced schistosity. The strike of deformation was observed to be 40 degrees true, the dip being uncertain.

That part of Henningayuk Lake examined during the traverse is underlain by a narrow band of granitic rocks, 4 miles in width, its contacts with the older strata crossing upper Maguse River, respectively, at its entrance to and exit from the lake. Neither contact was exposed.

One mile west of the granite are exposures of fine-grained, massive diorite or andesite. Outcrops of similar rocks are frequently met with between here and Padli, but their intrusive or extrusive nature could not be determined in the field. The other rock types present in this interval are various sheared chloritic rocks, presumed to be of volcanic origin.

At the western end of Kingaryualik Lake is an exposure of grey to pink-white quartzite. The strike and dip of this rock in any outcrop can not usually be determined while standing on the outcrop in question, but quite frequently they are very distinct at a distance of 100 yards or so. A long peninsula juts into the lake from the west and is wholly underlain by quartzite. This rock also occurs in a thin band on the south side of a point 1 mile east of the end of the peninsula. No quartzite occurs on the north side of the lake. The quartzite on the south side of the lake dips north and northwest, whereas on the north side of the peninsula the rock dips south, thus showing the quartzite to have synclinal structure at this point. Since the strikes on opposite sides converge toward the east, the syncline pitches to the west. No exposures of quartzite were observed on the lake or adjacent thereto, east of the most easterly one described above, which would lead one to suspect that the bottom of the syncline here rises above the surface of the ground.

The contact between quartzite and the underlying rocks was not found exposed in this locality. Usually several hundred yards of drift-covered country intervenes between outcrops of quartzite and chlorite schist. At the bottom of a small bay on the south side of the lake 2 miles from the western end, quartzite is exposed within 150 feet of an outcrop of greenish, siliceous conglomerate containing granite and quartz pebbles up to 2 inches in diameter, but usually under ½ inch. This rock is quite massive, no trace of bedding being discernible. One mile east of this locality, on a small point of land, quartzite was found underlain by a light-coloured, massive conglomerate. Green schists lie a few hundred yards south.

KAMINAK LAKE

Kaminak Lake for 10 miles south of its outlet into Quartzite Lake was examined in 1930 by D. F. Kidd. This part will be described later, together with Quartzite, Snug, Lost, and Helika Lakes and parts of Ferguson River examined by him at the same time.

In 1932, the writer proceeded from Maguse Lake, via one intervening lake, to the southernmost extremity of Kaminak Lake and examined the rock exposures on the shore as far as that part examined by Kidd. The trip was made in the late autumn under conditions that permitted of only a hurried study of the geology. The southern part of Kaminak Lake is a narrow arm 29 miles long, due north and south, with an expansion at the north end. For 4 miles north of the southern tip, the lake is bordered by hills of drift, 200 to 300 feet in height. Here a small stock of fine-grained diorite is bounded 1 mile to the north by green schists. The rock is very fresh and unaltered, consisting of approximately 60 per cent medium plagioclase, the remainder being largely hornblende. Near the point of contact between this rock and the older series, a short stream 2,000 feet in length flows over boulders from a lake 7 miles long. This lake was not examined.

On the opposite side of Kaminak Lake, northwest of this small stream, a bay 2 miles deep runs northwest, at the bottom of which granite is exposed in contact with chlorite schists, the contact running southwest. Granite is found intermingled intimately with these rocks for a distance of 200 or 300 yards in the vicinity of the contact. The granite body extends to the east side of the lake, the contact apparently bending to nearly true east, cutting across the tip of a small, narrow peninsula, and parallel the south shore of the first large expansion of the lake, offshore islands being underlain by granite.

On the west side of the lake, granite is exposed for 12 miles, as far as the entrance to a narrow channel leading north to an east-west bay. Along the west shore of this channel the exposures are of granite except near the entrance where green schists form a band a little over a mile wide bounded on both sides by granite. The granite is usually very coarse grained and composed of quartz, microcline, oligoclase, and some titanite. The composition is apparently very similar to that of the granite outcropping on Maguse Lake and it is believed that the granites on the two lakes are parts of one body.

The east-west bay at the head of the already mentioned narrow channel, which leads north from the northwest corner of the first expansion of Kaminak Lake, is about 10 miles long. Green schists outcrop in practically all parts of this bay, but quartzite is exposed on both the western and the eastern extremities, and in the middle of the south side is a northwest-trending dyke of andesite forming an attenuated peninsula.

Two bands of quartzite extend to this bay from the east from Quartzite Lake. The northern of the two is very poorly exposed. The other is exposed for 4 miles along the southern shore to a point where drift intervenes. A width of 1 mile was observed at one place, but the breadth is much less 2 miles east. The rock is for the most part pale pink quartzite and shows little or no evidence of bedding unless observed at a distance when some distinct dips of about 45 degrees to the northwest were observed. The continuations of both this band of quartzite and an andesite dyke mentioned above are lost in a large, drift-covered area on the south side of the bay. The north side of the eastern part of this bay is largely drift covered. The northern band of quartzite is exposed along the shore in several small outcrops a couple of hundred feet across, but the width and attitude could not be derived from these.

At the western extremity of this bay, a narrow, winding inlet runs westerly. The shores of the entrance are of drift for over a mile to where a small outcrop of quartzite is bounded by green schists on the south and drift on the north. One mile farther west, high, rocky knobs of volcanic rocks rise steeply from the water's edge, and a little farther, high bluffs of pinkish white quartzite do likewise. A slight bend in the inlet allows it to parallel the band of quartzite, which only occurs on the south side until the head is reached. On the north side of the inlet, in line with the quartzite band, green schists only are exposed. The quartzite is in the form of a narrow syncline, and its absence from the north side may mean either that the bottom of the syncline rises above the surface or that a fault exists. No quartzite could be seen to the northeast. Large outcrops of quartzite were seen to the southwest.

As already stated, the first large expansion of Kaminak Lake is bordered on the west and south by granite, part of a large body believed to extend southwesterly to and across Maguse River. The eastern and northern shores of this expansion are also bordered by granite except for a long diabase dyke on the south shore and an area of green schists in the vicinity of the narrow opening in the north shore, connecting with the next large expansion to the north of Kaminak Lake. The discharge is through a narrow, deep channel having a slight current. It leads into an expansion having a length in a northeast-southwest direction of 12 miles.

This bay is separated from the third large expansion of Kaminak Lake by a number of narrow channels between large and small islands. The north shores of these islands were examined in 1920 by D. F. Kidd, and with parts of Ferguson River are described in the following section.

FERGUSON RIVER WEST OF 94TH MERIDIAN

This area was examined by D. F. Kidd in 1930, and the following account is a summary, prepared by the writer, of a manuscript report by Mr. Kidd. The 94th meridian crosses a few miles below Helika Lake. This lake is about 4 miles long. The greater part of the bordering country is drift covered. An outcrop about 2 miles in length occurs on the east side and nearby islands, 1 mile north of the outlet. The rock is mostly of medium grain, dark green and structureless except for a small shear zone up to an inch in width. A small dyke of grey, granitic material cuts these rocks in one locality.

Lost Lake, the next expansion to the west of Ferguson River, is separated from Helika Lake by a short rapid. It is choked with many small islands. Rock exposures are found on the southern shore for 4 miles east of the head of the lake, and on the northern shore opposite the east end of those on the south. The rocks are for the most part massive greenstones. At the northern end of the eastern arm of Lost Lake are exposures of a fine-grained, greenish porphyry containing feldspar phenocrysts. On the east side of the middle arm of the lake, four small dykes of kersantite cut the greenstone assemblage, these varying in width from 2 inches to 2 feet and strike 290 degrees true.

Snug Lake is joined to Lost Lake by a short rapid. Except along its northern side, bedrock is well exposed on its shores. The rocks are mostly greenstone, and on the west side are cut by a diabase dyke that has been traced for 6 miles in a northwestern direction parallel to the shore of the lake. On an island near the west shore of Snug Lake are outcrops of what appear to be pillow lavas, the elongated direction of the ellipsoids striking northwest.

Quartzite Lake is separated from the northwest corner of Snug Lake by a short rapid flowing among islands. The upper part of the lake is about 10 miles long and lies between and parallel to two bands of quartzite which trend northeast. Bedrock is well exposed on the shores of all parts of this lake. The two bands of quartzite join to the immediate northeast of the lake to form one band 3 miles in width. The two bands appear to dip towards each other, west of their junction, but no conclusive evidence of synclinal structure could be obtained from the wide exposure northeast of the lake, although it is strongly suspected. Lying parallel to and immediately north of the southern band of quartzite is a diabase dyke 1,000 feet wide, bounded on the north by green schists.

Immediately south of the eastern part of the lake is a contact between the greenstones and a large mass of granite that extends to the south and to the west, and without doubt is continuous with the large body crossing Kaminak and Maguse Lakes.

Ferguson River enters Quartzite Lake by a rapid over the northern band of quartzite near the western extremity of the lake. The quartzite is bounded on the north by what is apparently a large mass of quartz-mica diorite. This rock was found at numerous places a short distance north of this band of quartzite, and in many places is separated therefrom by narrow exposures of green rocks.

Tyrrell descended Ferguson River and describes only granitic rocks along that part above Quartzite Lake. Small areas of greenstone have been reported along the upper river by members of the Nipissing Mining Company's field parties in 1929, and the writer later verified these occurrences from the air, and in addition noted a band of quartzite, apparently bounded by greenstone, on a large lake some 30 miles northwest of Quartzite Lake.

Kaminak Lake is separated from Quartzite Lake by a short series of falls, the inlet being only $1\frac{1}{2}$ miles south of the mouth of Ferguson River. The northern expansion of Kaminak Lake is about 9 miles north and south by 12 miles at its greatest extension northwest and southeast. Bedrock is well exposed along its shores. The two bands of quartzite found on Quartzite Lake continue in scattered exposures along the north side of the bay and extend west to join the bands already described as outcropping about the east-west bay reached from the second expansion of Kaminak Lake. Quartz-mica diorite is found at a number of localities to the north of the northern band, but, as north of Quartzite Lake, the relationships between it and the quartzite were not observable. Small, intrusive, dioritic masses occur between the two quartzite bands on the north side of the bay, their relationships to the quartzite being also unknown. Granite outcrops along the south side of this northernmost expansion of Kaminak Lake and is believed to extend east to the southeastern end of Quartzite Lake. On the eastern side of the lake expansion is a small outcrop of sodalite-nephelite syenite, about one-half mile in length, and very narrow. The remaining rocks examined along the shores of this part of the lake are green schists and dark, fine-grained sediments.

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AMISK LAKE AREA, SASKATCHEWAN

By J. F. Wright

CONTENTS

Illustrations

INTRODUCTION

Amisk (or Beaver) Lake is about 12 miles southwest of Flinflon, the end of the Canadian National branch line from The Pas. In 1931, the government of Saskatchewan commenced to build a motor road from Flinflon to the east side of Amisk Lake, and, in the early autumn of 1932, continued work on this road, and it is expected that in the near future the lake will be accessible by truck from the railhead. The canoe route westward from Amisk Lake, via Sturgeon-weir River, to Pelican Narrows and beyond is good; consequently, this road, in addition to bringing Amisk Lake area within easy reach of the railway, will also serve as the route of entry to the prospecting territory between Amisk Lake and Lac La Ronge and northward to Reindeer Lake.

Free gold was discovered in vein quartz on Amisk Lake in 1913, and, during the succeeding years, the area received attention from prospectors and mining men. A very large area was staked and a few prospect pits were made at many localities, but no extensive exploration of any deposit was undertaken. The area then was rather difficult to reach from The Pas by Saskatchewan and Sturgeon-weir Rivers. The latter river, between Namew and Amisk Lakes, a distance of about 22 miles, is particularly difficult to ascend, owing to long stretches of swift water and shallow rapids over nearly flat-lying beds of early Palæozoic dolomite. A few of the early prospectors are still in the country, and, in the past nineteen years, have continued to do assessment work on their holdings. Now, however, that the country is more easily accessible from Flinflon, many additional prospectors have entered the field, and more prospecting and preliminary exploration of the deposits were completed during the summer of 1932 than in any previous year. Much of the work, too, was more effective, for it was planned to display the worth of the deposits rather than to remove rock to obtain credit for assessment.

In 1914, E. L. Bruce made a reconnaissance geological investigation of Amisk Lake and, in the succeeding three years, continued this work eastward in Manitoba. The results of the study about Amisk Lake were presented very briefly in the Summary Report of the Geological Survey for 1914, and later more fully in Memoir 105, accompanied by Athapapuskow Lake map on a scale of 3 miles to 1 inch. In 1931, J. B. Mawdsley spent a short time in the area for the government of Saskatchewan, but no account of his observations was published. In view of the known occurrences of gold and the present activity in this area, which is within easy access of the railway so that deposits of merit could be explored and developed economically without delay, the geology of an area of about 700 square miles, outlined in Figure 7, was investigated in some detail during the summer of 1932. In the field studies, Messrs. Willis Wright, Stephen Ogryzlo, and Elroy Nicholson assisted ably. Their enthusiastic co-operation and also the many courtesies extended to the party by prospectors and others are acknowledged with appreciation. This report briefly presents the main conclusions of the investigation regarding the general geology and gold deposits about Amisk Lake.

GENERAL FEATURES OF THE AREA

Amisk Lake is about 965 feet above sea-level; the surrounding country, except in the south, is rough and rocky, many rock ridges rising from 75 to 125 feet, and a few 160 feet, above the level of the lake. The south side of the lake is bordered by nearly flat-lying, early Palæozoic dolomite, the north boundary of which locally forms nearly vertical cliffs up to 70 feet high, back of which the surface is flat or gently rolling and drift covered. In the northern rocky area, underlain by formations of Precambrian age, the axes of the ridges closely parallel the strike of the bedding, schistosity, and foliation of bedrock. This relationship of topography to structure is particularly prominent in areas underlain by quartzose sediments, and also south and west of Wildnest Lake, where gneisses are the abundant rock types. Long, narrow swamps and occasional lakes occupy the lower areas between ridges. The swamps, although numerous, are not extensive except west and southwest of Johnson Lake.

The area is especially favourable for geological study and for prospecting; rock exposures are abundant owing to the many and extensive forest fires that, during the past twenty years, have traversed the country. Travel is difficult over areas burned six or more years ago, as here the new growth of bushes is thick, and the burned timber has fallen, to make in places almost an impassable barrier. This is especially the case where the timber originally was heavy in valleys, as west of the north corner of Amisk Lake, whereas in other areas practically all the timber was burned and here, as in the large area southwest of Wildnest Lake, the country is open and the rock is well exposed for miles in every direction.

The drift deposits are widespread, and little is known regarding their character. In rocky areas, boulders and coarse gravel are exposed near the bottoms of hills. Peaty material and moss cover the drift under the flat areas. Between Table and Amisk Lakes, and south to Meridian Creek, ground moraine deposits are exceptionally thick and extensive, and this is probably the best area of agricultural land about Amisk Lake. The forest here is heavy, with fair-sized poplar and jackpine and thick underbrush. So far as is known, no stratified clays, such as those deposited in Glacial Lake Agassiz, are present. Some of the sand and gravel deposits are roughly stratified, and are outwash fans and kame-like deposits. A large deposit of sand extends for miles between Annabel and Tyrrell Lakes. This is a very pure and fine-grained sand, and the surface of the deposit is slightly rolling. In some areas miles of the sandy belt completely hide the rocks. This sand may be wind-blown glacial outwash material. The Hudson Bay Mining and Smelting Company are using it, from a point north of Annabel Creek, as a flux in their smelter.

The last continental ice-sheet to cross the area moved from the north-east. Many rock surfaces show excellent glacial scratches and grooves; these trend about south 25 degrees west, true bearing, there being but little variation over the whole area except about Wildnest Lake where some grooves run from south 30 to 35 degrees west. Although the large grooves and scratches have about the same general trend, glacial markings on the sides of hills, and just above the water-level of lakes, vary 20 or more degrees from the main direction. Such markings at nearby points may vary in strike from 10 degrees west to 20 degrees east of the main striæ, and undoubtedly such local variations resulted from deflexions of the bottom layers of ice in passing around and over hills. If blocks of ore are found, the striæ in all nearby outcrops should be noted carefully as a guide to the direction of the source of the blocks.

