CANADA
DEPARTMENT OF MINES
HON. W. A. GORDON, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

GEOLOGICAL SURVEY
W. H. COLLINS, DIRECTOR

Summary Report, 1931, Part C

CONTENTS

OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1932

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NOTE. Part B of the Summary Report formerly included reports relating to the provinces of Manitoba, Saskatchewan, and Alberta, and to the part of the North West Territories lying north of these provinces. It now contains only reports that deal with the southern and western parts of this region, underlain chiefly by Palæozoic and later formations. Part C is a new part comprising reports that relate to the northern and eastern portions of the same region, which are underlain chiefly by Precambrian formations. What has hitherto been called part C is now part D. It relates to the provinces of Ontario, Quebec, New Brunswick, Prince Edward Island, and Nova Scotia, and to the part of the North West Territories lying north of these provinces and east of Hudson bay.

OXFORD HOUSE AREA, MANITOBA

By J. F. Wright

CONTENTS

INTRODUCTION

LOCATION AND ACCESS

Oxford House area lies between latitudes 54 and 55 degrees and longitudes 94 and 96 degrees. The map-area is about 80 miles long, east and west, and 70 miles wide, north and south. Its southwest corner is about 80 miles east of the northeast end of lake Winnipeg. The larger lakes of the map-area are accessible by canoe in summer and dog team in winter, from Norway House at the head of deep water navigation on lake Winnipeg. The canoe route to Oxford and Knee lakes follows the Nelson, Echimamish, and Hayes rivers. The route usually taken to Gods lake follows a chain of small lakes, connected by portages or small streams, and branches from the Oxford Lake route on the south shore of Logan lake, about 9 miles east of Robinson portage. The cost of freighting supplies by canoe to Oxford lake and Gods lake is about $8 and $12.50, respectively, per hundred pounds. Steamers leave Selkirk weekly for Norway House from June 1 to October 1. The winter route to Norway House is from Wabowden on the Hudson Bay railway. Hydroplanes have been used to reach the various lakes of the map-area, the most satisfactory starting points being either The Pas or Cormorant.

FIELD WORK AND ACKNOWLEDGMENTS

In 1925 an area about Oxford lake was studied geologically and in 1927 Island lake, south of Oxford House sheet, was investigated. In 1928 free gold was discovered at a number of points about Island lake, and in 1929 a sulphide body carrying some gold and situated near the west end of Oxford lake was diamond drilled. Free gold had been reported from a number of localities in the area about Gods lake and, as the district appeared to offer opportunities to prospectors, the country about Gods lake between Oxford and Island lakes was explored geologically in 1931. Mr. Harold S. Hicks assisted ably in the field investigations. Mr. H. C. Horwood, assisted by Mr. R. O. Shuttleworth, mapped the southern part of Cross Lake sheet adjoining Oxford House sheet on the west. Copies of the Oxford House and Cross Lake sheets, on a scale of 2 miles to 1 inch, were supplied by the Topographical Survey of Canada as a base-map for field work. The topography on this map is based on control surveys by Mr. R. C. McDonald in 1923 and 1925 and poor oblique photographs by the Royal Canadian Air Force in 1925. Thanks are due Mr. C. A. Clarke and Mr. R. G. B. Butchart of the Hudson's Bay Company at Norway House and Gods lake, respectively, for courtesies extended the party.

GENERAL FEATURES OF THE AREA

TOPOGRAPHY

The surface of Oxford House area is flat or only gently hilly and is from 600 to 750 feet above sea-level. Island lake, south of the middle of the south side of the area, is about 800 feet above sea-level, and the surface slopes from this locality north and northeast towards Hudson bay. No hills are known to rise over 150 feet above the level of the nearby lakes or muskeg. Much of the area is flat and swampy, with only a few ridges as much as 50 feet high. Two prominent hills are known, Otter hill and Beaverhill. Otter hill is at Gods Narrows, and trends northwest for several miles. Beaverhill is on the northeast side of Beaverhill lake, and is a round hill, resembling in general shape a very large beaver house.

The parts of the map-area underlain by volcanic and sedimentary strata are more rugged than most areas of granitic intrusives. The hilly character of areas of the volcanic rocks is well illustrated along the canoe route from Logan to Aswapiswanan lakes, where long, narrow valleys, following zones of schist, lie between hills of more massive andesitic and basaltic lava. Otter hill is of fine-grained quartzose sediments and the hilly country east to Knife lake is underlain by sedimentary and volcanic strata. The beds of all these areas stand nearly vertical, and the trend of the hills and valleys follows their strike. Bedrock is well exposed along the sides of the hills and, at some localities where the moss and timber are burned, rock exposures are large. The valleys are floored with drift or occupied by lakes. As mineral deposits are likely to be in the softer beds occupied by the valleys, prospectors accordingly are advised to search carefully all exposures near the foot of hills and in the lower ground of the areas underlain by the volcanic and sedimentary rocks. A few areas of granitic rocks also are rugged, as in the belt about 6 miles wide and extending east and west from about 4 miles north of Bolton lake, and the large area southeast and south of Beaverhill lake to Island lake and Island Lake river. The area bordering some lakes is also high and rocky, whereas inland, within from $\frac{1}{4}$ to $\frac{1}{2}$ mile, the surface becomes generally flat and heavily drift covered.

DRAINAGE

Oxford House area is drained northeast to Hudson bay by Hayes and Gods rivers. These are wide, shallow rivers with many rapids and low falls. The current in some of the stretches between the rapids is swift. The west-central, southwest, and south sides of the map-area are drained respectively by Mink, Stevenson, and Island Lake rivers. These rivers enter Gods lake, Mink river, from the west near the south end, and Stevenson and Island Lake rivers at the southwest corner through Beaverhill lake and 3 miles of river with a series of rapids, known as Kanuchuan rapids. The banks of the rivers throughout most of their courses are low and the streams do not follow definite valleys. Bedrock is exposed at many points at or below the high-water mark, and only at a few points do rock cliffs rise 30 feet above the level of the river. The rocks are exposed, also, at many of the rapids and falls where the river passes with a steep gradient to a lower level. Some rapids, however, are long boulder runs where the river flows through a shallow cut in drift and down the slope of a deposit of glacial materials. Island Lake river is typical of many streams in this district, and, north for 8 miles from Island lake, this river is narrow and fairly swift. It flows between ridges of granite with only a few falls and rapids. In the remaining distance to Goose lake, however, the banks are low and of drift, the river is much wider, at some points branching into several channels, and shallow rapids over piles of boulders are closely spaced. Since the drainage assumed its present courses, practically no bedrock has been eroded by water action, as glacial striæ are still preserved below the water-level along rock channels and even in the channels of some rapids. Furthermore, even the large rivers have not eroded their beds to a normal gradient in passing over barriers of glacial drift deposits. Large areas inland from the main lakes and rivers are swampy and only poorly drained. Many of the small lakes of such areas have no outlets, and the majority of the tributary streams entering the larger lakes and rivers are unnavigable by canoe.

GLACIATION AND GLACIAL DEPOSITS

Facts regarding the direction of movement of the ice-sheet and the distribution and character of its deposits are important to prospectors in searching for the source of blocks of mineralized rock. In Oxford House area, the approximate position of contacts between formations was determined across wide drift areas by noting the character and distribution of blocks on the surface. The presence of rounded pieces of rock is of no value in mapping or prospecting, as such boulders may have been carried many miles by the ice. At some localities, however, blocks were proved not to have moved over 10 feet from their source. The character of the bedrock under the drift along the lake shore also can be determined at most points from a study of blocks that have been broken from bedrock below the water-level, and pushed on the beach by the expansive force of lake ice. As the thickness of the drift is variable within short distances, the depth to bedrock cannot be predicted with certainty at a particular spot.

Polished and striated rock surfaces and the gently sloping northeast, and the abrupt southwest, slopes of hills and islands prove that the whole area was crossed by a continental ice-sheet. More than one ice-sheet may have crossed the district, but no evidence was seen of more than one ice invasion. The last ice advanced across the map-area from the northeast, and this sheet is assumed to have been a part of the Labradorean glacier. The small boulders of limestone and sandstone in the drift about Gods lake, which must have come from the area of Palæozoic strata about the west side of Hudson bay, indicate that the ice covering the area originated at least 150 miles to the northeast.

The direction of ice movement across the map-area was from south 25 to 45 degrees west, and the majority of the striæ at any particular locality are parallel. In the west-central and northern parts of the map-area, most of the striæ trend between south 38 and 45 degrees west; about the central part of Gods lake south 26 degrees west; and south and east of Beaverhill lake south 32 degrees west. At some localities, a few striæ vary in direction as much as 25 degrees from the averages given, and striæ on the same large outcrop cross each other at angles varying from 5 to 25 degrees. An older set of striæ at one point on a large outcrop may cross striæ of still another trend indicating three directions of ice movement. Striæ with such relations, however, probably resulted from local variations in movement of the bottom layers of the ice-sheet in passing low hills oriented at an angle to the general direction of ice flowage. The presence of striæ of several ages is not considered proof of an older ice-sheet or a local advance of the front of the last ice during its retreat across the map-area. Determinations of local variations of ice movement by studying the striæ at a particular point have an important application in prospecting, as blocks of mineralizated rocks originating nearby naturally were carried by the bottom layers of ice. Consequently, the direction of striæ on all outcrops surrounding the point where blocks of ore has been discovered, should be noted carefully, as a guide to the direction of the most probable source of the mineralized rock.

The deposits of glacial origin are boulder clay, poorly stratified sand and gravel, and finely stratified sand and clay. These deposits partly fill many depressions, and in some areas cover the bedrock for long distances. Rock is not exposed, even along the lake shore, for stretches of 5 miles or more near the south end of Gods lake, and on Beaverhill lake. Some lakes, 4 or 5 miles long, are entirely within drift. No bedrock is exposed for 15 miles along Gods river from a point 5 miles below Gods lake. No outcrops were seen on some traverses inland for 4 miles from lakes. In other parts of the map-area, and especially where sediments and lavas are the bedrock, as east of Gods narrows, drift deposits are not so widespread as in the areas mentioned above. The thickness of the deposits is variable and is not known except locally where the mantle of unconsolidated materials is only a few feet thick. Over most of the area, however, the drift is believed to be thick, probably a hundred feet or more at many points.

Boulder clay is only locally exposed in cuts along streams or lake shores. It may be present throughout the whole area, as only a few sections cut through the stratified clays that overlie the boulder clay. The boulder clay is grey with no sign of bedding and contains many boulders of variable size. Poorly stratified sands and gravels are widespread in deposits whose surface is flat or only gently undulating, and in long, narrow, or rounded ridges representing eskers and kames. Eskers are well developed from the southwest end of Gods lake and on Beaverhill lake. One esker was examined at localities along a course varying from southwest to south, for 12 miles from a point on the east shore of Gods lake about 6 miles northeast of Kanuchuan rapids. A prominent esker crosses the northeast corner of Beaverhill lake as a series of long, narrow islands of gravel. This esker curves southwest to form the chain of islands in the wide part of the lake west of the entrance to the bay leading east on the Island Lake route. The islands represent the wider and higher parts of the esker, although the water is shallow along the strike of the esker between the islands. Erosion by wave action since the formation of Beaverhill lake has modified but little the form of the ridges of sand and gravel in the lake basin, which reach nearly to the water-level. Other large and prominent drift hills trend about north and south in a narrow area along a line commencing at the east end of Oxford lake, and passing east of the east end of Munro lake, the west end of Touchwood lake, and southwest of Beaverhill lake. Deposits of sand extend several miles west from these hills, and the country on their east side is hummocky with a few kettle-hole ponds. These relations are well exhibited at the east end of Munro lake. This series of drift hills, distributed roughly, in line at intervals across the area, may be parts of a terminal moraine, formed at a time when the ice was stationary in its retreat towards the east.

At some localities in the northwest part of the map-area finely stratified sand and clay overlie the gravel and boulder clay. These stratified deposits are exposed in cuts along the north shore of Oxford lake near the east end, on the southeast side of Rat lake, and south of the inlet of Touchwood lake. Similar clays have not been recognized in the southeast part of the area where the non-stratified or only poorly stratified materials are at the surface. The bedded clays are grey to chocolate, and evidently were deposited in quite extensive bodies of water. These clays, however, are not known to be varved like the clays deposited in glacial Lake Agassiz which covered the country farther west. It is certain that some beds of clay and sand are not varved, although on account of the slumped and disturbed character of the materials on the face of the banks, it is impossible to determine, without making cuts to undisturbed surfaces, if varved clays are absent from the whole section. Some sandy horizons up to a foot thick are very finely laminated, others are not banded. Other horizons at least 10 feet thick are of alternating layers, from an eighth to a half inch thick, of white sand and darker, more clayey materials. In the cliff just south of the inlet of Touchwood lake, two sandy horizons, each over a foot thick, are separated by a bed, less than half an inch thick, that contains a few pebbles of granite. One flat pebble is 2 inches long, the others noted are smaller. Deposits of this general character may have formed in shallow glacial lakes covering parts of the northwest half of the map-area.