An interesting feature of the distribution of glacial erratics is the presence of blocks of Palæozoic dolomite and limestone at a dozen or more points over the area and situated at or near the tops of hills. At most localities only one such block is present, although at a few points two blocks occur within a few hundred feet of each other. The blocks are angular, which suggests they have not travelled far. Some are 8 feet high and 16 feet long. A pinkish, thin-bedded limestone of one block on the high hills west of Wildnest Lake has poorly preserved fossils. The source of the blocks is not known, as no body of Palæozoic limestone or dolomite was recognized nearby, nor is one known for hundreds of miles to the north or northeast. Many of the blocks have the appearance of the dolomite crossing the south side of the map-area, but, as the ice moved from the north, they could not have come from this source. Two large but thin outliers of dolomite are present north of the main body of dolomite in the area from Meridian Creek to Amisk Lake, and it is concluded that other but smaller outliers were present here and there over the area during the last ice advance, and that the blocks originated from these. The outliers were probably thin and in low ground, consequently they were completely removed by glacial scour, for any remnants are now covered with muskeg, or outcrop in such positions that they were not found during the geological mapping.

The main stands of timber of possible value in the area are on the east and west sides, respectively, of Amisk Lake, near the south side of the map-area. The areas of timber in other parts of the area are small and are situated along rivers, creeks, and near the shores of lakes. Throughout most of the district, it will be difficult to secure either good mine timber or cordwood for fuel. Electrical power, however, would probably be available from the Hudson Bay Mining and Smelting Company's power plant at Island Falls, through the Flinflon transmission line.

The country about Amisk Lake has been so intensively trapped that fur-bearing animals are scarce. The best hunting ground is limited to the small areas of green timber. Moose and deer were fairly abundant in parts of the area during the summer of 1932. Until about fifteen years ago, the Hudson's Bay Company had a trading post near the southwest corner of Missi Island, and the Beaver Lake Trading Company has a post on the east side of the lake at the end of the road from Flinflon. This company has a fair stock of provisions and equipment for prospectors and trappers.

GENERAL GEOLOGY

The known bedrock about Amisk Lake is tentatively grouped as follows:

Table of Formations

Palæozoic:
- Ordovician dolomite
  - *Great unconformity*

Precambrian:
- Intrusive:
  - Pegmatite and lamprophyre
  - Granite with gneissic and stratiform aplitic and massive pegmatitic and porphyritic phases, syenite, granodiorite, and quartz diorite
  - Feldspar porphyry
  - Norite, gabbro, and diorite

Early Precambrian:
- Missian sediments
  - Conglomerate, arkose, quartzite, greywacke, quartz-mica-garnet gneiss, and gneissic quartzite
  - *Unconformity*
- Pre-Missian? granite and quartz-sericite schist
- Wekuskoan lavas, sediments, and intrusives
  - Quartz-feldspar porphyry
  - Trachyte and dacite with porphyritic phases, agglomerate, tuff, greywacke, hornblende schist, sericite schist, quartz-hornblende-garnet gneiss
  - Grit, arkose, greywacke, slate, argillite, chiastolite schist, quartz-mica-garnet schist, sericite schist, and quartz-hornblende mica-garnet gneiss.
  - Amisk volcanics including basalt, andesite, pillow lava, amygdaloidal lava, tuff, agglomerate, chlorite schist, and hornblende-plagioclase-garnet schist and gneiss.

GENERAL DISTRIBUTION OF FORMATIONS

The main bodies of intrusive rocks are shown on Figure 7. The rest of the area, so far as is known, is underlain by either Missian or Wekuskoan strata with many small bodies of intrusives. The localities where members of the various groups may be seen are mentioned in succeeding paragraphs descriptive of the general character of the rocks. The main prospecting territory is considered to be that underlain by the groups of volcanic and sedimentary strata, and some details regarding the geological features of the more important of these areas will be presented in the section of this report descriptive of the mineral occurrences. An interpretation is presented on Figure 8 of the structural relations of the various formations along certain lines, indicated on Figure 7, and the sections give an idea of the situation of the main bodies of the three groups of volcanic and sedimentary strata, and also of the Missian strata.

WEKUSKOAN LAVAS, SEDIMENTS, AND INTRUSIVES

The Wekuskoan comprises a variety of rocks, some of which may be of widely separate age. The base of the group and the floor on which it formed have nowhere been recognized, the lowest lava flows lying against a younger intrusive granite. The lower part is predominantly volcanic; the main bodies of sediments are above the middle of the assemblage, and are interpreted as clastics formed in bodies of water on the lava field during periods of quiescence. Grey, fairly acidic lavas, black hornblende schists, large bodies of agglomerate, and thin beds of tuff and greywacke apparently represent what is considered the top part of the group. Members of this latter assemblage are well exposed on the west shore of Amisk Lake north from near the Sturgeon-weir. On the west side of Missi Island and the mainland to the west, lavas and sediments are cut by numerous bodies of very fine-grained, grey rock with eyes of smoky quartz, and at some localities small crystals of white feldspar. Some narrow bodies of this rock, wherein the eyes of smoky quartz are not prominent, are difficult to distinguish from grey lava. The bodies of the intrusive rock are interpreted as a late phase of the very long period of volcanism.

The lava flows and associated bodies of sediments are steeply folded, and over wide areas the dip of the beds is from 40 to 80 degrees, with some beds standing vertically and others overturned. Across narrow areas along the axis of folds the strata are lying nearly horizontal, and beds dipping 40 degrees may be standing at 80 degrees a few thousand feet along their strike. The strike and dip of the schistosity and cleavage parallel in a general way the outline of the granite bodies. In many outcrops schistosity stands nearly vertical and its dip may vary from 5 to 10 degrees in both directions from vertical within a quarter mile across the strike. About the east side of Amisk Lake the regional dip of both the strata and their schistosity is westward and the strike north to northwest. On the west side of the lake, and inland, many of the dips are eastward. The facts available suggest that the Wekuskoan strata lie in a broad syncline with a number of minor folds on the limbs, and that the axial plane of some of the folds is nearly vertical and of others is overturned.

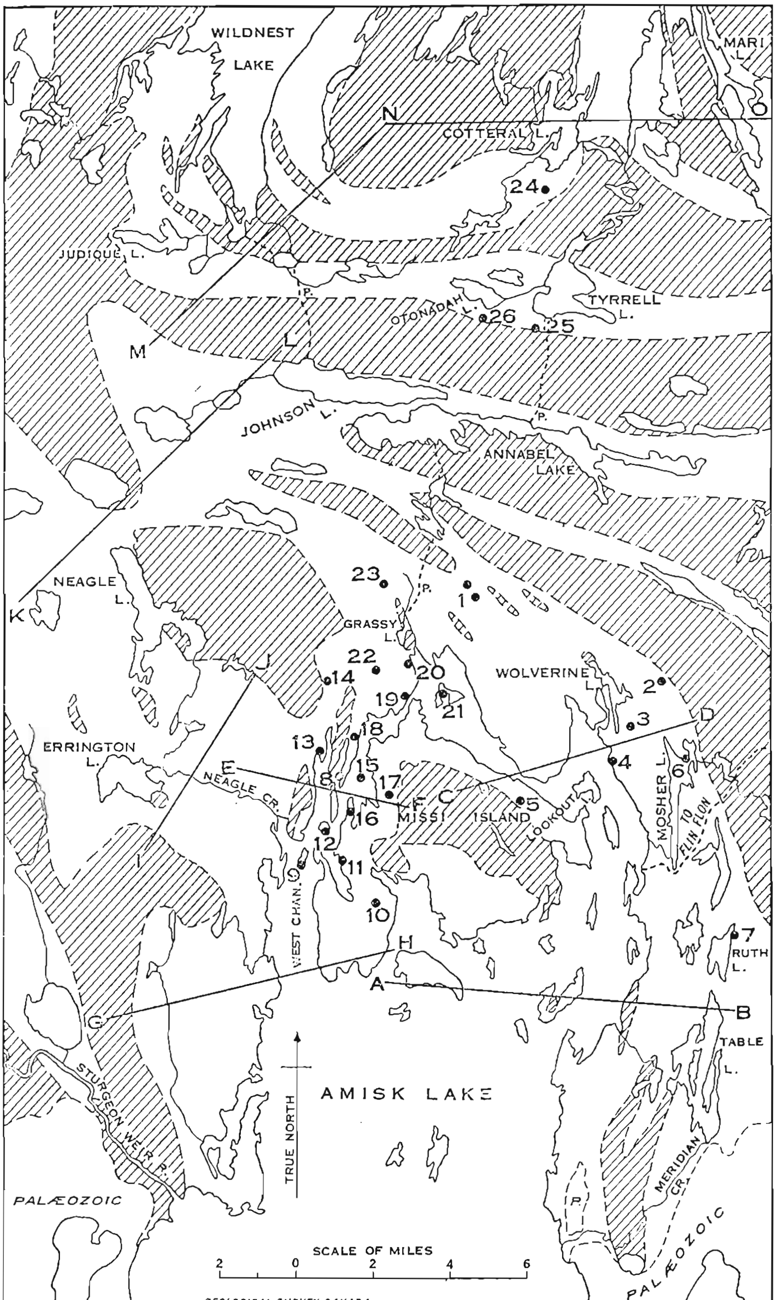


Figure 7. Amisk Lake area, Saskatchewan. Areas of intrusive rocks are indicated by a pattern of inclined ruling; mineral localities are numbered as in report; for geological structural sections along lines AB, CD, EF, GH, IJ, KL, MN, and NO, *See* Figure 8.

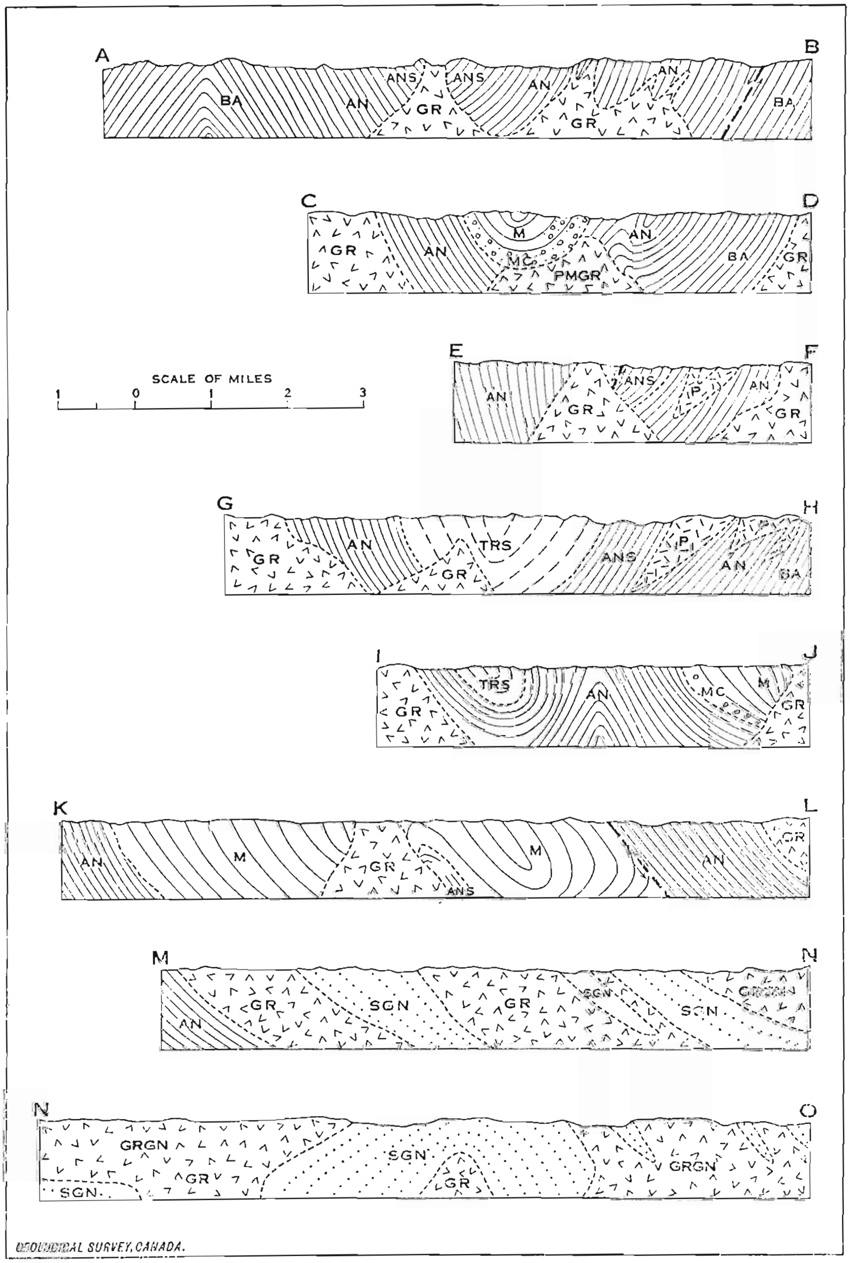


Figure 8. Diagrammatic and generalized structural sections (*See* Figure 7). BA = basalt; AN = andesite; ANS = andesite and sediments; TRS = trachyte and sediments; P = quartz-feldspar porphyry; PMGR = pre-Missian (?) granite; MC = Missian conglomerate; M = Missian sediments; SGN = sedimentary and volcanic gneisses; GRGN = granite, granite-gneiss, and sedimentary gneiss; GR = granite.

Basalt and Andesite

The flows of the early and main volcanic phase of the assemblage are of thick, massive-appearing basalt and andesite. Parts of some flows exhibit pillows and of others amygdules. One flow on an island southeast of the west side of Missi Island has an amygdaloidal border 75 feet wide. Agglomerate and bedded deposits are not abundant. The typical basalt is black to greenish black, medium to coarse grained, and some of it weathers mottled black and white. Although the rock appears fresh and massive, its minerals are altered, albite, calcite, saussurite, uralite, and chlorite and epidote-like minerals being abundant. Basalt is typically exposed about the east side of Amisk Lake on the bare hills east of Comeback Bay, and about Birch, Konuto, and Table Lakes.

The andesite is black to greenish, and is much finer grained than the basalt. Some flows are porphyritic with crystals of white-weathering feldspar, from one-tenth to one-quarter inch long, in a black, dense groundmass. The amygdule fillings of feldspar and quartz in some andesite on the east shore and nearby islands of Amisk Lake, north of Meridian Creek, weather very similar in appearance to the large crystals of the porphyritic lava. The minerals of the typical andesite are altered, and large bodies of andesite and some basalt are altered to chlorite schist. West of Annabel Lake, about Mari, Wildnest, the south end of Neagle, and on Errington Lakes, lava is recrystallized to a fresh, medium-grained, plagioclase-hornblende-biotite-quartz-garnet rock that is banded and has the general appearance of a gneiss originating from a sediment. Bodies of such rock formerly were mapped as a part of the Kisseynew sedimentary gneisses. Andesite is interlayered with basalt on the east side of Amisk Lake, whereas in other areas, as in the southeast part of Missi Island, the predominant rock, for a mile or more across the strike, is a black, dense, apparently structureless, andesite.

Sediments Interbedded with Lavas

The sediments in the lavas are grey to black rocks of both very fine and fairly coarse grain. Many outcrops show bedding, although at some localities this is not conspicuous and is best displayed on the weathered surfaces extending for a few feet above the present level of the lake. The surface of certain bodies of black, dense rock weather in alternating layers of black, dark grey, greenish grey, and brownish colours, the fresh surface being massive or with a few layers of more grey, cherty-appearing material than others. Some cherty types exhibit very perfect bedding. One type of sediment is a black, very fine-grained rock that has the appearance of black andesite, except for the bedded character, and it is considered to be an argillite formed from deposits of clay and silty clay derived from the weathering of ash and lava. Southeast of Grassy Lake, beds of well-bedded, argillaceous sediments are in part recrystallized, and glistening needles of hornblende, up to one-half inch long and orientated in various directions, are abundant on the fresh surface. Some of the black sediments have excellent slaty cleavage. Other sediments between the lava flows are grey, dense, thick-bedded, greywacke-like types. Well-bedded cherty rocks occur within these sediments at some localities, and a cherty quartzite, with small white spots on its grey-weathering surface, outcrops on the east shore of the point east of the entrance to Neagle Creek. Some of the cherty quartzite is crossed by two or more well-defined sets of joints, and the rock readily breaks in small, angular blocks. West of Duck Lake, greywacke-like and black argillite sediments are interbedded. Near the granite these sediments contain abundant, small, red garnets; the more clayey beds carry many crystals of chiastolite up to one-half inch long and showing, on their weathered surface, the characteristic two black bands crossing the crystals diagonally. The schists of this locality, when studied in detail, will, probably, be found to contain a number of the other minerals generally associated with chiastolite. Some greyish, apparently clayey, beds contain lenses of granite from an inch to a foot long, which are bordered by a black layer of variable width, depending on the size of the lens of granite, but never greater than 5 inches and perhaps representing a reaction zone between granite and sediments. Some of these "eyes" or lenses of granite weather so as to resemble pebbles. No typical conglomerate, however, was recognized among the sediments associated with the lavas, although a few thin layers have abundant, elongated, pebble-like pieces of vein quartz. This rock is highly schistose, and the quartz may have been injected along foliation planes of the schist. Other beds have pieces of quartz up to one-half inch across and long, narrow fragments of black lava. No pebbles of granite were seen in any of these beds. Some beds of gritty-appearing and arkosic material, however, do carry angular fragments of what appears to be fine-grained granite, and, in addition, bits of feldspar, quartz, lava, and chert. These may be tuffs.