TIMBER AND WATERPOWER

No large areas of commercial timber were seen in the parts of Oxford House map-area that were investigated. The trees are small and short in most areas of green woods. The spruce on some large islands and on low areas near the lake shore is suitable for cabin building. The trees that locally are large enough for timber and wood include white and black spruce, balsam, jackpine, poplar, and white birch. In recent years the forest has been burned over very large areas. A large area about Gods Narrows was burned in 1928, and here the thin mantle of soil has been washed from the hills, leaving a desolate, rocky country. Much of the small timber that in the future might have been valuable in the area about Oxford and Knee lakes has been burned within the past twelve years. Since 1927 a large area about the north end of Island lake and along Island Lake river also has been burned. After a few years, travel across these areas will be difficult due to many fallen logs and the thick second growth of bushes in the lower areas.

The possible waterpower sites of the area have not been investigated. It is apparent from a general inspection, however, that many of the falls along the rivers are not suitable sites for power development. At many localities, the drop at the falls is less than 10 feet, although the total drop of a series of low falls and rapids distributed along a half mile or more of river may be sufficient to develop a large head. The banks bordering the streams at such points, however, are low, thus necessitating long dams and embankments to form storage basins. Power might be developed cheaply by building a flume from the east end of Logan lake to Max lake, a distance of about 1,200 feet. Max lake is estimated to be about 30 feet lower than Logan lake. Hayes river, the outlet of Logan lake, would have to be dammed to raise the water-level on Logan lake.

INHABITANTS

The inhabitants of the area include two bands of Cree Indians located on reserves at Gods Narrows and at the east end of Oxford lake. These are comparatively small reserves, each with a population of about 300 persons. The Hudson's Bay Company has maintained trading posts on these reserves for many years, and recently a number of independent traders have entered the district. The fur-bearing animals are the main resource to be exploited, although the abundant white fish and trout of the large lakes, and moose, have been important items of food. The yearly value of the fur taken from the map-area may be estimated conservatively at $100,000. Each year, however, the fur-bearing animals are becoming scarcer, and the Indians have to go farther from the reserves during the hunting season. The main fur-bearing animals are

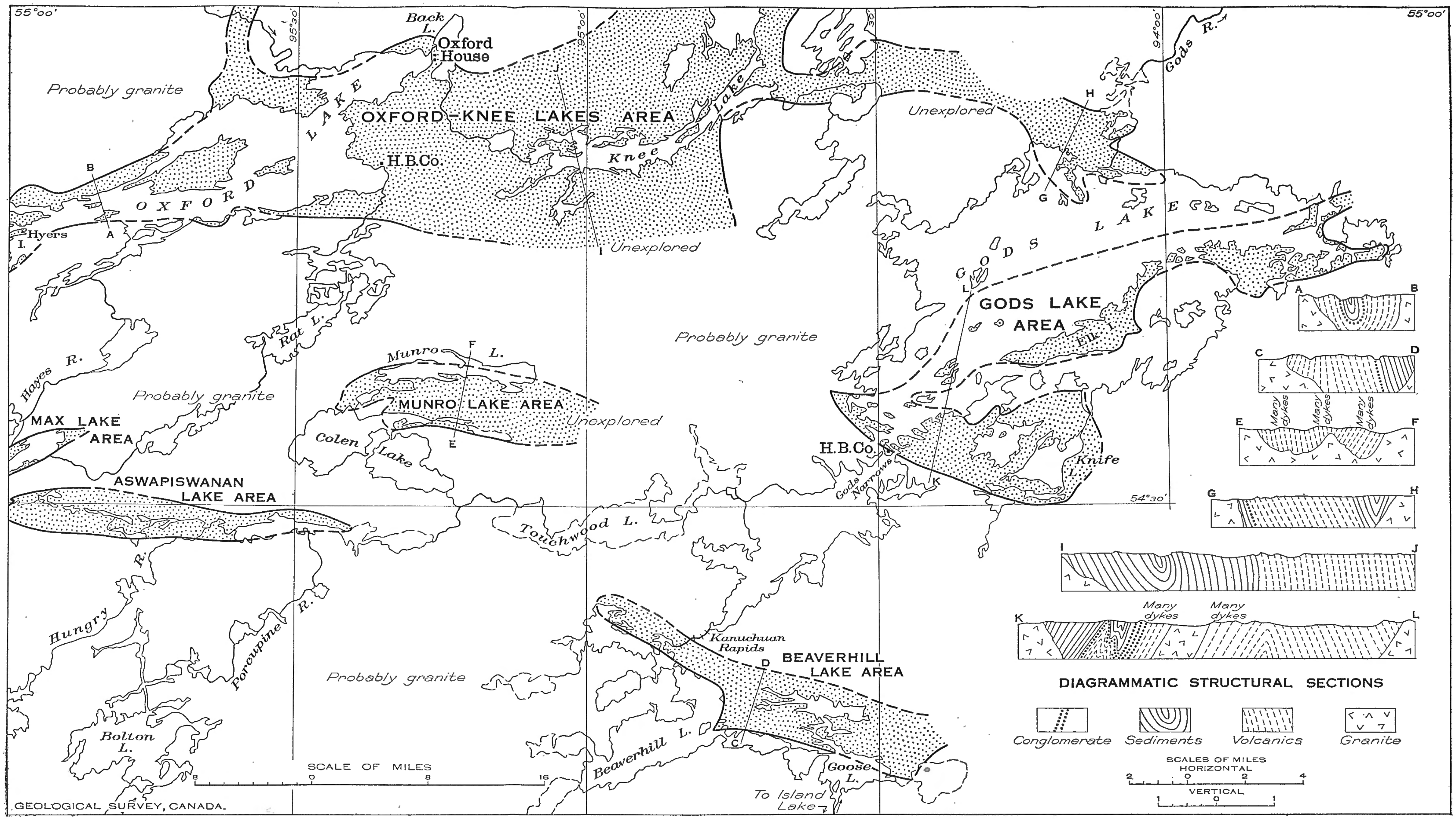

Figure 1. Northern part of Oxford House area, Manitoba. Areas of volcanic and sedimentary strata are shown by pattern of stipple.

cross, silver, black, and red foxes, mink, marten, fisher, otter, and muskrat. Beaver are very scarce, even though they have been protected by law for several years. The increasing scarcity of fur-bearing animals in the future may force the natives to undertake farming on a small scale to supplement their present food supply from the return of hunting and fishing. Some areas of land near Gods and Oxford lakes could easily be cleared for gardening. In the summer of 1931, Father Albert Chamberland had a very fine garden near the mission at Gods Narrows, and his plan is to expand gardening about the reserve. The first heavy frost in the summer of 1931 was on August 23, which is a week or more earlier than usual for heavy frost in the area.

GENERAL GEOLOGY

Summary Statement of Formations

Precambrian
- Basic intrusive: diabase, lamprophyre
  - (Intrusive contact)

Early Precambrian
- Granitic intrusives: granite, granite-gneiss, porphyritic granite, feldspar and quartz porphyry, granodiorite. All the granite of the area may not be of the same age. Some bodies may be Late Precambrian. A characteristic "quartz-eye" granite on Gods lake cuts the Hayes River lavas and sediments, but may be older than the Oxford sediments
  - (Intrusive contact)
- Basic intrusives: gabbro
  - (Intrusive contact)
- Oxford sediments: slate, greywacke, quartzite, arkose, conglomerate, sericitic and micaceous schists
  - (Unconformity)
- Hayes River lavas and sediments: basalt, andesite, trachyte, tuff, iron formation, chert, mica schist, chloritic and sericitic schists

General Character and Structure of Formations

Rocks belonging to the Hayes River and Oxford groups are distributed principally in five, long, narrow areas whose situation and outline are shown approximately on Figure 1. In the Max and Aswapiswanan Lakes areas, only members of the Hayes River group were recognized, whereas in Oxford-Knee, Gods, and Beaverhill areas, Oxford sediments either lie within or border on one side of the areas of Hayes River lavas. The strata of these groups are folded into almost vertical attitudes, and the beds locally are overturned. Schists derived from the lavas and sediments are widespread. The areas of Hayes River and Oxford rocks are surrounded by intrusive granite and granite-gneiss. The granitic rocks are widespread, and the bodies of lavas and sediments are erosion remnants of formations that formerly were more extensive. The essential features of the rocks of the various groups are summarized in the following paragraphs.

HAYES RIVER LAVAS AND SEDIMENTS

Volcanic rocks are by far the most abundant members of this group, the sediments, although widespread, are localized to narrow bands within the lavas. Of the lavas, an abundant type is medium-grained, either massive or schistose, basalt. Its surface may be black, greenish grey, or brownish. Some flows are porphyritic. In a few outcrops white crystals up to 1½ inches long, and perhaps of feldspar, are about equal in area to the greenish schistose groundmass. Pillow structure is well developed in some flows. Fine-grained, black andesite is more abundant than basalt at most localities, and flows of basalt and andesite are interlayered at a few horizons. The andesite is massive and schistose, and some of its outcrops are of a greyish black, dense, glassy-appearing rock. Needles of black hornblende and shreds of chloritic materials are the only minerals recognizable in hand specimens. Pillows are abundant in some flows and, in addition, others contain lens-shaped masses that weather epidote green. The direction towards which the tops of some of the steeply dipping flows face is indicated where the flat or bottom side of a long, narrow pillow is shaped to fill irregularities in the adjoining top surface of the underlying pillow.

Grey, fine to medium-grained trachyte and dacite locally are abundant members of the Hayes River group. Small crystals of white feldspar are visible on their weathered surfaces and dark-coloured minerals are not so abundant as in the basalt and andesite. Quartz and biotite occur in many specimens. Some flows are porphyritic, with angular crystals of feldspar up to a quarter inch long. Pillows are not well developed in the grey lavas. Greenish grey to white chlorite-sericite schist, derived from trachyte or dacite, occurs locally. No rhyolite was seen among the lavas, although white and purplish tinted pebbles of rhyolite are present in the conglomerate at the base of the Oxford sediments that overlie the Hayes River lavas and sediments. These pebbles may be from flows of rhyolite that were near the top of the volcanic group, and that were eroded before the conglomerate was deposited.

Water-sorted volcanic debris or tuffs and quartzose clastic beds constitute a few horizons within the Hayes River group. These sediments are grey rocks, fine grained and laminated or coarse and obscurely bedded or non-bedded. The fragments are up to 4 inches long in some tuff beds; in the typical rock, however, they are subangular and average about the size of peas. The fragments weather slightly lighter in colour than the greenish matrix. Beds of laminated chert and more massive and not so finely bedded cherty quartzite and greywacke are interlayered with the lava flows. Some of the cherty beds carry abundant magnetite, and the layers of such horizons are intricately drag-folded. The weathered surface of some beds of tuff and greywacke is pitted and very irregular, especially at the water-level of lakes. Lumps, up to ½ inch in diameter, dot the surface of other beds. Such lumps may represent certain constituents of the sediment that have recrystallized to minerals more resistant to weathering than the matrix. Some of the bedded rocks and their adjoining lavas are highly schistose.

The base of the Hayes River group of lavas and sediments is not known. The lower members are basalt and andesite, with only a few thin beds of tuff and chert. Grey trachyte and dacite are present with the andesite in the upper part of the group and there bedded deposits are more abundant, and individual beds are thicker than they are among the basaltic flows. Time did not permit the following of individual horizons to determine the lateral extent of flows or bedded deposits. The Hayes River strata are overlain by a group of sediments, designated the Oxford sediments, as members of this group are typically developed on Oxford lake. The contact between the Hayes River lavas and sediments and the Oxford sediments was studied closely, and, at most localities, conglomerate lies between the volcanic and sedimentary groups. This conglomerate may be only a few feet thick or it may be over half a mile thick. At some localities, as on Knee lake, thick beds of conglomerate, etc., derived from erosion of lava, lie between the volcanic and sedimentary groups. At different points, the conglomerate rests on andesite, basalt, pillow lava, trachyte, carbonate schist, and tuff. Southwest of Trout lake (east of Gods Narrows) the line of contact between conglomerate and lava follows an irregular course, as if the conglomerate had been deposited on a hilly surface. At most points, the basal layers of conglomerate carry many subangular pebbles of lava, and these and the material of the greenish or black, chloritic matrix, undoubtedly were derived from a lava floor nearby, and represented by the Hayes River lavas and sediments adjoining the conglomerate. The character and relations of the basal beds of conglomerate indicate that the Hayes River lavas and sediments were being eroded at the time the Oxford conglomerate was deposited.

The strata of both the Hayes river and Oxford groups everywhere are folded to nearly vertical attitudes, and both groups of rocks appear to have been folded to the same extent. Only the general features of the folding are known, and these are indicated diagrammatically along the structural sections accompanying Figure 1.