The sediments associated with the lavas are typically exposed at points along the west shore of Amisk Lake north from south of the bay leading to Neagle Creek, and they were formerly mapped as the Lower Missi series. The thickness of all bodies is not known, some are only 100 feet, whereas others are at least 2,000 feet thick, and, although one area of these sediments is a mile wide at one point, there the dip of some of the beds is low, and this suggests gentle folding and perhaps not such a great thickness of strata as the width of the outcrop would suggest. Some bodies of these sediments are known to extend for miles along their strike. They are bordered at many points by lava without evidence that the sediments might represent either an older or a younger series brought to their present position with respect to the lava by either folding or faulting. These sediments are interpreted as deposits formed in bodies of water at intervals when lava was not being extruded in this part of the volcanic field.

Trachyte, Dacite, and Sediments

Grey and greenish grey lava and associated agglomerate, tuff, hornblende, and biotite schists, outcrop extensively on the west shore of Amisk Lake from about 2 miles south of Neagle Creek to near Sturgeon-weir River and inland to the west 2 miles or more. Some of the lava is porphyritic and much of it is schistose. Some black and greyish plagioclase-hornblende and biotite schists have a general layered or bedded appearance, and locally carry abundant red garnets. Although quartz is fairly abundant in some of the lava, no typical rhyolite was recognized; the abundant types are dacite and trachyte with some andesite. A number of large bodies of agglomerate, with a few spindle-shaped bombs up to 18 inches long, occur within these lavas. The majority of the fragments of the agglomerate, however, are angular or subangular and they weather lighter in colour than the fine-grained, greyish matrix, and also many are porphyritic. In addition to fragments that are of lava very similar to the matrix, the agglomerate carries at places a few thin fragments of black lava up to 6 inches long, and others of grey rocks that may be quartzite or perhaps a fine-grained, acidic granite. Bedded tuff is present near some of the agglomerate, and thin layers of this carries water-worn fragments of lava and a very few pebbles of what appears to be a grey granite. Bodies of greywacke-like, poorly bedded rocks, up to 100 feet or more across, are interlayed with some of the grey lava. The greyish lava, agglomerate, and associated bedded deposits are well exposed for study on the west shore of Amisk Lake, north for 5 miles from the entrance of the deep bay at about 3 miles north of the bay leading to Sturgeon-weir River.

Quartz-Feldspar Porphyry

Small and large bodies of greyish, fine-grained rock with small eyes of smoky quartz, and, at some localities, white crystals of feldspar, are exposed at many points on the west side of Missi Island and the mainland immediately to the west. Other bodies of similar-appearing rock were noted inland west of Amisk Lake, and particularly from 1 mile to $2\frac{1}{2}$ miles southeast of Neagle Lake, but the relation of these rocks to the lava and granite was not determined. On Missi Island the porphyritic rocks form elongated, lens-shaped bodies following the schistosity of the lava. As many of the gold-bearing deposits on the west side of Amisk Lake are in or near bodies of these rocks, the position and outline of the larger masses are indicated on Figure 9.

The typical quartz-feldspar porphyry is grey to dark grey, and is remarkably uniform in colour and texture throughout the whole mass. At a few localities, some small areas are almost dense, even granular, with no quartz recognizable on the weathered surfaces. Across wide bodies the small eyes of smoky quartz are a characteristic feature. In addition to smoky quartz, small crystals of white feldspar are abundant on the greyish weathering surface. The minerals are in part altered, calcite, sericite, and chlorite being abundant among small grains of quartz, orthoclase, plagioclase, and biotite. Small grains of pyrite, and locally arsenopyrite, are widespread in the porphyry, in some large bodies every piece of rock examined had sulphides. Schistose porphyry carrying sulphides weathers rusty and gold can be panned from many of these gossans. Some of the rock is markedly jointed, in places two or more sets of nearly vertical joint planes are so prominent and closely spaced that the rock breaks into small rhombs. In other places joint planes dipping at from 10 to 50 degrees give the rock a bedded appearance. The greyish porphyry is very difficult to distinguish from some of the grey lava, and unless an intrusive contact can be found it is difficult to determine the origin of some masses. The quartz-feldspar porphyry is cut by dykes of highly schistose porphyry with large phenocrysts of white feldspar, and also by dykes of fine-grained, massive granite. Their fine grain and the general uniform character throughout fairly large masses suggest that these intrusives formed nearer the surface than the nearby bodies of coarse-grained and somewhat heterogeneous granitic rocks. Much of the fine-grained porphyry has the general appearance of some of the grey lava and is altered similarly. These fine-grained, in places almost glassy-appearing, rocks that are older than the granite are interpreted as intrusives, perhaps formed near the end of the period of volcanism.

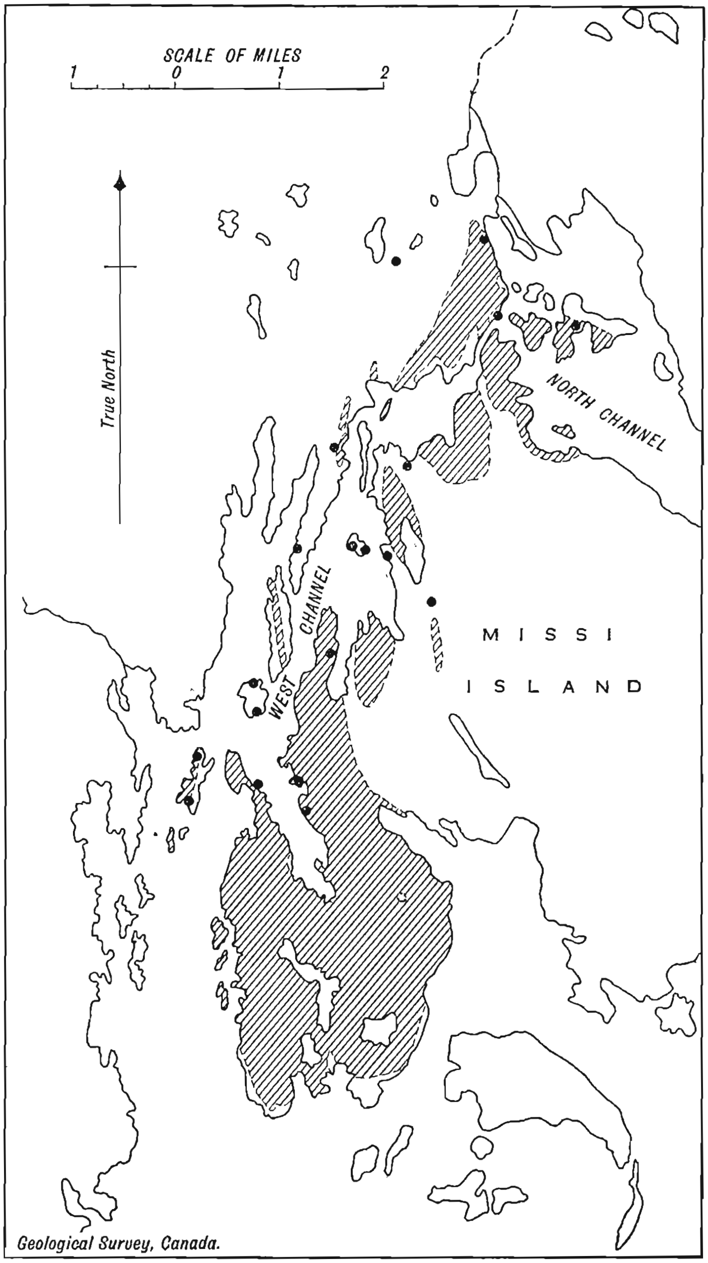


Figure 9. Main bodies of quartz-feldspar porphyry in vicinity of West Channel, Amisk Lake; gold deposits are indicated by solid black circles.

PRE-MISSIAN (?) GRANITE

Certain bodies of granite on Lookout and adjacent islands at the northeast corner of Missi Island cut the Amisk lava but appear to be older than the Missian sediments. This granite was studied in detail and the situation of the granite bodies is indicated on Figure 10, together with structural sections of a possible interpretation of the relations of the rocks at this locality.

The granite is pinkish to grey, and in many of its outcrops appears massive. Some of the rock is a quartz-feldspar-sericite schist, and the abundant flakes of white mica on the broken surface of even the most massive-appearing granite indicate that it has been slightly schistified. Small eyes of dark quartz are abundant in the schistose granite, also granulated crystals of both white and pink feldspar. In places the granite is jointed and the rock breaks in large slabs. Some of the schistose granite is cut by vein quartz, veins of green epidote, and aplite. No pegmatite was seen. The lava surrounding the granite is cut by many dykes of white and pink aplite and medium-grained granite. Inclusions of lava occur locally in the granite.

The contact of the Missian conglomerate and granite was found at two localities, the one on the island just west of the southwest point of Lookout Island, and the other on the island to the north of the northeast corner of the same island. An interpretation of the relations of the conglomerate to the granite at the former locality is indicated in section EF of Figure 10. The conglomerate here is pinkish and has the appearance of the granite, except for the presence of a few pebbles of black lava and grey schist. This material is not bedded and it may be a mass of disintegrated granite to which a few pebbles of lava and other rocks have been added. This granitic-like conglomerate, about 5 feet thick, is well exposed in a vertical face on the east side of the island. Upward it passes within 3 feet into typical grey arkosic conglomerate, and downward, just above the water level, into schistose granitic rock, similar in appearance to the matrix of the conglomerate, except that no pebbles of black lava were seen in it. The line of demarcation between the material with pebbles and without is fairly sharp. The schistose granitic rock outcrops on the high ground in the centre of the island, but here the rock is largely covered with moss and drift, and no outcrops were found along the contact.

At the second locality on the island north of the northeast corner of Lookout Island, the contact of granite and conglomerate is exposed about 50 feet along its strike and dips nearly vertical. The line of junction of the two rocks is fairly sharp and definite, and the granite is not noticeably finer grained at the contact than a few feet within the mass. It is a pinkish, medium-grained, slightly schistose rock. The conglomerate is grey, arkosic, and of the same general character as some of the beds in contact with lava. At some points, the granite, for a few inches away from the conglomerate, is broken into thin fragments 2 inches long and surrounded by a matrix of schist. No definite evidence could be found at this locality to prove the age relations of the granite to the conglomerate. The granite, however, is identical in character with the rock of the nearby masses, and, if one mass is older, the others also may be older. The rocks along the line of contact have been so schistified that it is difficult to determine

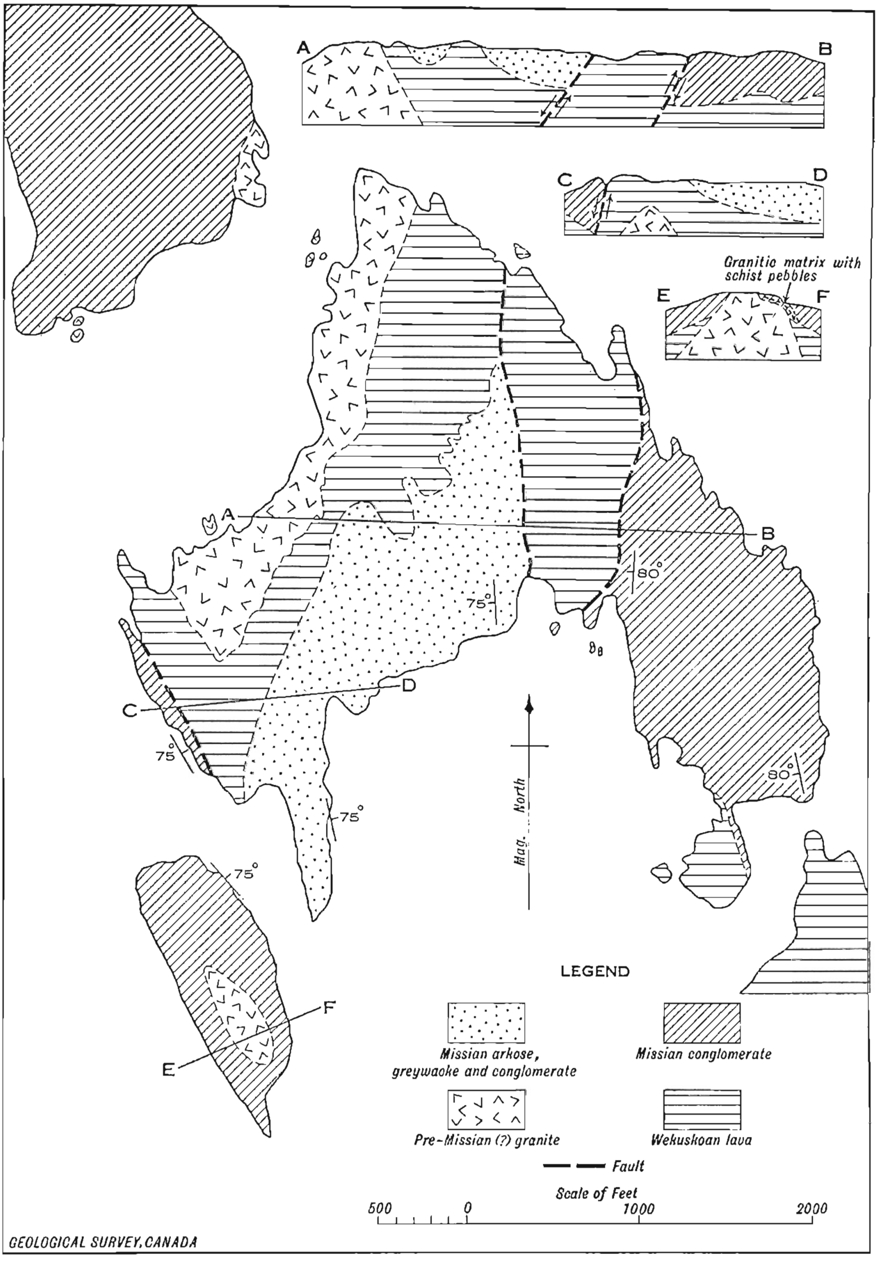


Figure 10. Lookout Island, Amisk Lake, Saskatchewan.

definitely the original relations. It may be that here practically all the disintegrated granite was carried away, and the typical arkosic conglomerate rests on the granite just as it does on the lava, whereas, at some points, the character of the conglomerate indicates that it was derived for the most part from the adjoining lava and on the island perhaps from an older granite.

Other facts suggesting that the granite bodies at this locality may be older than the conglomerate are: the abundant dykes of granite in the lava and their absence in the adjoining conglomerate; the pebbles of granite in the conglomerate that are identical in appearance with the rock of the nearby granite masses; and, further, some of the granite pebbles are crossed by veinlets of quartz and green epidote, as is some of the nearby granite. Veinlets of epidote are not abundant in the granite of the area, and their presence in this supposedly older granite, and also in the pebbles of granite in the conglomerate, is strong evidence that these pebbles were derived from the bodies of granite nearby. To the northwest, south of Portage Lake, the granite cuts the Missian sediments, but where Missian strata are absent it is impossible to distinguish the later granite from the older. The large granite body on Missi Island and only $1\frac{1}{2}$ miles southwest of Lookout Island may be either older or younger than the Missian.

In conclusion, although the evidence presented strongly suggests that the granite on Lookout and nearby islands is older than the Missian conglomerate, the possibility that it is a younger intrusive granite also must be considered. The pebbles in the granitic matrix may be relics from a bed of conglomerate that was injected by a magma and almost completely made into granite. The evidence from the study of the two localities where the contact of granite and conglomerate is exposed thus is not definite enough to prove beyond question the age relations of these two rocks. Granite intrudes Missian quartzite at other localities to the northwest and here the younger age of the granite is easily proved. Until more extended and detailed field work is completed, the pre-Missian age of the granite on Lookout and nearby islands, therefore, must be considered doubtful.