OXFORD SEDIMENTS

Conglomerate is the basal member of this group at most localities. The conglomerate is overlain by medium-grained arkosic sediments and micaceous quartzose beds. East of Gods Narrows, the majority of the sediments above the conglomerate are light grey, fine-grained, quartzose types, such as quartzite, and dark grey to black clayey beds, represented by argillites and slates. The sediments of this group are exposed over a wide area from near the west end of Oxford lake, east through Knee lake, on Gods lake from Gods Narrows east and southeast for 12 miles, and north and east of Beaverhill lake.

At many localities, the majority of the pebbles of the basal beds of conglomerate are black and grey lava. Many such pebbles are angular or subangular, although a few are round. These pebbles are in a greenish to black matrix of chloritic material. Conglomerate of this type closely resembles pyroclastic beds in appearance, except that fragments of different types of lava are present, and at a few localities a few round pebbles of granite and quartz occur among the materials derived from lavas. The basal beds pass upward into typical conglomerate carrying many pebbles and boulders of granite, in a grey, quartzose, chloritic, and micaceous groundmass that is bedded at a few horizons. Towards the top of the conglomerate horizon, layers from a foot to 20 feet in thickness and wherein over half the area exposed by the surface is of pebbles, alternate with bedded quartz-mica layers without pebbles and from 4 inches to 5 feet in thickness. Thin conglomerate beds occur within the quartzose sediments for 2,000 feet or more above the main conglomerate horizon. Some boulders of granite in thick beds are 2 feet in diameter and others are lenticular, with exposed cross-sections up to 25 inches long and 9 inches wide. The pebbles of granite and lava are elongated in the plane of the dip of the schistosity in some beds where the conglomerate member is thin and the strata are compressed on the limb of a narrow fold. In many beds the pebbles are from ½ to 4 inches in diameter, and these are all well rounded. Some of the pebbles are of grey granite-gneiss, and the conglomerate east of Gods Narrows carries abundant pebbles and slabs of feldspar porphyry and "quartz eye" granite. The latter rock has the same general appearance as that of the bodies of "quartz eye" granite cutting the Hayes River lavas just east of the conglomerate. The "quartz eye" granite is not known to cut the Oxford sediments.

Above the conglomerate, grey arkose and quartzite, and dark grey to black argillite and slate are about equally abundant. In some sections, rocks of these types are interlayered, whereas in others, arkose and quartzite predominate. All these types exhibit bedding, and a few thin layers of arkose are crossbedded. Some horizons, at least 2,000 feet thick, are of alternating beds of fine-grained, white to light grey quartzite and laminated, greenish to dark grey argillite. Some beds of sediments are altered to white quartz-sericite schist, and others to grey quartz-mica schist. The sediments near the granite are locally recrystallized to a banded quartz-mica rock carrying red garnets. Other beds of fine-grained, laminated, cherty types are intricately drag-folded. Thin bands of magnetite-bearing sediment alternate with cherty beds along some horizons.

Evidence that the Oxford sediments are younger than the Hayes River strata has been stated briefly in the description of the Hayes River group. The general relations of the areas of Oxford sediments with respect to those of the Hayes River lavas are briefly indicated below. At the west end of Oxford lake, the Oxford sediments lie in a narrow, closely compressed syncline within the lavas. This fold widens to the east, and here the beds on the north limb are overturned. Where the syncline is 5 miles or more broad, as at the the east end of Oxford lake and on Knee lake, the part of the south limb that should be occupied by the lavas of the Hayes River group and the basal conglomerate and some of the higher beds of the Oxford group, is occupied by a large body of intrusive granite. The conglomerate horizon in the north limb of the syncline outcrops on islands and at intervals on the mainland from the bay at the entrance of Carrot river to Hayes river south of Back lake. The conglomerate is well exposed at Eightmile point and on the main shore and islands at intervals east of Hyers point. At the outlet of Back lake, the trend of the strata changes from north of east to south of east, and for 8 miles to the east no outcrops have been found in the vicinity of the contact between lava on the north and sediments on the south.

Conglomerate occurs within the Oxford sediments on Hayes river south of Back lake, but the beds are perhaps a half mile or more south of the lavas. Sediments are interlayered with lava flows adjoining the main area of Oxford sediments on Knee lake and north of Wolf river farther east. Some of the lava is also brecciated and pyroclastic materials are locally abundant. The exposed members of the Oxford sediments lying immediately south of this main body of dominantly volcanic rocks, comprise chlorite and carbonate schists, quartzose materials exhibiting poor crossbedding, and thin layers of quartose and magnetite-rich materials. Some of these rocks are fairly well-bedded, in others the bedding is obscure, and the irregular surfaces of many outcrops show no sign of bedding. Such types may be slightly water-sorted sediments derived from a floor of volcanic rocks. The conglomerate at the base of the Oxford sediments in Oxford lake does not appear to be represented at this horizon on Knee lake or along Wolf river. Rock exposures here are very scarce along the junction of the two groups of rocks.

The body of Oxford sediments east of Gods Narrows is separated from the underlying Hayes River lavas by a conglomerate that is continuous along its strike for 12 miles or more, and it varies in thickness from 400 to 3,600 feet. The Oxford sediments of the areas west of the outlet of Gods lake and north of Beaverhill lake are separated from the Hayes River lavas by a conglomerate horizon from 5 to 100 feet in thickness. The conglomerate in these areas varies in thickness from point to point, and it may not be continuous for the whole length of the contact. The conglomerate beds carrying pebbles of lava at the base of the Oxford sediments are continuous enough, however, to mark the boundary between the Oxford sediments and the Hayes River lavas and sediments.

BASIC INTRUSIVES OLDER THAN GRANITE

Small bodies of basic rock cut the Hayes River and Oxford strata. Blocks of similar rock are abundant locally as inclusions in the granite. A few bodies of the basic rock are cut by dykes of granite and pegmatite. The basic rocks are gabbro, consisting essentially of labradorite and hornblende, and they are black and of medium to coarse grain. Some masses locally contain abundant magnetite, as on the large island of the group near the south shore of Oxford lake, 2 miles west of the west inlet. Many narrow dykes of gabbro parallel the bedding of the Oxford sediments. A few boss and lens-shaped masses are as much as 1,000 feet across. Some of the gabbro along the margin of the larger bodies is schistose. In other areas in Manitoba, sulphide deposits carrying nickel and copper are associated with bodies of peridotite, gabbro, and quartz gabbro that are similar in their general features to this group of basic intrusives of Oxford House map-area.

GRANITIC INTRUSIVES

Granitic rocks are widespread in Oxford House map-area. They surround the areas of Hayes River and Oxford strata. The granite is variable in colour, texture, and mineral composition, though areas of several square miles may be mainly of one type. A widespread granite is grey or pinkish grey and of medium grain. It is mostly massive, although some areas a half mile wide are gneissic and typical banded gneisses occur locally. The granite of other areas is pink, massive, and medium grained. Other areas are underlain by grey to black, coarse-grained granodiorite. Rocks of this latter type are exposed in the rugged area east and south of the southwest end of Beaverhill lake. A zone of porphyritic granite, about 4 miles wide, extends east and west across the area north of Bolton (Porcupine) lake east to and beyond Porcupine river. Rectangular crystals of feldspar, up to an inch long, are abundant in some of this porphyritic granite. A massive grey to pink granite cutting the Hayes River lavas on Gods lake contains abundant "eyes" of dark quartz many of which are about a quarter inch long and some as much as a half inch long. The age of this "quartz eye" granite with respect to the granites of surrounding areas is not known.

The contact between any of the main body of granite and lavas and sediments is definite, although for from a hundred feet to a half mile away from the contact the lavas may be penetrated by dykes of granite and the granite may hold inclusions of lava. Inclusions of lava and black schist may also occur far within the main granite bodies. Such inclusions may be less than a square foot in size or they may be several hundred feet across and tend to be distributed in long, narrow zones. The contact between a large body of granite and granite-gneiss on the south and Oxford sediments on the north, is well exposed in the burned area west of Gods Narrows. Here the line of contact of the main body of granite is sharp, although dykes of granite occur in the sediments 1,000 feet or more north of the contact. The granite adjacent to the sediments is finer grained than the rock of the interior of the mass, and also is schistose and stratiform and thus resembles the sediments in general appearance. For this reason, the contact between granite and quartzose sediments of certain types may seem indefinite in wooded areas where outcrops are small and scattered and the study of such an area alone would undoubtedly suggest that the sediments graded into granite within a zone of variable width. About Gods lake the position and nature of the contact between granite and Oxford sediments could be determined only where outcrops were abundant and the moss was burned off the large rock ridges.

Granites of more than one age may be present in the map-area, for pebbles of granite in the Oxford conglomerate prove that a granite was exposed nearby at the time this formation was deposited, but all the granites noted in contact with the Oxford sediments are younger than these rocks. South of the east end of Aswapiswanan lake, a grey, banded granite is cut by massive, pink, aplitic granite and pegmatite. These rocks cross and parallel the gneissic structure of the grey granite. They may, however, be only slightly younger than the granite-gneiss that they intrude. In Oxford House map-area, as in most other areas within the Canadian Shield, it is difficult to map separately granites of different character and age, unless very detailed field work is undertaken.

BASIC INTRUSIVES YOUNGER THAN THE GRANITE

A few narrow dykes of diabase cut the granite and members of the Hayes River and Oxford group of strata. The dyke rocks are black, fine grained, and fresh appearing. The outcrops of some of them weather brownish. They exhibit a diabasic texture and consist essentially of labradorite and augite. A few of the larger bodies contain olivine. Dykes of diabase are not abundant in Oxford House map-area, and no large dykes or sills of these rocks were seen similar to those on Island lake to the southeast or about Landing and Wintering lakes to the northwest.

ECONOMIC GEOLOGY

Only a small part of Oxford House map-area has been prospected except in a very hurried manner. Most of the work to date has been in the area about Oxford and Knee lakes, which has been visited by parties at intervals since 1918, when gold was discovered on Knee lake by Mr. H. M. Paull and associates. In 1922, Mr. Nels Mattson prospected wide zones of schist about the west end of Oxford lake that carried disseminated sulphides and stringers of gold-bearing quartz. In the autumn of 1928, one of these deposits on Hyers island was optioned by Ventures, Limited, and in 1929 twenty-two shallow holes were drilled to trace the continuation of this deposit to the east under the lake. No further work has been undertaken in the area since 1929, when Ventures, Limited, discontinued exploration.

The field work of 1931 was undertaken to outline additional areas southeast of Oxford lake that might be favourable for the occurrence of valuable minerals, and especially gold. The investigation was almost entirely limited to a study of the areas of lavas and sediments, as the ore deposits of other areas in the Canadian Shield are in rocks of a similar type. It is important, consequently, that prospectors know the situation, approximate outline, and general character of the formations of all areas of such rocks in a district. This information, for Oxford House map-area, is shown on Figure 1. The accompanying cross-sections give a diagrammatic interpretation of the rock structures along certain lines across these areas. As stated already, the dominantly volcanic rocks are designated the Hayes River group and the sediments the Oxford group. The age relations and lithological character of the strata of these groups are similar to those assemblages known as "Keewatin" and "Timiskaming" in areas to the south and east in Ontario. In the succeeding paragraphs, the main features of the geology and mineral prospects of each of the main areas of these rocks are given more specifically than in the foregoing sections dealing with the general geology of the whole map-area.

OXFORD-KNEE LAKES AREA

The largest area of Hayes River and Oxford strata is that extending through Oxford and Knee lakes. The longer axis of this belt trends about east and west for at least 65 miles and may extend southeast another 18 miles from Fishing lake to the outlet of Gods lake. Lavas of the Hayes River group also extend north and northeast for miles along the shore of Knee lake, beyond the north edge of the central part of the map-area. The area is 13 miles across at its widest known point. Its south margin has not been explored east of the west end of Knee lake where no canoe routes are known.

In this large area, members of the Hayes River group lie next the granite along the north margin and also along the south margin from near the west end of Oxford lake to 4 miles east of the inlet of this lake. At the west end and in the central part of Oxford lake, Oxford sediments lie between the Hayes River lavas on the north and south. They continue eastward but they are bordered on the south by granite. The dip of the strata is everywhere steep and many beds are vertical or overturned. The strata are closely compressed and the rocks are altered to schist along belts up to 100 feet across. Small dykes of gabbro cut the Hayes River lavas near the west end of Oxford lake, and a few small dykes of quartz and feldspar porphyry cut the lava along the north shore of Knee lake. Small bodies of intrusive rock, however, are not known to be abundant in the Hayes River and Oxford strata of this area except at a few localities. The lavas and sediments adjoining the granite are only locally recrystallized or otherwise altered by the effects of the granite magma.

The main development work on the mineral deposits in Oxford-Knee Lakes area has been done on: Hyers island and the mainland to the north; the south shore of Oxford lake a mile east of the east inlet; and about Painkiller bay on the north shore of Knee lake.