MISSIAN SEDIMENTS

These are grey to dark grey, thick-bedded sediments. The basal member is a conglomerate without good bedding and consisting of boulders of granite, lava, quartzite, jaspilite, and vein quartz in either a chloritic greywacke or an arkosic matrix. Grey and pinkish arkose lies above the conglomerate at some localities, and these thick-bedded, massive rocks may carry thin layers of conglomerate with small, round pebbles of granite. Some layers are crossbedded. The bulk of the series is grey, thin-bedded quartzite and greywacke. The fresh surface of some quartzite is dense and almost black, with little evidence of other minerals except glassy quartz. Some of these beds weather white and others light grey. The greywacke on the average is coarser grained than the typical quartzite or arkose and bits of feldspar, biotite, hornblende, abundant chloritic material, and some calcite are scattered amongst the quartz grains. Missian sediments are well exposed from Lookout Island northwest to and beyond the west side of the map-area. Along the strike to the northwest, however, the sediments change in character to fine-grained, dark grey quartzite and black, clayey, quartzose types, some beds of which are recrystallized to quartz-mica-garnet schist and gneiss. No basal conglomerate was seen northwest of Grassy Bay. Northwest from Neagle Lake Missian quartzite, arkose, and greywacke are recrystallized to garnet-bearing gneissic rocks, and massive, thick-bedded quartzites in the area east of Tyrrell Lake pass into gneissic quartzite west and northwest of that lake. These continue westward to south of Judique Lake and there turn northwest and north passing west of Wildnest. The greywacke and other types of sediments with the quartzite are completely recrystallized to quartz-mica-garnet gneiss.

North of Lookout Island, the Missian sediments lie along a syncline within the Wekuskoan lavas, and at many points the basal beds are of chloritic materials derived from the nearby lava, or, if the matrix is arkosic, large blocks of lava are present in it. A narrow body of conglomerate lies within the lava south from the long, narrow, south bay of Wolverine Lake, and perhaps represents an outlier. If so, the conglomerate was deposited on an irregular surface of the lava. The Missian sediments locally are closely folded. Over large areas, however, the beds dip at angles of from 20 to 60 degrees. The sediments are altered to schist along some zones and are also drag-folded. The pebbles in some of the conglomerate are elongated; in some beds granite pebbles may be only 2 inches thick and $2\frac{1}{2}$ feet long. Some of the pebbles are bent with the matrix in drag-folding. Where the basal conglomerate is absent and the quartzite and greywacke rocks are recrystallized and closely folded with the lavas, it is impossible to prove an unconformity between the lavas and Missian sediments. The Missian strata are cut by granite and some schist bodies in these sediments carry gold-bearing quartz.

BASIC AND ACIDIC INTRUSIVES

Norite, Gabbro, and Diorite

The Wekuskoan lavas and sediments are cut by small bodies of medium to coarse-grained rock that are black, massive, and whose minerals are fresh or only slightly altered. In the coarse-grained types, the abundant minerals are labradorite and augite. In some specimens, green hornblende and brown biotite are present. Specimens from bodies about a mile west of Meridian Creek at a point about $1\frac{1}{2}$ miles south of Table Lake, and at the east end of Errington Lake, contain hypersthene in addition to augite and hornblende, and are norites. The large body of gabbro extending north on the point west of the Amisk Gold Syndicate's property is of a hornblende-rich rock. The high hills west of the outlet creek and at the northwest corner, respectively, of Grassy Lake are of fine-grained diorite. The minerals of these rocks are more altered than those of the average basic rock of this group. The altered diorite of the body west of the outlet creek carried abundant scattered grains of pyrrhotite.

Some of the masses of basic rock are cut by dykes of granite, and these rocks are interpreted as early basic phases of the magma that later consolidated to form the large bodies of granite of the area. The basic rocks were not seen in contact with the Missian sediments about Amisk Lake, but if they represent early phases of the granite, which intrudes the Missian, they are also younger than the Missian. Certain long, narrow bodies of black, coarse-grained, plagioclase-augite-hornblende-garnet rocks in the gneisses about Wildnest Lake and elsewhere are interpreted as recrystallized basic intrusives, probably of the same age relations as the fresh basic rocks about Amisk Lake.

Feldspar Porphyry

The quartz porphyry on the west shore of Missi Island is cut by many dykes with white-weathering crystals of plagioclase in a black, schistose matrix. Some of the plagioclase crystals are half an inch long, and have their corners rounded. Narrow dykes appear to have as large feldspar crystals as the larger bodies. The dykes are of variable width; one narrows from 50 feet to 8 feet within 50 feet along the strike. No dyke was traced over 400 feet along its strike. The dykes have very sharp contacts against the country rock and they appear to represent fillings along irregular fractures.

The porphyritic dyke rock is massive on its fresh surface, but the minerals are altered. The large crystals of feldspar are crossed by cracks and, in part, have gone to calcite, white mica, and biotite. Flakes and irregular patches of biotite are abundant in the matrix of greenish chloritic material, small grains of quartz and feldspar, and needles and grains of arsenopyrite, pyrite, and magnetite. Dykes of this character cut the quartz-feldspar porphyry near a few of the prospect pits where some gold has been found, and similar looking dykes cut the sediments near the Amisk Gold Syndicate's property. The age relation of these dykes to the granite is not known. Their distribution immediately in front of the west end of the Missi Island granite body suggests that they may be related in origin to this intrusion.

Granite, Granite-Gneiss, Syenite, Granodiorite, and Quartz Diorite

The granitic intrusives are in large and small bodies and in some the rock is remarkably uniform in appearance throughout, whereas in others it is variable from point to point. The rocks of the same body are both massive and foliated; no regularity in the two types could be determined, although in some bodies foliated rocks are more abundant near the margin than elsewhere. Some bodies of granite, as the southern part of the one north of Annabel Lake, present a remarkably uniformly layered or pseudobedded structure owing to well-developed, parallel joint planes dipping at from 10 to 40 degrees north or towards the centre of the mass. The contact of the granite masses against lava or sediments is sharp, although dykes of granite may be present in the country rock for a half mile or more from the main body, and inclusions of country rock locally extend an equal distance within the granite body. In places the country rock is recrystallized, the lava to a medium-grained, hornblendic, dioritic rock and the sediments to schists. West of Duck Lake the sediments adjoining are recrystallized to garnet and chiastolite schist for at least one-half mile away from a V-shaped projection from the granite mass. The wall of many bodies of granite dip steeply and parallel the dip of the schistosity or foliation of the surrounding rocks. The outlines of the granite bodies at most localities follow closely both the strike and dip of the structures of the older rocks.

The granite of the several different bodies typically is grey to pinkish grey and even granular. The mass east of Amisk Lake and extending northwest to Portage Lake is pinkish grey, many outcrops with lenses of quartz up to one-quarter inch long. Some of it is porphyritic with crystals of white and pinkish feldspar up to one-half inch long. This granite, near its contact with lava, has abundant hornblende and little quartz. It is in contact with Missian quartzite and is younger than this series. The mass between Meridian Creek and Amisk Lake is variable in mineral content; some of it is grey granite, other parts are porphyritic, and some parts are of diorite and gabbro. The granite of the body on Missi Island is uniform in mineral content and massive, medium to coarse grained. Around the margin the rock is fine grained and schistose; small masses beyond its east end are in part altered to quartz sericite schist. The roughly circular granitic body west of the north end of Amisk Lake and extending to Neagle Lake is variable in texture and mineral content, especially along its west margin, where large areas are of granodiorite. The granitic body extending northwest from Sturgeon-weir River includes large areas of granodiorite, quartz diorite, and syenite. The granodiorite and quartz diorite phases are black, medium-grained rocks carrying abundant grey plagioclase and black hornblende. No sharp line of contact could be found between these more basic rocks and the normal pinkish granite. Pink, coarse-grained syenite is well exposed on the ridge west of the creek crossing the northeast corner of the Sturgeon-weir Indian Reserve. Fairly large masses on Sturgeon-weir River, west of the creek leading to Wolf Lake, are of pegmatitic granite.

North of Annabel Lake and in the vicinity of Wildnest, Cotteral, and Mari Lakes, the granite bodies are long and narrow and the typical rock is fine to medium grained. Long, narrow bodies of the older gneisses lie within these granitic rocks at some localities. In some places, as in the large mass west of Cotteral Lake, massive, coarse-grained granite, grey to black granodiorite and diorite, and aplitic granite locally carrying red garnets, are intermixed. Much of the fine-grained or aplitic rock presents a layered or bedded appearance. This rock, at some points at least, cuts the gneissic country rock. These peculiar, quartz-rich, gneissic rocks perhaps might be designated granulites. They form mappable units, and over areas a mile or more across are uniform, whereas in other parts of the body the rocks are of variable texture and composition. A large area of coarse-grained and pegmatitic granite lies southeast of Cotteral Lake.

Lamprophyre and Pegmatite

Dyke rocks of various types are included in this group. Some of them cut the granite; others cut the Missian sediments. The age relations of many of the different dyke rocks included, however, are not known with reference to each other. Narrow, irregular-outlined dykes of black hornblende and mica rocks are abundant within and around the margin of the granitic mass east of Neagle Lake. Other dykes of hornblendic rock cut the Missian conglomerate and arkose on Lookout Island and at several localities to the northwest. Dykes of similar-appearing grey and black rocks cut the Amisk lava, especially south for 2 or more miles from Wolverine Lake. A few, irregular-outlined dykes of black and grey rocks cut the body of Wekuskoan sediments extending north from the Amisk Gold Syndicate's property to or beyond Duck Lake.

Dykes of pegmatite are not known about Amisk Lake, but are numerous at some localities in the gneisses north of Annabel Lake. Very large masses and wide dykes of pinkish and white pegmatite cut the gneisses south and southwest of Wildnest Lake. Pegmatite, in small, irregular-shaped masses, also cuts the gneiss on Mari Lake and west to Cotteral Lake. The fine-grained aplitic granite and gneiss are cut by pegmatite. The pegmatites are believed to be the youngest Precambrian rocks in the map-area. They have not been examined in detail for the rare minerals associated with some pegmatites in other areas.

DESCRIPTIONS OF MINERAL PROPERTIES

The descriptions in the following pages are confined almost entirely to the gold prospects that have been reinvestigated or discovered since 1931, for the walls of trenches made prior to this date are so slumped that little can be seen. In addition to the gold-quartz deposits, occurrences of arsenopyrite, of pyrite or pyrrhotite carrying some gold and copper, and of asbestos, are known, but as the whole activity in the area at present is directed towards the discovery and exploration of gold ore, the deposits of other minerals will be mentioned only briefly.

Two main types of gold ore are known: (1) bodies of vein quartz carrying free gold and small quantities of sulphides; and (2) bodies of schistose rock carrying disseminated sulphides, quartz, and gold, in part free but largely associated with the sulphides. The gold-bearing quartz bodies are mostly in the Amisk lavas and the lavas and interbedded sediments of the Wekuskoan. Only a few occurrences are known in the Missian sediments, and a short distance within the margin of a few of the granite bodies. The quartz bodies lie along highly schistose zones in these rocks; they are irregular in shape and their outcrops are not extensive. Small areas of the large quartz masses carry abundant free gold, and some small lenses of quartz are spectacularly rich in free gold. The schist adjoining and within the quartz carries more sulphides than the quartz, but in practically all cases the gold content of mineralized schist is very small.

The schist bodies of the second group and carrying disseminated sulphides and quartz are mostly in the quartz-feldspar porphyry, only a few, as the Amisk Gold Syndicate deposit, are in the lava. They are wide bodies of rock that has been intensively jointed, slightly schistified, and mineralized with pyrite, arsenopyrite, and quartz. Some of the quartz is in stringers and lenses along joint planes, but in some of the rock it is evenly distributed as if the whole mass had been penetrated by solutions rich in silica. The large body, however, is not uniformly mineralized, the more massive parts carrying only small quantities of sulphides and quartz. Samples from narrow areas of more highly schistified and mineralized rock are reported to carry enough gold to be an ore, but, up to 1932, not enough systematic sampling had been done to demonstrate that a large body of this mineralized rock will average high enough in gold to be mined profitably.

A more detailed description of the two main types of gold deposits will be presented in the following sections. To do this advantageously the area studied will be divided into four main parts as follows: (1) east side of Amisk Lake from Meridian Creek north and northwest to Annabel Lake; (2) west channel and northward; (3) Errington and Neagle Lakes; and (4) Wildnest, Tyrrell, Cotteral, and Mari Lakes.

EAST SIDE OF AMISK LAKE FROM MERIDIAN CREEK NORTH AND NORTHWEST TO ANNABEL LAKE

General Geology

In this prospecting belt, Amisk lavas of the Wekuskoan are the most widespread formation. At the northeast end of Amisk Lake and to the northwest the lavas are overlain by large bodies of Missian sediments. Both the Amisk and Missian strata are folded and altered to schist over wide areas, and along narrow zones to highly fissile, chloritic and sericitic schists. The gold deposits are along the narrow schist bodies, both in the Amisk lavas and the Missian sediments. Small bodies of intrusive rock, including norite, gabbro, black and grey lamprophyre, feldspar porphyry, and granite cut the lavas and sediments, and locally these intrusives are abundant. A large body of granite forms the east boundary of the area and the lava adjoining this mass is in part recrystallized to a medium-grained, massive, dioritic-appearing rock, and hornblende schist. The granite and feldspar porphyry of many of the small masses within the lava are altered to quartz-sericite schist. Some of the gold-bearing quartz is in the schistose granite of these small masses and in the adjoining lava.

Most of the prospecting on the east side of Amisk Lake has been done from Mosher Lake northwest to the portage from Grassy to Portage Lakes. Some work has been done south from Mosher Lake, but apparently no gold occurrences of importance have been found.

Descriptions of Deposits

Graham (1).[1] This property was staked in 1915 by Mr. R. Graham, and during the succeeding years two deposits were explored by trenches, and the prospect shaft was sunk 35 feet in the deposit farther east. Work was again undertaken during the late summer of 1932, financed by the Emmett-Irving-Kenward Company of Duluth, and a 10-ton unit of a mill was to be built.

The bedrock in the property is Missian conglomerate, arkose, and quartzite. The north deposit near the northwest corner of the Mother Lode mineral claim is in conglomerate, and the one about 2,000 feet to the southeast in the Chigagoff mineral claim is in quartzite, with beds of conglomerate. The beds dip steeply and some of them are drag-folded. Southwest of the deposit, the line of junction between quartzite on the south and conglomerate, arkose, and quartzite on the north is a definite, drag-folded and schistified zone, and the conglomeratic beds may have been brought to their present position, with respect to the large body of quartzite to the south, by faulting.

The deposit on the Mother Lode mineral claim is exposed across a trench 33 feet long, and the thin mantle of overburden has been completely stripped for 60 feet along the strike. The conglomerate is highly schistified and many of the granite pebbles are squeezed to long, narrow bodies resembling in appearance dykes of injected granite. The vein quartz apparently lies near the axis of an anticlinal drag-fold plunging about

[1] The numbers following the names of the mineral properties are the symbols used on Figure 7 to indicate the approximate situation of the deposits.

35 degrees northwest. The south 8 feet of the trench is about one-half schistose, chloritic conglomerate and about one-half vein quartz, iron carbonate, and pink feldspar. This quartz and schist body carries some pyrite and a little chalcopyrite, and is followed to the north by a quartz vein 14 inches wide, also carrying pyrite, chalcopyrite, arsenopyrite, and free gold. The next 21 feet is conglomerate cut by veins and lenses of quartz. A definite quartz vein, 2½ feet wide, lies near the north wall. At the surface the quartz-bearing schistose conglomerate ends 5 feet north and about 75 feet south of the trench, except for a few small veins near the margin which extend about 50 feet farther along the strike. It may be that the body of schist and quartz lies nearly horizontal and that it plunges northwest with the axis of the fold. If so, the true thickness of the deposit is not nearly so great as that exposed across the trench, and future work, consequently, would be more effective if directed down the axis of the drag-fold.

The deposit on the Chigagoff mineral claim trends slightly north of west and the dip is vertical. The rock is well exposed along the strike for 840 feet. The main trenches and the shaft are near the east end. The vertical shaft follows a quartz body averaging about 3½ feet wide and 60 feet long. This main body of quartz is followed at both ends by a schist body, about 5 feet wide and 80 feet long, well mineralized with narrow quartz veins, veinlets of aplitic granite, pyrite, iron carbonate, and some pink feldspar. The main body of quartz carries small masses of chloritic schist with abundant cubes of pyrite and iron carbonate. The walls of black, micaceous quartzite of the main quartz body are sharp. A narrow, parallel schist body, about 10 feet north of the shaft, also carries some vein quartz and sulphides. Some of the quartz is a greyish, greasy-appearing variety, and it carries pyrite, iron carbonate, and free gold.