HYERS ISLAND

Mineral claims were staked over twenty years ago on Hyers island, and at that time a few pits were dug to explore the large deposits of iron carbonate along the north side of the island. This locality again received attention when Mr. Nels Mattson staked the New Falu mineral claim in May, 1924, and Mr. G. A. Adair staked the adjoining Radia mineral claim in September, 1926, on the east end of Hyers island. In the autumn of 1928, Ventures, Limited, optioned these and surrounding mineral claims, and, in the succeeding months, drilled twenty-two holes on the ice in Oxford lake to explore the eastward extension of a large body of schist carrying sulphides and vein quartz and outcropping on the east end of Hyers island. An islet along the strike of this schist zone, bare in 1928 when the water was exceptionally low, carried enough chalcopyrite and gold to make a copper-gold ore, and this encouraged the investigation of the intervening area under the lake by diamond drilling. As the water was high in Oxford lake during the autumn of 1931, this islet could not be examined and the casings put down in drilling also were under water.

The body of schist carrying iron, copper, zinc, lead, and antimony sulphides and gold-bearing quartz on the New Falu and adjoining mineral claims, at the east end of Hyers island, lies in lavas of the Hayes River group. The lava is highly altered in an area about 750 feet wide and extending along the north side of Hyers island. Much of the lava within this zone is so highly altered to chloritic, talcose, and sericitic schists that its original composition cannot be determined. The rocks, however, very probably were basalt and dacite, similar to the flows that lie both north and south of the zone of schist. A bed of conglomerate, forming the base of the Oxford sediments, outcrops on the small island about 2,000 feet east of Hyers island. This conglomerate lies on pyroclastic lava and appears to be in a syncline within the Hayes River lava. The dip of schistosity of both the lavas and sediments is nearly vertical at this locality. The schist zone on Hyers island thus may be on the south limb and near the axis of a closely compressed synclinal fold.

The area of Hayes River lavas is cut off by granite at the west end of Oxford lake, about 3 miles west of the schist body at the east end of Hyers island. This granite body also borders the lavas about $1\frac{1}{2}$ and $1\frac{1}{4}$ miles north and south, respectively, of the east end of Hyers island. The line of junction between lavas and granite is irregular, especially along the west end of Oxford lake, where long, narrow tongues of lava extend for several thousand feet within the granite. At some localities, as on the bare hills on the mainland west of the west end of Hyers island, porphyritic granite is brecciated, and the fragments are cemented in a matrix of granite containing abundant chloritic material perhaps derived from the lava. Many dykes of granite and granite porphyry cut the lava at least a mile away from the main granite body. These dykes are exceptionally abundant along the main belt of schist referred to above. The dyke rocks also are altered to quartz-sericite schist, but not so extensively as some of the nearby lava.

Large bodies of iron carbonates occur along the schist belt on the north side of Hyers island, but though very interesting, are not at present valuable as a source of iron ore. One of the bodies of iron carbonate is at least 3,000 feet long and 50 feet wide. Several parallel bodies are exposed within 750 feet across the strike, and the intervening schist also carried abundant carbonates. The carbonate bodies are largest about half-way along the north side of Hyers island, becoming smaller along the strike both east and west from this locality. The amount of carbonates in the schists also decreases along the strike on both sides of the central area containing the main carbonate bodies. The bodies of iron carbonate are massive. Brownish siderite is the abundant carbonate, although white ankerite is also present and some calcite. Lenses and stringers of vein quartz are abundant in some of the carbonate, also pyrite in cubes and grains. The quartz and pyrite are not known to be gold-bearing. Some narrow veins of carbonate in the schist are crenulated as if folded since they were formed. The dykes of granite and granite porphyry contain carbonates, but in smaller bodies than in the adjoining lava. The basal members of the Oxford sediments on the small islands east of Hyers island also contain carbonates. The schist and carbonate bodies are cut by narrow dykes of black, massive rock. The carbonate bodies formed after the intrusion of the granite and the main period of deformation. The main part of the quartz and sulphide mineralization, the part carrying gold, is later than the carbonate bodies. Grains of carbonate are included in the gold-bearing quartz and carbonates are in part replaced by granular pyrite and chalcopyrite. An interpretation of the sequence of mineralization is that residual liquids, derived from the granite magma and rich in materials that formed iron carbonates, some quartz, and pyrite, entered the zone of schist where the large iron carbonate masses are, and gave rise to them.

At a slightly later time, other solutions from the same source circulated along other parts of the same schist zone, and deposited gold-bearing quartz, pyrite, chalcopyrite, sphalerite, galena, and stibnite.

The copper-gold deposit explored by Ventures, Limited, as exposed at the northeast corner of Hyers island, is in a belt of chloritic, talcy, and sericitic schist derived from lava and about 200 feet thick. Within this zone, certain layers are highly schistose and the original rock is completely altered to a fissile, white, sericitic, and talcy schist. A few narrow dykes of granite cut the lava in this zone, and the dyke rocks also are highly altered to sericite schist. Stringers and lenses of quartz cut the schist. The quartz, although distributed in small bodies throughout the whole mass, is more abundant along certain narrow zones, and there chalcopyrite also is more abundant than elsewhere. Such zones from a foot to 3 feet wide may assay $8 to $10 a ton in combined gold and copper, the average of a body of schist 8 feet wide or thereabouts is, however, less than $3 in combined gold and copper. Two samples, together weighing about 20 pounds, from a high-grade lens, were tested by Mr. J. S. Godard in the Ore Testing and Research Laboratories of the Mines Branch, Ottawa, and the following analyses of the ore are from page 62 of the report of this laboratory for 1928.

——	Sample No. 1	Sample No. 2
Gold	0·27 oz. ton	0·23 oz. ton
Silver	3·78 " "	2·10 " "
Copper	5·50 per cent	5·06 per cent
Iron	14·07 " "	17·34 " "
Arsenic	0·04 " "	0·03 " "
Antimony	nil	nil
Insoluble	62·06 " "	53·83 " "

From tests made, Mr. Godard concluded that the "gold and silver are mainly associated with the chalcopyrite, and to a lesser extent with the iron sulphides. Over 50 per cent of the gold is freed on grinding to about 85 per cent—200 mesh. . . . The gold is free but does not float with the copper . . . the silver is not amenable to amalgamation."

The results of the diamond drilling of the extension of the deposit under the lake eastward from Hyers island are not known. The drill cores are stored in piles in one of the cabins and apparently the holes for most of their length intersected schist similar to that outcropping on the east end of the island. Much of the schist of the cores is sparingly mineralized with quartz and sulphides. A few narrow bodies of schist that may be commercial grade gold-copper ore were intersected.