To the west along the strike from the main schist and quartz body, the conglomerate is drag-folded and schistified, and there is but little quartz or sulphide up to 430 feet from the shaft, where a schist lens has been trenched for 50 feet along the strike and 30 feet across at its widest point. There is no well-defined quartz vein here, but a series of stringers and irregular-shaped masses, and free gold is abundant in some of these narrow quartz bodies. About 370 feet farther to the west another similar mass of schist has been trenched; it is about 55 feet long and up to 10 feet across. All these bodies of schist and quartz have been thoroughly sampled, and it is reported that small lenses carry enough gold to be an ore. It is planned to mill on a small scale the gold-bearing quartz and to explore this deposit in depth.

Black Prince (2). This deposit is along a depression just south of a small lake, and surface trenching and diamond drilling were done at this locality a number of years ago by those developing the Flin Flon deposit. Massive, basaltic and andesitic lavas form the hills on both sides of the depression, and the rock along its floor appears to be fine-grained lava with bedded rocks, probably tuff, cherty tuff, and greywacke. The strata exposed in the trenches are dark grey, banded types, perhaps a cherty tuff or else a highly schistified and silicified andesite. Some layers are black and hornblende-rich. The deposit is 60 feet wide in one trench, and is exposed in four trenches for about 310 feet along the strike, passing under drift at both ends. The rock in the trenches is brecciated and schistified and carries lenses and veins of massive pyrite (one of which is $4\frac{1}{2}$ feet wide) and also scattered grains of the sulphide. The massive white pyrite is somewhat similar in appearance to that of the Flin Flon massive ore. Very little chalcopyrite could be seen in the material on the dumps. Vein quartz is scarce and the gold and copper content of the large body of rock and disseminated sulphide is not known. No exploration has been done at this locality in recent years.

Sye (3). In 1931 Mr. A. C. Symons staked the three Sye mineral claims near the south of Wolverine Lake. Some trenching was done to explore wide bodies of schist in basaltic lava that carried stringers of quartz, and iron carbonate and some pyrite and arsenopyrite, but no body of such material proved to be a gold ore. In July, 1932, Mr. Symons discovered a small body of quartz with abundant free gold south of the original holdings, and a large group of mineral claims was staked. Near the end of August, seven trenches exposed the new deposit. The wall-rock is pillow lava cut by grey to black lamprophyre dykes. The body of chlorite schist is exposed 140 feet along its strike. To the north it passes under deep clay, but to the south it may extend 1,000 feet or more, as in this direction two small outcrops of schist lie along the projected strike. At one point the schist body is exposed across 14 feet. The main quartz body averages about 14 inches wide and is 62 feet long. It is bordered by from 1 to 6 feet of schist carrying quartz stringers, and the schist along the strike for 50 feet beyond each end also carries quartz. In the farthest north trench, quartz was not abundant. Some of the quartz is white and granular. In certain pockets coarse free gold is very abundant and specimens will assay $1,000 or more a ton in gold. In exploring the deposit, the high-grade material might be shipped to the smelter at Flinflon to cover the cost of the work. Although the outcrop of the deposit is small, it warrants more careful prospecting and sampling than it had had up to the end of August, 1932.

Mr. C. M. Mitchell holds a group of claims to the west of Wolverine Lake and adjoining the Sye group. On his property wide bodies of chlorite schist have been trenched. Vein quartz is erratically distributed throughout the schist, but no large body of quartz and mineralized schist was found that had the appearance of a probable gold ore. These and other bodies of schist about Wolverine Lake have not been sampled systematically. Some rusty zones are reported to pan gold, and vein quartz is widespread in the schistose lava at this locality. Prior to 1915, some trenching was done on a large quartz-bearing schist body northwest of Wolverine Lake. This deposit is along the contact of Missian conglomerate and basaltic lava. The trenches are slumped and the rock is weathered rusty.

Amisk Syndicate (4). In 1928, Mr. James Hayes staked a group of thirty-seven mineral claims, between Mosher and Amisk Lakes, for himself and associates. Most of the prospecting has been near the shore of Amisk Lake, south of the entrance of the bay leading to Wolverine Lake. This consists of trenches and pits across wide schist bodies and a tunnel about 40 feet long into the side of the hill from just above the water-level of Amisk Lake.

The bedrock is well exposed along ridges of bare rock and comprises thick flows of basaltic lava with layers of coarse tuff, up to 100 feet thick, between some of the flows. A narrow body of Missian conglomerate lies within the lava extending south from about 2,000 feet south of the south bay of Wolverine Lake. The lava flows stand nearly vertically and are cut by dykes of lamprophyre and very small bodies of schistose, fine-grained granite.

The main work on the group has been along the body of schist on the hill back of the tunnel. The surface schist here is weathered rusty, and the fresh rock carries iron carbonate, pyrite, arsenopyrite, and some vein quartz. It is cut by lenses and stringers of grey, schistose granite that carries vein quartz and pyrite. The pyrite and quartz appear to be more abundant in the schist adjoining the granite. The main schist body is 50 feet wide, is exposed 400 feet along the strike, and perhaps continues for a great distance both to the north and south. There appear to be three narrow zones across the main mass wherein the rock is more highly altered and carries more vein quartz and sulphides than in the intervening areas. The tunnel was driven to get at the fresh rock below the rusty capping and it exposed schistose, tough basalt carrying disseminated pyrite in grains and cubes, a few bits of arsenopyrite, and quartz veins, up to 4 inches wide, that follow joint planes. Some of the veins are not continuous, even across the roof of the tunnel. In two areas, each about 2 feet wide, the quartz veins are closely spaced, the vein quartz being scarce in the intervening rock. The quartz is a dark variety, and carries granular pyrite; this quartz is reported to carry gold. Several additional bodies of schist on the property have been trenched, and are similar to the one on the hill at the tunnel. Undoubtedly the gold is associated in distribution with the vein quartz and sulphides, hence it is useless to continue trenching the large bodies of soft schist, and future prospecting on the property should be confined to the location and detail study of only those parts of schist bodies wherein vein quartz and sulphides are fairly abundant.

Derby (5). In 1929, Dixon Mines, Limited, acquired a large block of mineral claims on the north side of Missi Island and did some trenching along a wide sulphide-bearing zone in andesitic lava cut by porphyritic granite. The property was soon abandoned, but, in 1931, it was re-staked by Shorty Russick and associates. A trail, about a half mile long, leads from the northwest channel south to the cabin. The main pits are about 300 feet east of the cabin, where a large body of jointed and schistified andesite carries pyrite, a little vein quartz, and some chalcopyrite. The andesite is cut by dykes of granite porphyry and, for about 700 feet to the southwest of the trenches, bodies of granite and andesite alternate, south of which granite is the predominant rock. Several small pits and trenches expose a schist body, up to 3 feet wide and 150 feet long, in granite adjoining an andesite inclusion along the contact of the andesite and granite. Vein quartz carrying pyrite is $1\frac{1}{2}$ feet wide at the bottom of a pit 6 feet deep, but, at the surface, and in all the other trenches, the quartz is only in stringers. A quarter of a mile north and a little west of the east end of the small lake southwest of the cabin, a pit 6 feet wide and 4 feet deep exposes a body of quartz 4 feet wide. This deposit is in a small body of schistose granite that carries abundant pyrite. The quartz is white and granular. Much of the rock at this locality is covered with moss. The body of schist and quartz apparently is fairly large, and, if it carries gold, more trenching in both directions along the strike from the main pit is advisable.

Mosher Lake (6). Gold-bearing quartz was discovered on Mosher Lake in 1914 and some trenching of the deposits was done at that time. The deposits have not been re-investigated in the past two years. At the entrance to the northeast bay, a trench, 10 feet deep and 20 feet long, exposed a body of chlorite schist and vein quartz carrying pyrite, iron carbonate, and some chalcopyrite. Within 100 feet along the strike to the north the schist body narrows and passes into more massive lava, and, 50 feet to the south, it passes under the water. One body of white quartz near the foot-wall side of the schist body is 2 feet wide and 30 feet long. Across the 20 feet in the trench, vein quartz is about one-third as abundant as chlorite schist. The quartz is in narrow veins, trending in various directions, and veinlets and small pockets. Much of the quartz does not carry sulphides and no free gold was seen.

On the west side of Mosher Lake, a shallow shaft and a trench expose a schist body 15 feet wide and 200 feet or more long. Four feet of the schist adjoining the foot-wall is stained rusty, and this carries lenses and disseminated vein quartz. Pyrite, arsenopyrite, and iron carbonate are fairly abundant in certain small bodies of the schist. The rusty capping is reported to pan gold, but the whole body is not uniformly mineralized, and the average gold content is not known across the width of the most highly mineralized section of the schist body. Other schist bodies, similar to the two prospected, outcrop along the shore of Mosher Lake, but these have not been trenched.

Ruth Lake Asbestos (7). In 1930, Mr. Hector Campbell and associates staked a group of mineral claims about the north end of Ruth Lake and did some trenching to expose an occurrence of asbestos. The title to these mineral claims had lapsed prior to 1932.

The pits are on the east shore of Ruth Lake, about 1,500 feet south of its north end. The east shore of this lake is remarkably straight and is formed by a steep hill of massive, coarse-grained basalt. Fine-grained andesite outcrops on the islands in the lake, and on the west shore at the north end. Basalt is abundant on Konuto Lake about a mile west of the pits. A narrow, deep valley continues a mile or more north and south beyond both the north and south ends of the east side of Ruth Lake, and perhaps the straight east shore, and this valley follows a fault plane between basalt on the east and andesite on the west.

The deposit on the east shore of Ruth Lake is exposed by two pits on a narrow shelf on the face of the hill, and just above the water-level. The rock on top of the hill is medium-grained, fairly massive basalt. This rock is crossed by well-defined joint planes running at about north 45 degrees east, magnetic. The rock in the pits is a bluish black to black serpentine crossed by closely spaced joint planes with smooth surfaces. Veinlets of white and grey carbonate, and others of green serpentine, follow some joint planes. The rock is a dense aggregate of fibrous serpentine, crossed by veinlets of carbonate, and no trace is left of its original texture or minerals. This serpentine is also crossed by seams of chrysotile asbestos, up to a half inch wide, the majority being about a fifth of an inch wide. These veinlets are discontinuous along their strike and show no regularity of trend. In the south pit, the asbestos-bearing serpentine is exposed from the water-level back 14 feet. Across parts of this width the asbestos veins form a third of the rock and for the whole body they are estimated to be about one-tenth. In the pit to the north, the mass is exposed across 8 feet and here there is more of the brittle picrolitic mineral than the pliable chrysotile. The chrysotile fibres of some veinlets are broken by a central crack that is parallel or nearly parallel to the walls, and the fibre is bent along this plane. No basic intrusive such as peridotite or dunite was seen near the pits, although the lavas to the south about Table Lake and west of Meridian Creek are cut by a mass of norite. The serpentine and asbestos may have formed from the lava along a fault plane. Serpentine carrying some asbestos outcrops at two other points on the east shore of Ruth Lake and apparently this asbestos-bearing body of rock is fairly extensive along its strike. Some of the material in the pit is good quality asbestos suitable for the manufacture of roofing products. The work done to date is insufficient to prove if there is a large body of material similar to that exposed in the south trench. At present, the asbestos deposits in Black Lake-Thetford area, Quebec, can more than supply the market in Canada for asbestos products; there is, therefore, little encouragement to develop this deposit.

WEST CHANNEL AND NORTHWARD

General Geology

The majority of the gold discoveries about Amisk Lake are along the west channel. The bedrock here is lava flows with interbedded sediments of various types. The rocks vary markedly in character within short distances across their strike. The strike of the flows and beds of sediments is near north and south and their dips from 45 to 80 degrees west. This area of lavas and sediments is from 4 to 6 miles wide and many of the gold discoveries are between the body of granite in the central part of Missi Island in the east and the large mass of granite and granodiorite about 3 miles west from the northern part of the northwest channel. Many small bodies of intrusive rock, ranging in mineral composition from very fine-grained, acid quartz porphyry to basic gabbro cut the lavas and sediments in the area between the two granite bodies. Many of the gold deposits are in bodies of the very fine-grained quartz-feldspar porphyry and near bodies of feldspar porphyry. The deposits are in bodies of jointed and schistified rock, and, in some, vein quartz is abundant, whereas, in many, the gold ore is schist carrying sulphides with only stringers and lenses of quartz.

Descriptions of Deposits

Amisk Gold Syndicate (8). This property is controlled by Mr. J. M. Iles and associates of London, England, and it comprises some thirty mineral claims, in two main groups. Most of the prospecting has been done on the June 4 mineral claim, near its east side. This and other nearby claims were staked in 1929 by Mr. George Chatten, and the present holders became interested in this property in 1930, when they were investigating showings to the east on Gull Island and owned by Mr. J. A. Cox and associates. Surface work was commenced in 1930, and No. 1 shaft was sunk 125 feet on an incline of 45 degrees, and No. 2 shaft, 225 feet to the south, is down about 30 feet on the incline. The surface showing has been exposed along the strike by shallow trenches, and, during the summer of 1932, some crosscutting and drifting at the 105-foot level in No. 1 shaft, and trenching to the north of this shaft were in progress. Mr. George Bottoms is in charge of the field operations and all the work had been done by hand.

Figure 11 presents the general geology of the part of the property on which most of the work has been undertaken. The trenches expose andesite largely altered to chloritic schist, in some places intricately drag-folded, and in others altered to a banded, hard, quartz-bearing, dark grey to black rock. The black, andesitic lava on both the east and west sides of the point is largely altered to schist. The sediments, forming the high, central area of the point, are in part thick-bedded, grey types, with thin layers of well-bedded, cherty rocks. They are fine-grained arkose, greywacke, and impure and cherty quartzite. Some beds are tuffaceous in character and other non-bedded grey rocks have markings resembling flow lines and cavities that may have been amygdules, suggesting that thin flows of acid lava are interlayered with these sediments. The minerals of both the lavas and sediments are altered, in part, to green, chloritic minerals and green biotite. In the specimens examined, the original texture and minerals are destroyed. The sediments are cut by small, irregular dykes of grey to black rocks. One fairly large body of a slightly porphyritic grey intrusive cuts the foot-wall greywacke just north of the main body of gold-bearing schist. Some of the dykes are hornblende-biotite lamprophyre.

The strike of the contact between greywacke-like sediments forming the foot-wall of the schist body and the lava on the west is irregular. This appears to have been a zone of movement during the deformation of the strata, consequently, the adjoining rocks, and particularly the incompetent lava, were jointed and schistified against the competent greywacke and quartzite. The main body of schist and the one that has been prospected most extensively lies just north of where the strike of the contact swings from nearly northwest to north. To the south for 2,000 feet from the main workings smaller bodies of schist have been trenched at a number of points. From about 400 feet north of No. 1 shaft, the contact is covered. At No. 1 shaft the schist body is at least 100 feet thick, and to the north a mass of schist at least 30 feet thick is intricately drag-folded. This main schist body is at least 800 feet long, although within it some rock is fairly massive.

No large and continuous body of quartz is exposed in any of the trenches or workings. Certain sections of the black, chloritic schist, however, carry quartz in stringers and disseminated through the intervening schist. Such rock also carries pyrite and arsenopyrite in grains and crystals. Some of the pyrite weathers with a copper stain and a small piece of galena was seen, also a black, soft mineral, probably sphalerite. Some of the arsenopyrite is in white, needle-shaped crystals up to one-quarter inch long. Iron carbonate is abundant in some of the fissile chloritic schist.

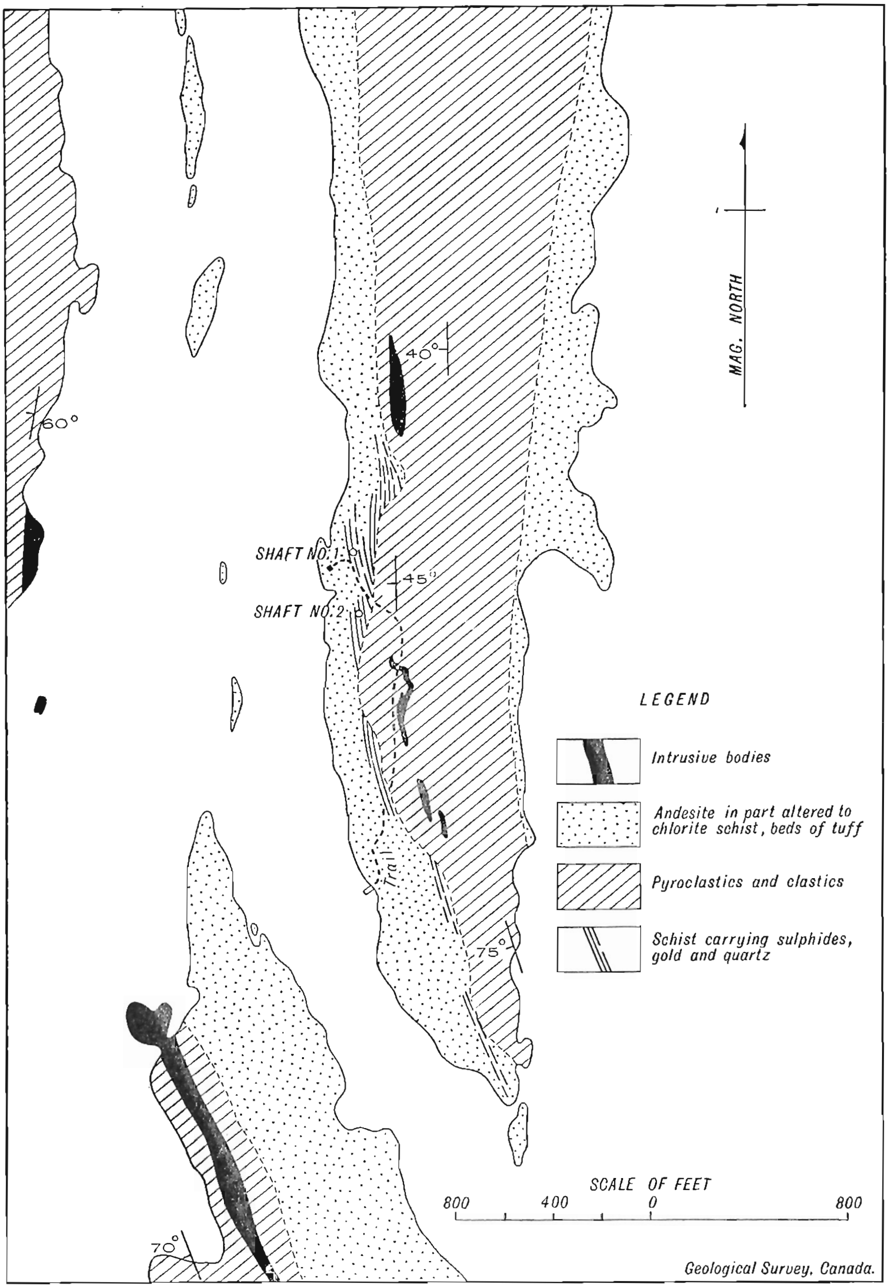


Figure 11. Amisk Gold Syndicate deposit, Amisk Lake, Saskatchewan.

The main quartz and sulphide-bearing zones within the schist trend at an angle to the strike of the contact between the lava and sediments. No free gold was seen in the quartz, but all the rusty capping pans gold in very fine grains. Much of the gold may be associated in distribution with the sulphides, and particularly the arsenopyrite. Before undertaking additional surface work, the gossan should be panned in short sections to determine those parts carrying the most gold, and the gossan here removed to determine the grade of the underlying, fresh schist.

No. 1 shaft was commenced on the hill-side near the south edge of a body of highly mineralized lava about 9½ feet thick. This is well exposed on the sides and on the hanging-wall of the inclined shaft, and it is reported to carry on the average about $13 in gold a ton across 5 feet. At 105 feet down the dip, a crosscut was extended 8 feet in the hanging-wall, and by August, 1932, the drift was extended south about 10 feet. No definite quartz vein was found, only stringers of dark-coloured quartz in a hard, brittle, well-jointed, black andesite carrying abundant disseminated quartz and sulphides. The main body of gold-bearing schist here appears to trend at 30 degrees west of north, magnetic, and at an angle to the long axis of the body of schist. In No. 2 shaft, dark grey and black, massive and schistose andesite carries some quartz and sulphides.

In highly fissile schist, the quartz is white and in narrow, parallel bands, and iron carbonate is abundant. This material carries only a small quantity of gold; the best gold ore appears to be the jointed and schistified, hard andesite that is uniformly mineralized with sulphides and grey quartz.

In conclusion, this property is along a structure that may have continuity, both in depth and along its strike, beyond the limits at present explored. As the material is weathered to a rusty schist at the surface, all trenches should be extended to fresh rock before sampling. If the section exposed in the present No. 1 shaft and the few trenches reaching unweathered rock between No. 1 and No. 2 shafts will assay on an average $8 in gold across 4 feet, the deposit probably should be drilled to get several complete sections of the schist body at depths of 200 feet or more.

Sonora (9). This group of eight mineral claims was staked in 1931 on Waverly Island by Messrs. Shorty Russick, John Hyslin, Rudolph Singbeil, Roy Besler, and Richard Nelson. This ground has been held by a number of parties since 1914, and extensive trenching has been done at three localities, and some diamond drilling at two points. In 1932, the recent stakers completed a trench about 100 feet long, 12 feet wide, and 10 feet deep at the west side of the island near its south end.

Black andesitic lava extends from the east shore to over half-way across the island, to be followed to the west by a grey, fine-grained rock that carries small inclusions of black schist and probably is a highly altered quartz-feldspar porphyry. The strike of the schistosity of both the lava and intrusive porphyry is about north, and the dip nearly vertical. The andesite on the east side of the island is cut by small bodies of pinkish, grey, highly schistose granite, and at the southeast corner by fairly massive, medium-grained, feldspar porphyry.

Near the north end of the island, one pit and four trenches expose chloritic and sericitic schist carrying iron sulphides and vein quartz. In the pit 12 feet deep and near the west shore, 10 feet of jointed and schistified rock carried abundant sulphide and some vein quartz. Here the andesite across about 2 feet is cut by stringers of aplitic granite and vein quartz and sulphides are more abundant in this part of the exposure than elsewhere. The joint planes in the more massive andesite are slickensided, and seams of clay material occur in much of the rock. This deposit was drilled from a point near the water-level to the west. Four trenches on the higher ground to the east expose rusty schist and black, chloritic schist with disseminated pyrite. A quartz vein 2 feet wide is exposed in one trench. It is a white, fine-grained quartz, without sulphides. No trenching has been done along the projected strike of these deposits.

The main trenching has been done on the west side of the island about 1,000 feet from its south end. These trenches are in a body of grey, fine-grained, highly altered, quartz-feldspar porphyry, near its east side adjoining lava. Here a shaft was sunk 10 feet below the bottom of a trench about 90 feet long. The east 6 feet of the trench is in chlorite schist, derived from andesite, and the remainder in a fine-grained, greyish schist, some of it carrying black lenses and streaks up to 3 inches long. Near the west end of the trench, the schistose rock is followed by a fine-grained, slightly porphyritic, grey, granitic rock. At the shaft, a body of greyish schist, about 10 feet wide, carries quartz stringers and disseminated vein quartz, pyrite, and iron carbonate. The rusty material at the surface over this body pans abundant, fine, free gold. Another trench, 200 feet to the north, was made during the summer of 1932, and this exposed 100 feet of grey and black, schistose and massive, highly jointed rock. In it, brown biotite is abundant, also quartz and a few crystals of plagioclase. Grey carbonate and chlorite are the most abundant minerals, and the rock is so altered that its original character is not known. It is assumed to be the fine-grained intrusive porphyry. Across several narrow areas this rock carried vein quartz, pyrite, and some arsenopyrite. The clayey material along the joint planes pans free gold, also the rusty capping. The floor of this trench should be sampled in short sections to determine if certain parts carry enough gold to warrant further work.

A body of arsenopyrite and quartz on the east side of the island, about 300 feet north of the cabin, has been explored by two trenches and a diamond drill hole. The trenches are each about 25 feet long, but their walls are slumped. Specimens of massive arsenopyrite are abundant on the dump, but the sizes of the bodies of massive sulphide are not known. The massive arsenopyrite apparently does not carry sufficient gold to be an ore. Some chalcopyrite is present with some of the arsenopyrite. The bedrock here is andesite altered to a chlorite schist, and this deposit of massive arsenopyrite and quartz is 600 feet north of a small mass of feldspar porphyry. The schist body passes under the lake both to the north and south along the strike. A small pit on the shore about 750 feet to the north exposes chlorite schist carrying vein quartz and arsenopyrite.

Ace (10). This comprises four mineral claims staked by Mr. Roy Besler and associates. The bedrock is fine-grained quartz-feldspar porphyry, some small areas of which are slightly coarser grained than the average rock and in these small phenocrysts of white feldspar are abundant on the weathered surface. The porphyry is intensively jointed and schistified along certain zones, and these carry pyrite and some chalcopyrite.

Some of the porphyry in the trenches breaks along joint planes into rhombohedral blocks from 3 to 8 inches long. No veinlets of quartz were seen in the trenches, although some of the schistose porphyry is altered to a hard, dense, siliceous rock, perhaps through the addition of quartz. The mantle of drift here is thin and the fractured porphyry, for 2 feet or more below the surface, is weathered rusty, and this capping pans gold. In all, seven trenches were completed across widths of from 10 to 70 feet of jointed and pyritized porphyry. No well-defined body of schist carrying abundant sulphides was found and the trenching was discontinued.

Star (11). This group of six mineral claims was staked in 1930 by Messrs. A. S. Davenport and Patty Houlihan. The bedrock is quartz-feldspar porphyry cut by dykes of feldspar porphyry. The trenching has been done at three main localities on the lake shore. At the southern, a trench just above the water exposes 4½ feet of schistified and jointed, grey porphyry with disseminated pyrite and quartz stringers. Narrow layers of chlorite-schist carry sphalerite. In the second pit on the point to the north, the porphyry has abundant crystals of feldspar, one-tenth inch long, in a grey, dense groundmass. This rock is also jointed and altered to schist along some of the joint planes. Some masses of the rock break into slabs, up to 2 inches thick, due to well-developed fracture cleavage. In certain narrow areas veinlets of quartz and others of calcite carry abundant pyrite and some chalcopyrite. The whole body across 25 feet contains scattered crystals and grains of pyrite. At the third locality across the bay to the north, two trenches, each 50 feet long and from 2 to 8 feet deep in rock, also expose jointed and schistified porphyry with pyrite, in scattered cubes and grains, and veinlets of quartz. Dykes of feldspar porphyry, with some plagioclase crystals one-half inch long, cut the fine-grained porphyry on the hill to the north of the trenches. In the trenches, some grey to black, chloritic phases of the porphyry are crossed by veinlets of quartz and calcite with abundant pyrite, sphalerite and galena, and some chalcopyrite. The intervening rock is grey, hard, and dense, with but little pyrite and vein quartz. It is doubtful if the large bodies trenched will carry enough gold to be ore, but certain narrow sections with abundant sulphides and vein quartz may assay high enough to warrant further work on them.

Mack (12). This group of six mineral claims is controlled by Patty Houlihan and associates. The main trenching has been at the southeast corner of Bessie Island. The bedrock is schistose, basaltic, and andesitic lava cut by narrow dykes of aplitic granite and porphyry. The main pit is about 20 feet deep and exposes a width of 7 feet of black schist, some of which is drag-folded. Some quartz is distributed throughout the whole mass, but the larger lenses and stringers are on the axes of the drag-folds. Pyrite is not abundant in much of the schistose rock. Quartz and pyrite were both more abundant at the bottom of the pit than at the surface. Another trench, 50 feet long, and south of the pit, was full of water. The large blocks of dark quartz on the dump here, however, suggest that vein quartz was more abundant than in the pit. This quartz has the appearance of the variety that carries gold at other localities. On the north end of the island a trench at water-level exposes a width of 6 feet of rusty schist near a mass of quartz porphyry. The iron-stained capping here pans free gold, but no trenching had been undertaken to the underlying schist.

Leonard (13). Two prospect pits, about 60 feet apart, cross jointed and schistified argillite in contact with basalt on the east. The foot-wall basalt is fairly massive and coarse grained. The adjoining, slaty argillite is altered to a black, soft schist carrying abundant, black, graphite-like material. This schist is cut by veinlets and lenses of massive pyrite and arsenopyrite. Some of the material on the dump carries enough arsenopyrite to be an ore of arsenic. This body of graphitic schist and massive sulphide is at least 20 feet wide and passes under drift and water to the west. The deposit thus is wide, but its gold content apparently must be low. The deposit, on account of water and thick drift, cannot be traced by trenching. Apparently it is along a fault between lava to the east and sediments to the west, which occupies the narrow valley extending north 3 miles and bordered by high, steep hills.

Black Diamond (14). Trenching has been done at several points on this group of four mineral claims. The bedrock is andesite with interlayed argillite and slaty sediments. The main prospect work is in andesite, about 500 feet east of the contact of the granite and andesite. Three prospect pits, along the side of a depression extending north from a small lake, expose chlorite schist and massive, jointed andesite carrying pyrite and arsenopyrite. The schist body is up to 15 feet wide and has been traced 350 feet along its strike. Vein quartz is not abundant. Another deposit, carrying lenses of massive pyrite and arsenopyrite, lies about 100 feet to the east. No information is available regarding the gold content of the bodies of sulphide-bearing schist.

Gull (15). This mineral claim occupies most of Gull Island. The bedrock is andesite cut by grey granite porphyry and pinkish granite. The granite occupies almost the whole of the east two-thirds of the island. Both the lava and intrusives are largely altered to chloritic and sericitic schist.

Three large pits on the east side of the island expose large bodies of quartz-sericite schist derived from granite. One mass is 18 feet wide and is cut by veinlets of white quartz and iron carbonate. Small grains of pyrite and chalcopyrite are scattered throughout the schist and in some of the quartz. A pit near the southeast corner of the island exposes a quartz vein a foot wide and at least 50 feet long. The quartz and adjoining schist carries abundant iron carbonate, pyrite, and some tourmaline, galena, sphalerite, and chalcopyrite. No free gold was seen and the average gold content of narrow bodies of the schist carrying abundant quartz and sulphides is not known.

A body of schist in andesite on the west side of Gull Island has been trenched thoroughly. In it widths of 12 feet carry abundant veinlets of quartz and some iron carbonate. The whole body in one trench 35 feet across carries pyrite in fine grains and cubes. Some narrow sections may carry gold. A body of schist also has been trenched along the contact of the granite and lava on the hill, about 250 feet back from the west shore. Here sericite schist derived from dykes of granite and chlorite schist from andesite both carry white quartz, iron carbonate, and cubes of pyrite. No large body of vein quartz was found in any of the prospect trenches. On the mainland immediately to the east of Gull Island, chlorite and sericite schist on the Wera and Esma mineral claims carry white quartz and sulphides. These large bodies of schist have been explored only in a general way. Future trenching and very careful sampling should determine the possibility of shoots of medium-grade gold ore within the schist.

Beaver (16). This group of ten mineral claims was staked in 1925 by Mr. John Hyslin and associates. The main trenching was along the lake shore from the north side of Beaver No. 1 mineral claim south for 1,200 feet. In all, six trenches and a shaft 28 feet deep, with a crosscut, 7 feet long, to the west, were sunk. In the summer of 1932, the property was optioned by Canadian Minerals, Limited, organized during the summer of 1932 by Messrs. Young and Elliott, and some additional trenching was undertaken near the end of September.

The bedrock is quartz-feldspar porphyry cut by dykes of feldspar porphyry. Some phases of the older porphyry are medium grained with crystals of feldspar and without quartz. The prospect trenches expose jointed and schistified older porphyry, in part altered to a greenish, chloritic schist. The shaft crosses pyrite-bearing, chloritic schist and massive, jointed porphyry. The schist has abundant pyrite in cubes, quartz in veinlets, and some chalcopyrite. Certain chloritic zones are rich in magnetite, distributed in narrow seams, lenses, and round lumps. Quartz, calcite, and chalcopyrite are also present with some of the magnetite. The magnetite-bearing schist is reported to assay high in gold. The rusty capping at a number of points on the claim, west and south of the workings, pans free gold. The bodies of schist carrying sulphides and gold are wide, and certain parts of the large mass may carry enough gold to encourage further work.

Across the bay from the cabin near the south end of the workings on the Beaver No. 1 mineral claim, an inclusion of lava in quartz-feldspar porphyry is altered to a drag-folded chlorite schist that carries pyrite in cubes, stringers of quartz, and veinlets and lenses of massive sphalerite. This deposit, apparently, is small. An outcrop of quartz-feldspar porphyry at the foot of the bay has abundant pyrite, and the fresh, fairly massive rock carries magnetite in cubes and also in lenses and round lumps. Calcite occurs with the magnetite in the pits. Whereas iron carbonate is a widespread carbonate at most localities, here it was seen only in the sheared inclusions of lava where no magnetite was recognized.

Missi Island (17). In June, 1932, Shorty Russick and associates staked the Missi Island group of nine mineral claims lying west of the large granite mass on Missi Island. Only a few shallow trenches had been dug on the property prior to August, 1932. The forest and moss were burned off this part of Missi Island in the spring of 1932. The bare ridges of rock are of black andesite cut by dykes of quartz-feldspar porphyry. Both the lava and intrusives are in part altered to schists. The trenches are near the west corner of No. 2 and No. 3 mineral claims and they exposed schistose andesite cut by quartz stringers. Pyrite is abundant in some of the schist, also arsenopyrite, and some of the quartz carries galena and sphalerite. The rusty capping pans free gold. The schist bodies have not been traced along their strike. Several additional rusty zones on the property pan free gold, and this group of mineral claims should be prospected carefully.

The Wera, Mack, Moroca, and Ideal mineral claims lie northwest of the Missi Island group and prospect trenches on these claims expose large bodies of chlorite schist cut by stringers and veins of white quartz. Iron carbonate is abundant in some of these deposits. In others, arsenopyrite is plentiful. In one pit on the Ideal, massive arsenopyrite is estimated to be about equal to the chloritic schist across a width of 5 feet. The quartz-feldspar porphyry, grey granite, and feldspar porphyry dykes are also schistified and carry stringers of white quartz, iron sulphide, and carbonate. Some of these schist bodies are up to 100 feet wide, but apparently carry very little gold.

Prince Albert (18). This property was staked in 1913 by Messrs. Tom Creighton, John Mosher, and L. Dion. In 1914 the vein was stripped for 150 feet along its strike and an incline shaft was sunk about 70 feet along a body of white quartz. The property is held by Prince Albert Gold Mines, Limited. No work has been done since 1914.

The vein is in an impure, greywacke-like quartzite, which is thick bedded and some beds are altered to grey chlorite-sericite-quartz schist. The foot-wall is a greenish, intricately drag-folded schist probably originally a tuff. These rocks belong to the sediments and interlayered lavas of the Wekuskoan. A dyke-like mass of schistose granite cuts the tuff bed and apparently forms the foot-wall of the main body of schist. The schistosity dips about 55 degrees west and the quartz follows this structure.

At the shaft, the quartz body is 8 feet wide and is reported to continue with about that width for the 70 feet followed down the dip. The quartz is a dense, white variety, some of which carries pyrite and arsenopyrite. It is crossed by cracks along which is a thin film of white mica. Free gold occurs in films with this white mica and also as small specks in some of the apparently unfractured quartz. Much of the quartz is not mineralized. Some specimens of quartz carry abundant calcite and iron carbonate. The schist included within and adjoining the main quartz body carries abundant crystals of pyrite and a few of arsenopyrite. The quartz body extends only 25 feet north from the shaft where the schist body turns east and passes into granite with only a small amount of quartz in stringers. At 130 feet along the strike south of the shaft, the schist is 4 feet wide, but here the quartz is only in stringers. Some of the schist carries abundant iron carbonate and continues to the south for 300 feet, but the main quartz body is a lens about 150 feet long. Its average gold content is not known.

Martin (19). This group of claims was staked in 1928 and 1932 by Messrs. J. L. Griffin and Edward Buckles. In 1932 Mr. Andrew Flett staked additional claims on Missi Island to the south and east. The bedrock is mostly quartz-feldspar porphyry with intervening narrow bodies of lava. The intrusive, fine-grained, porphyry rock is in part altered to schist and the andesitic lava is mostly a chlorite schist intricately drag-folded along certain horizons. The intrusive rock forms high hills, and near the base of the hill back of the cabin on the west side of the channel between the mainland and Missi Island, the andesite passes under the porphyry intrusion, suggesting that the porphyry masses are thin, sill-like bodies. Prospecting has been along a highly schistose zone in the andesite about 250 feet east of the porphyry. The shallow pits cross rusty schist, in one place 40 feet wide, and the gossan pans a little fine gold.

Below the gossan, stringers of quartz and iron carbonate are abundant in some of the schist and the whole mass carries pyrite and some arsenopyrite. The work completed up to August, 1932, was not extensive enough to determine if this schist body carried enough gold to justify systematic exploration along the strike of the deposit.

Blue Quartz (20). This group was among the early stakings in the area, and includes seven surveyed mineral claims. Only a small amount of prospecting has been done. The forest has been burned almost completely and the rocks are well exposed. A large body of quartz-feldspar porphyry with many inclusions of lava occupies the east side and quartzose and black, slaty sediments and lava flows the west side of the property. Most of the work has been done at the lake shore, near the boundary between the Blue Quartz 4 and 5 mineral claims. Here a large pit and shallow shaft on the side of the hill crosses jointed and schistified quartz-feldspar porphyry cut by dykes of feldspar porphyry. Back of the shaft, the older porphyry carries inclusions of grey quartzose sediments. This shaft appears to be near the north end of the porphyry mass. A quartz vein trends diagonally across the shaft and at an angle to the strike of the schistosity of the porphyry. This quartz is only 2 inches wide at the surface, but down about 14 feet it has widened to 20 inches. At the surface it continues only a few feet to the southwest beyond the shaft. Some of the quartz is reported to carry free gold. The adjoining schist carries quartz stringers, also iron carbonate, pyrite, and arsenopyrite. Some lenses of massive white sulphide are 2 inches thick. The quartz is white with a few crystals of feldspar, also needles of tourmaline and cubes of pyrite. A few trenches at other localities on the group exposed bodies of schist carrying sulphides and some quartz. Near the southwest corner of the Blue Quartz No. 1 the lava is drag-folded and carries stringers of porphyry, vein quartz, and iron carbonate. There are thus several sulphide and quartz-bearing zones on this property, and these should be trenched to unweathered rock so that a few samples can be taken from across the most promising sections.

Royal (21). This property of six mineral claims is controlled by Mr. A. J. McDonald and associates. Two, long, shallow trenches expose a body of schistose rock about 300 feet wide, but no work has been done to trace the schist along its strike. The more massive rock in the trenches includes grey, fine-grained, cherty-appearing layers with large bodies of greenish chlorite schist and a black, fragmental rock, probably an agglomerate. On the lake shore to the south of the trenches the grey, cherty-appearing rock is cut by dykes of grey, granitic porphyry with eyes of smoky quartz. Andesitic lava outcrops north of the trenches. All the rocks in the trench are cut by dykes of black mica lamprophyre. The deposit is apparently near the north margin of a body of the quartz-feldspar porphyry with large inclusions of lava and cut by dykes of various types.

The various rocks crossed in the trenches are not all severely jointed and schistified, bodies of highly fissile, chloritic and sericitic schists, from 2 to 4 feet wide, alternating with areas of more massive but jointed rock from 10 to 20 feet or more across. The schist carries abundant pyrite but little quartz, whereas stringers of quartz follow the joint planes of the more massive rock. Veinlets of quartz are especially abundant near the small bodies of grey, granitic porphyry and along joint planes in the schistose granite, and as lenses on the axis of drag-folds in this rock. Some specimens of the chloritic schist and grey, cherty-appearing schistose porphyry carry abundant pyrite, some chalcopyrite, and vein quartz, and such rock is reported to assay up to $20 in gold. Sampling has not been sufficient to determine if any sections of the trench, from 4 to 6 feet wide, will carry enough gold to warrant trenching along the strike of the deposit.

Kent (22). This property was staked in 1914 by A. S. Davenport and E. W. Fahey. The vein lies in low ground at the west side of a hill of lava that trends about north and south. Black argillite, grit, and thin conglomeratic beds, with many small fragments of lava, grey quartzite, and white quartz are interlayered with the lava flows to the east and north of the deposit. The quartz body is in micaceous and chloritic schist, perhaps an altered lava. The high hill east of the vein is of basaltic lava. No rock is exposed immediately west of the deposit.

The quartz body dips 62 degrees west and is exposed by trenches and a shaft 16 feet deep for 122 feet along the strike, passing under drift at both ends. The outline is irregular and the average thickness is 4 feet 9 inches. Both white and grey quartz are intermixed, and much of it is unfractured. Pyrite and arsenopyrite are present both in the massive quartz and as films along joint planes. The schist for a foot or more away from the main quartz mass carries pyrite and arsenopyrite, and small masses of schist in the quartz contain abundant crystals of these sulphides. Free gold is abundant in cavities in the quartz formed by the weathering of sulphides and in some of the dense, massive, grey quartz. A large part of the white quartz is unmineralized. Some samples will assay high in gold, but the average gold content of the whole mass is unknown. The body of schist should be traced as far as possible along its strike and the whole mass should be sampled systematically.

Ross (23). In the early prospecting of the area, many mineral claims were staked northwest of Grassy Lake and some trenching was completed at a few localities. The most extensive work was near the No. 2 post at the northwest side of the Ross and Peggy mineral claims. The rocks here are slate, black argillite, and dark grey, fine-grained quartzite lying between andesite on the west and thick-bedded, massive, Missian arkose and quartzite on the east. A sill-like body of granite lies about 300 feet west of the prospect pits. The deposit on which the most work has been done is in slate and argillite, and comprises a series of parallel stringers of quartz up to a foot wide and extending across about 4½ feet. Some beds of the sediments are altered to a highly fissile, chloritic and sericitic schist carrying pyrite. This schist and quartz body has been traced along the foot of a hill for 300 feet where it passes under drift at both ends. No free gold was seen in the quartz and no information is available regarding the assay returns. Two large bodies of white quartz outcrop to the north and west of this group. This quartz, however, carries practically no sulphides and free gold has not been found in it. To the south from the Ross on the Dome group, schistose quartzite and slate carry vein quartz and pyrite. Farther to the south, near Grassy Lake, Messrs. Moody and Beda staked ground during 1932, but had done little work. Certain schist zones throughout this part of the area contain quartz and sulphides, but no extensive, careful work has been done to determine if they carry promising amounts of gold.

ERRINGTON AND NEAGLE LAKES

Mineral claims were staked just east of Errington Lake in 1909 and before gold was discovered on Amisk Lake. In recent years, however, little or no prospecting has been done inland west of Amisk Lake. The grey and greenish lavas and interlayered sediments on the west shore of Amisk Lake extend inland northwest and west beyond Errington Lake. Here the area of black, andesitic lava is $3\frac{1}{2}$ miles wide, and to the northeast it is bordered by thick-bedded Missian quartzite. A few small bodies of granite and dykes of granite porphyry cut the lava. The granite body south of Errington Lake cuts the lava with a sharp contact and the older rocks are but slightly recrystallized, whereas the lava and sediments adjoining the granite to the west of Errington Lake are recrystallized to coarse-grained hornblende and garnet gneiss and schist. About the outlet and west beyond the southwest bay of Neagle Lake, the sediments and lavas are recrystallized to grey and black gneisses intruded by numerous bodies of granite and pegmatite. Andesitic and basaltic pillow lava is well exposed along a series of high ridges along Neagle Creek, which is easily navigable by small canoes if the water is not too low. Some of this lava is altered to schist, some bodies of which are cut by veins and stringers of white quartz. No gold has been found in the quartz examined, and sulphides are not abundant. It is probable that only a few of the quartz-bearing bodies of schist in this large area of volcanic rocks, extending westward from Amisk Lake to beyond Errington and Neagle Lakes, have been examined and this part of the map-area should be prospected in some detail.

WILDNEST, COTTERAL, TYRRELL, AND MARI LAKES

These are the main lakes in the northern quarter of the map-area and the country adjoining them has been prospected hurriedly and a number of sulphide deposits have been trenched. The bedrock here comprises banded, grey to black, medium to coarse-grained types, representing recrystallized lavas and sediments, originally similar to and of the same age as the Wekuskoan and Missian strata about Amisk Lake. These gneissic rocks are cut by numerous bodies of granite and pegmatite. The different bands dip at from 10 to 45 degrees, and the recrystallized rocks are not folded so tightly as the lavas and sediments about Amisk Lake. The gneissic types are folded in a broad syncline whose axis trends east of north, and lies between Wildnest and Cotteral Lakes. A large body of aplitic and coarse-grained granitic gneiss, with many, long, narrow belts of sedimentary gneiss, occupies a large area between the east and west limbs of this syncline. All the deposits in the gneisses lying north of the long, narrow body of granite north of Annabel Lake carry pyrrhotite as their abundant sulphide, whereas either pyrite or arsenopyrite are the abundant sulphides of the deposits in the lavas and sediments about Amisk Lake.

In 1928, mineral claims were staked by Messrs. Harry Moody and James Hayes along the narrow lakes and rivers leading southwest from the west side of Wildnest Lake to Birch Portage on the Sturgeon-weir. The claims have since been dropped. The timber has been almost completely burned off this area and bare ridges of grey, gneissic quartzite and black, fine-grained quartz-mica gneiss extend for miles along their strike.

Certain of the beds of black gneiss are jointed and schistified, and such layers carry abundant pyrrhotite. These deposits weather rusty and can be traced for a mile or more along the strike, and are up to 50 feet wide. Only a few trenches have been dug below the rusty capping. Chalcopyrite, sphalerite, and vein quartz are not abundant.

The Tinnie group of six mineral claims was staked by Mr. A. J. McDonald along the south shore of Judique Lake. Here bare ridges of gneissic quartzite extend a mile or more along their strike, and some beds weather rusty. The underlying fresh rock carries abundant pyrrhotite without chalcopyrite or vein quartz. Small masses of pegmatite cut a few beds, also a large body of glassy, pegmatitic quartz without sulphides. Very little trenching had been done at this locality.

The Teejay group was staked south of Cotteral Lake in 1927, and, in 1928, Mr. Robert Jowsey and associates optioned the property and did extensive surface trenching and some diamond drilling. In 1931 this ground became open for re-staking. Sand is widespread south of Cotteral Lake and the few outcrops are thick-bedded, gneissic quartzite and black mica gneiss cut by pegmatite. The strike of the Cotteral Lake sulphide body (34) is north 65 degrees east, magnetic, and the dip from 40 to 60 degrees northwest. The deposit is exposed by fourteen large trenches for 1,600 feet along the strike. In several trenches, about midway between the farthest apart trenches, a width of 70 feet of quartzite and black gneiss carries stringers and veins of massive pyrrhotite. Some layers of schistose gneiss, 3 feet thick, carry disseminated pyrrhotite. Widths of 10 feet of unfractured gneissic quartzite do not carry pyrrhotite. Chalcopyrite is present with some of the massive pyrrhotite, also a little sphalerite. The grey to black, thin-bedded gneiss is in part altered to schist and it carries most of the sulphides. Some bodies of gneiss are coarse grained, hornblendic, and these may be recrystallized bodies of a basic intrusive. The whole mass is so recrystallized that the original contact relations with the sedimentary gneisses are destroyed. Irregular bodies of massive, white, pinkish, albite-rich pegmatite cut the gneiss at several points along the sulphide-bearing zone. The pegmatite is discontinuous along the strike, and, at places, cuts across the beds of the gneiss. Pyrrhotite and chalcopyrite are more abundant in trenches near the bodies of pegmatite.

In 1927 and 1928 groups of mineral claims were staked on a large pyrrhotite body in sedimentary gneiss just north of the granite body extending west from south of Tyrrell Lake. Of these, only the Tyrrell, Birch, and a part of the Fox group were in good standing in 1932. The Tyrrell (25) is controlled by Mr. H. L. Patton and associates, and in the spring of 1932 this deposit was explored by three shallow diamond drill holes. This sulphide body is exposed by five long trenches for 1,600 feet along its strike, and passes under drift at both the west and east ends. The rock in the trenches is a grey to black, medium-grained, biotite-mica-quartz-garnet gneiss. In the main trench near the west end, the gneiss, across 125 feet, carries pyrrhotite, both disseminated and in massive bodies. Some chalcopyrite and sphalerite are present in the pyrrhotite. On the Birch group (26), controlled by Mr. John Beda and associates, five long trenches expose a width of from 70 to 150 feet of jointed and schistified gneiss carrying pyrrhotite and some chalcopyrite. The surface work here was done by the Nipiwin Mining Company in the winter of

1929, under the direction of Mr. Harry Moody. The sulphide body is about 400 feet north of the granite. Grey, quartzose gneiss and black, hornblende gneiss are exposed in the walls of the trenches. Narrow bodies of a black, medium-grained, hornblende-augite-gneiss, carrying abundant magnetite, lie between the more acidic gneisses. These basic types may be narrow dykes of gabbro whose minerals are largely recrystallized. Rusty schist outcrops at a few points along the strike for a mile or more both east and west of the trenches. So far as could be determined from a hurried study of the partly slumped surfaces of the walls and floor in the trenches, chalcopyrite is not abundant enough, across sections of 6 feet or more, to make a copper ore, although certain narrow bodies of massive pyrrhotite are estimated to contain enough chalcopyrite to assay 4 per cent copper. This body of pyrrhotite-bearing gneiss outcrops at intervals for 6 miles along the contact of the gneiss and granite and, at some point, a large lens of pyrrhotite may carry enough copper and gold to be an ore. In places the drift is thick and the surface material is so weathered that it is difficult to locate by trenching the sections that carry the most chalcopyrite.

Prospecting about Mari Lake resulted in several large groups of mineral claims being staked. The lease to these had expired in 1932, except for the large group north of the deep east bay about half-way up Mari Lake and controlled by Wm. N. Boehme and associates. The bedrock here is grey, garnet-bearing, gneissic quartzite and quartz-mica gneiss cut by gabbro and sill-like bodies of granite and pegmatite. One body of white albite pegmatite on the Fly mineral claim is jointed, and widths of a foot are in part altered to white mica, some talc, and white clay, perhaps kaolin. A number of trenches expose jointed and schistified gneiss carrying pyrrhotite and some chalcopyrite. No minable body of sulphide-bearing rock, however, carries enough chalcopyrite to be an ore of copper. Here, as at many other localities in the sedimentary gneisses, the sulphides are scattered across a wide body of rock that weathers rusty. No well-defined sections across these deposits are known to carry enough chalcopyrite to assay 2 per cent or more copper. Vein quartz that might carry gold was not seen about Mari Lake. A few masses of pegmatitic quartz were noted, but these, as a rule, do not carry gold.

SUMMARY OF ECONOMIC GEOLOGY

The gold deposits of Amisk Lake area, up to the end of 1932, have been explored only by trenches, shallow pits and shafts, and a few shallow diamond drill holes. Much of this work has been done as assessment requirements, and without systematic sampling, consequently no specific information is available regarding the average gold content across many of the trenches. Free gold is plentiful in some quartz, and can be panned from the rusty gossan overlying other deposits.

Gold deposits occur in the Wekuskoan lavas, in quartz-feldspar porphyry, in Missian sediments, and schistose granite. They are thus younger than the Missian sediments and probably all the granitic intrusives. The lavas and quartz-feldspar porphyry are cut by dyke rocks of various types, and many of the deposits are near the small intrusive masses, especially a porphyry with large white crystals in a schistose matrix.

The gold occurrences are more abundant along the west channel where feldspar porphyry and other types of dyke rocks are more numerous than elsewhere. The bedrock here is Wekuskoan lavas and interbedded sediments, rocks that vary markedly in character within short distances across their strike, and a few deposits are along incompetent zones between lava flows and beds of sediments. The dyke rocks are assumed to be connected in origin with bodies of granite that outcrop on Missi Island and 3 miles west of the northwest channel, and the vein quartz, gold, and sulphides may be a late phase of the magma that formed the feldspar porphyry and other types of dyke rocks and the granite.

The two main types of gold ore comprise bodies of vein quartz and of schist carrying stringers and lenses of quartz, and disseminated and massive pyrite, arsenopyrite, and at a few localities galena and sphalerite. The quartz veins cut chloritic and sericitic schists, and are irregular in outline. The majority of those carrying free gold are not large. Some wide bodies of schist are cut by two or more narrow, parallel veins. The large bodies of quartz may hold large, included masses of schist. Much of the quartz does not carry sulphides, and at most localities sulphides are more abundant in the adjoining schist than in the quartz. The sulphide-bearing schist, however, does not assay more than a trace of gold unless quartz is present. In the same specimen, the gold may be in small specks in massive quartz or as films along cracks. Some bodies of schist, carrying stringers of quartz and sulphides, are large, but within them some of the rock is but slightly schistified and carries only scattered grains of sulphides and practically no vein quartz. To prove the value of these deposits, much more extensive and systematic surface work and sampling must be done than that undertaken in the past. The samples should be cut in short sections. Some small quartz bodies may carry enough gold to be mined profitably on a small scale, and some of the large schist bodies may average enough gold to warrant extended investigation to determine if a large-scale, low-grade operation could be undertaken. Although prospectors have worked in the area at intervals during the past twenty years, certain areas, both adjoining and back from the lakes, should be reprospected more carefully. The area is fairly easy to reach and exploratory work could be undertaken without heavy transportation charges. It is believed that this field is worthy of much more detailed prospecting than hitherto has been undertaken, and that some of the deposits already discovered should be investigated more thoroughly.

OTHER FIELD WORK

Geological

J. F. Henderson. Mr. Henderson began a study of Granville Lake area on Churchill River, between latitudes 56 and 57 degrees and longitudes 100 and 102 degrees. This area is easily accessible from Sherridon on Kississing Lake at the end of the Canadian National branch line from The Pas. Field work was done about Granville Lake and northwest about 25 miles to and beyond Sickle Lake, and also along North River, which enters the north side of Granville Lake near its east end.

The bedrock about Granville Lake consists of gneisses and schists cut by bodies of granite and pegmatite. The gneisses include both altered lavas and sediments. Northwest of Granville Lake the lavas are less altered. West of Sickle Lake, a body of sediments, with a basal conglomerate, lies in the trough of a syncline. The lavas and sediments about Sickle Lake, and also to the north and south, are cut by bodies of basic rocks, including pyroxenite, gabbro, and diorite. These several varieties appear to be distributed irregularly throughout the masses. One body of basic rock along the northwest arm of Granville Lake is roughly lens-shaped, 6 miles long and about a mile wide. The form and size of the bodies east and north of Sickle Lake are unknown, but apparently they are extensive, for the mass east of Sickle Lake is at least 20 miles long, and judging from the appearance of the country from aerial photographs it is 6 miles or more across. The west boundary of this mass is irregular and, at the north end of Sickle Lake, it follows the basal conglomerate around the east side of the syncline. Some schistose phases carry sulphides, mostly pyrrhotite, and the country along the margins of these bodies of basic intrusives may be worthy of careful prospecting.

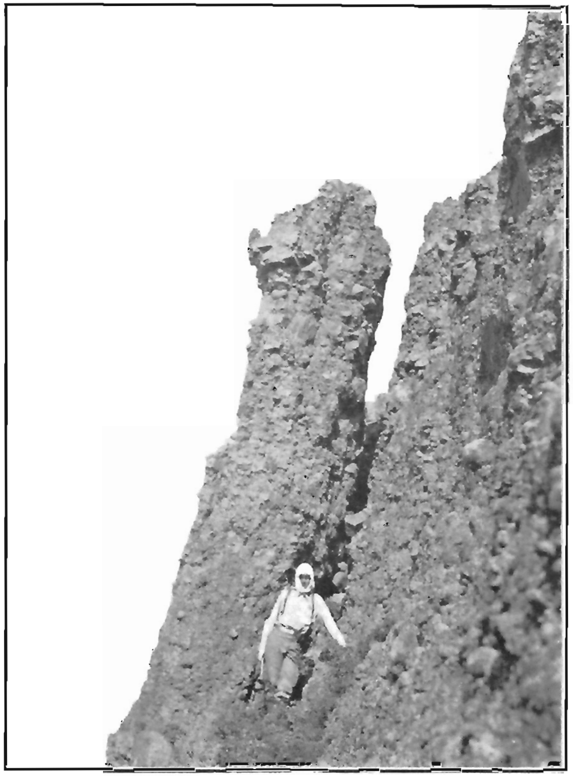
A large area about the northeast end of Granville Lake and up North River for about 25 miles is underlain by granite and granite-gneiss. Another mass of granite and pegmatitic granite, about 12 miles long and up to 2 miles wide, crosses Granville Lake and follows its north shore. Several smaller bodies of granite outcrop along the projected strike of this mass. Many dykes of pegmatite and a few bodies of quartz were noted in the schists and gneisses surrounding the smaller bodies of granite, and the area northwest and northeast of the inlet of Granville Lake might be a favourable one in which to prospect for gold ore.

H. C. Horwood. Mr. Horwood completed the field work in Cross Lake area lying along Nelson River just north and east of Lake Winnipeg and bounded by latitudes 54 and 55 degrees and longitudes 96 and 98 degrees.

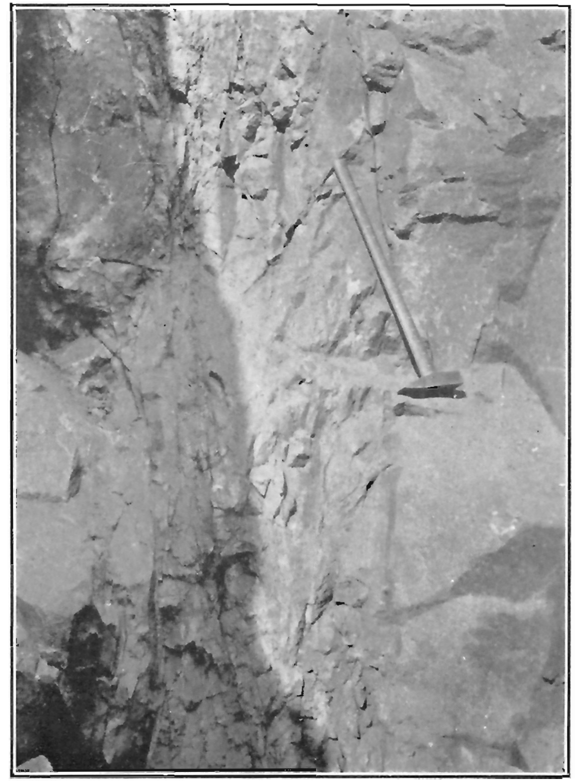
Topographical

R. C. McDonald. Mr. McDonald established geographical control along the west coast of Hudson Bay, between latitudes 61 degrees and 64 degrees, required for the preparation of maps of the region to the west which is being geologically explored by L. J. Weeks.

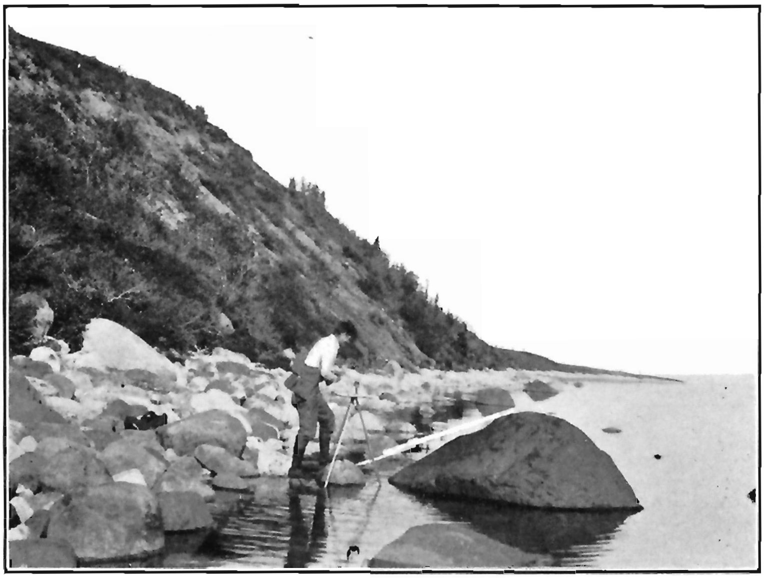
PLATE I



A. Coarse cobble conglomerate, Cameron Bay group, east of Cameron Bay. (Page 4.)

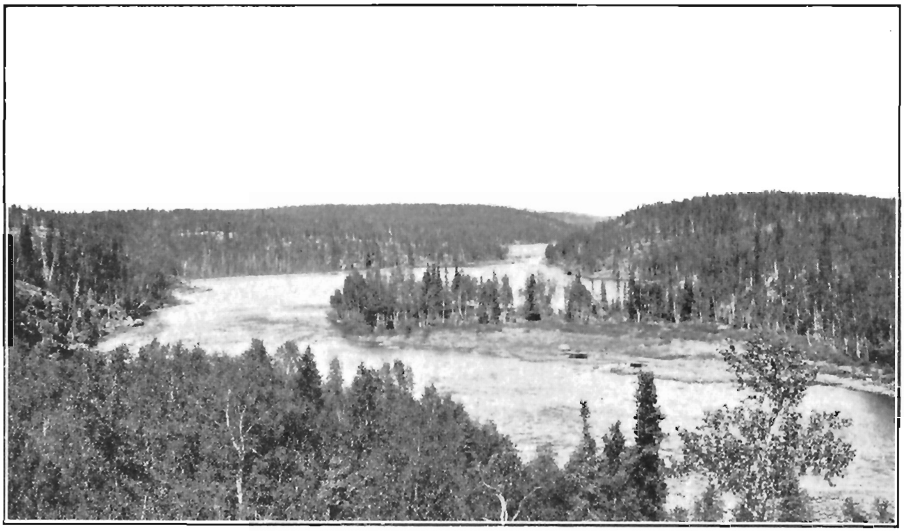


B. Shear and fracture zone in diorite or granodiorite, pit No. 1, M group, Contact Lake. Foot-wall on left. (Page 32.)

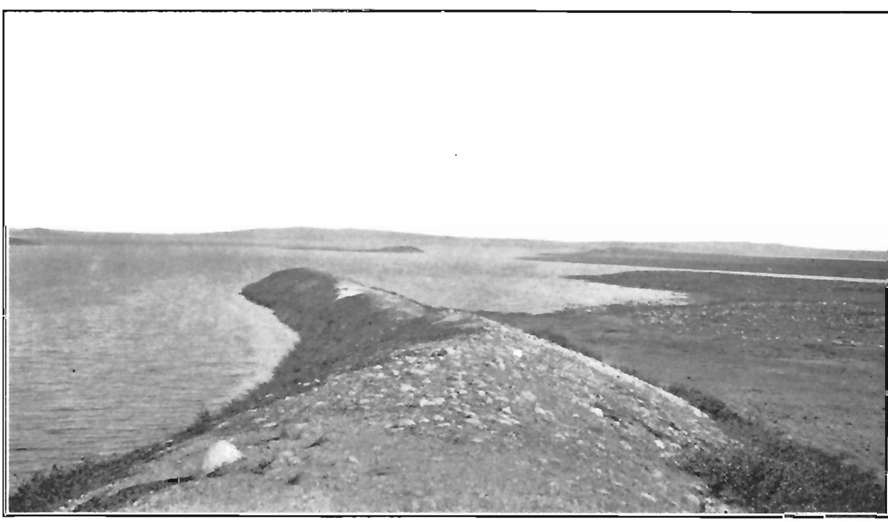


A. Shoreline near coal outcrops, Etacho Point. (Page 33.)

B. Cameron Bay fault looking north. The bedding of the rocks in centre of photograph dip away from the observer and strike into the base of the high hill of feldspar porphyry on the left. (Page 18.)

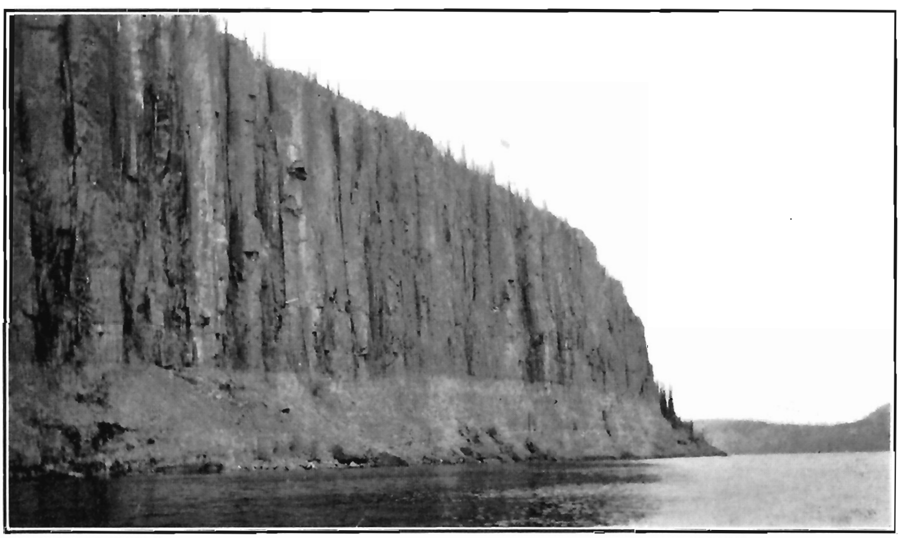


A. Rocky country along Yellowknife River between Rocky and Fishing Lakes. (Page 43.)



B. Esker and drift-covered country, Little Marten Lake. (Pages 43, 44.)

A. Sedimentary gneiss, north shore of McLeod Bay, Great Slave Lake. (Page 49.)



B. Columnar jointing in diabase sill, 400 feet thick, Redcliff Island, Great Slave Lake. (Page 60.)

INDEX

The annual Summary Report of the Geological Survey is issued in parts, referring to particular subjects or districts. This year there are five parts, A I, A II, B, C, and D. A review of the work of the Geological Survey for the year forms part of the Annual Report of the Department of Mines.