The gold-copper deposit explored by drilling lies along the south margin of the schist belt and apparently no stibnite occurs in this part of the mineralized zone. The schist exposed by a pit on the northeast corner of Hyers island, near the north side of the schist belt, however, does carry stibnite. The pit is about 8 feet deep on a shear zone about 5 feet wide.

A lens-shaped body of vein quartz and schist carrying sulphides and about 90 feet long and 3 feet wide at its widest point, lies in this shear zone. This mineralized schist body also contains iron carbonates and stringers of plagioclase-quartz pegmatite. The stibnite occurs either massive or disseminated in the schist. Some veins of massive stibnite are 2 inches thick and pockets are 1½ feet long and 9 inches wide. Some of the stibnite is in crystals with striated faces. The stibnite cuts the carbonates, quartz, and feldspar of the pegmatite, and is the latest mineral to be deposited. This mineralized body of schist narrows within 35 feet both east and west from the pit, and although iron carbonates are abundant, no stibnite was seen over 10 feet away from the main pit. Apparently the highest grade antimony ore is at the pit, where Mr. Mattson collected several tons of high-grade material, while doing assessment work. This deposit would be valuable as a source of antimony only at a time when the price of this metal was very high.

OXFORD LAKE SHORE NORTH AND WEST OF HYERS ISLAND

Many mineral claims were staked on Hyers island and the mainland about the west end of Oxford lake in the autumn of 1928 and the winter and spring of 1929. Some trenching was undertaken on some of these claims. The trenches along the shore of Oxford lake north of Hyers island exposed wide bodies of sericite and chlorite schist, derived from basaltic lava and granite porphyry. Quartz in veins, lenses, and stringers is fairly abundant in some of the schist. Iron sulphides and iron carbonates are also widespread. The gold content of such deposits apparently is low. Mineral claims were also staked along the narrow bays at the southwest corner of Oxford lake along tongues of lava extending west into the main granite body. A wide belt of schist, near the water-level along the south side of the deepest bay extending west from the southwest bay of Oxford lake, is well mineralized with vein quartz, sulphides, and carbonates. The deposit is about 100 feet north of the granite contact. So far as is known, the deposits prospected did not carry encouraging quantities of gold.

Big Lynx Group

The Big Lynx group was staked by Mr. N. Mattson in 1922 and 1923 along the south shore of Oxford lake, just east of the east inlet. In succeeding years, Mr. Mattson completed some trenching to expose a body of schist carrying sulphides and quartz. In all, eleven trenches were dug in an area extending from the water-level of the lake for 700 feet along a strike of south 70 degrees east. The deposit dips steeply north.

The bedrock exposed in the pits and vicinity is andesite, greywacke, and tuff of the Hayes River group. Granite outcrops on the small island a few hundred feet north of the deposit, and also on the mainland to the west and east. The rock is largely drift covered immediately south of the deposit, but granite is assumed to be the bedrock at points only a few hundred feet south of the showing, and the area of Hayes River rocks is believed to be only a narrow tongue within the large body of granite to the south. Lava and tuff outcrop on the large islands to the north and northwest of the deposit.

At the water-level, the main body of schist is 60 feet wide, and it gradually narrows on the hillside to the east. The schist is chloritic and sericitic and may be derived from a narrow bed of tuff or greywacke adjoining andesite on the south. The schist is cut by narrow veinlets and small lenses of quartz and massive sulphides, including pyrite, chalcopyrite, sphalerite, and galena. The sulphides also occur in grains and bunches distributed throughout some bands of schist. The sulphides are more abundant at the water-level than in the higher ground to the east. Some sections of mineralized schist at the lake shore are estimated to assay 4 per cent combined copper, zinc, and lead across widths of 4 feet. The gold content is not known, although the abundant quartz in parts of the deposit suggests that gold may be an important constituent. The deposit can be sampled satisfactorily only when the water is low in Oxford lake. Schist, mineralized similarly to that at the prospect trenches, outcrops on the points along the shore of Oxford lake from a half to three-quarters of a mile west from where the work has been done. If exploration work were in progress in the area, it might be advisable to test the continuation of this deposit under the lake by a few shallow diamond drill holes.

GOLD PROSPECTS ON KNEE LAKE

Gold was discovered on Knee lake in 1918 by H. M. Paull and associates, when two groups of mining claims were staked: one on the large island about 7 miles east of the inlet and the other on the bay, locally known as Painkiller bay, 2 miles farther to the north and east. Some trenching of the deposits on these claims was done in the following years, but no large body of gold ore was uncovered. The area received little attention from 1919 to 1927, when Mr. Paull again did some more work on the original showings, and a number of prospecting parties closely examined the surrounding country. Drift deposits are widespread and bedrock is poorly exposed except on the lake shore and inland for a thousand feet. In 1928, the timber and moss were burned off a large area north of Painkiller bay. The title to the original claims having lapsed, Messrs. Fred Coleman and Sam Roche in April, 1929, restaked a large area about Painkiller bay.

The bedrock exposed in this area comprises porphyritic and non-porphyritic grey lava, probably dacite and trachyte. Most of the lava is slightly schistose and some of it is altered to a grey or greyish white chloritic and sericitic schist. The schistose lava is cut by a few narrow dykes of grey quartz and feldspar porphyry. The dyke rocks are schistose and jointed. No large body of granite is known within 5 miles of this locality. The gold-bearing quartz is in lenses and veinlets in the schistose lava and intrusive porphyry. No large, continuous body of gold-bearing quartz was found. Some of the quartz stringers, however, are exceptionally rich in gold. Some of the quartz carries pyrite and chalcopyrite and the schist between quartz stringers is also mineralized with pyrite, chalcopyrite, and specks of arsenopyrite. Selected samples of quartz assay high in gold, but the average gold content of widths of 5 feet of quartz and schist is far too low to make a commercial deposit. A number of bodies of quartz, up to 5 feet wide and several hundred feet long, are reported in the area, and also farther north near Cinder lake, but such bodies unfortunately are barren or average only a trace of gold. The geology of the area along the north shore of Knee lake appears favourable for the occurrence of gold ores. The area has been prospected probably more closely than any other area in northeast Manitoba, and the results of the work to date have been discouraging. It should be emphasized, however, that the scarcity of rock exposures inland and the thick bush and the moss covering the rock at the time the prospecting was undertaken, made it impossible to examine the country except in a very general way.

MAX AND ASWAPISWANAN LAKES AREAS

A narrow belt of Hayes River lavas extends westward from the east end of Max lake and another extends westward from the west end of Aswapiswanan lake which lies to the south and east. These two areas of lavas are separated by a granite area lying south of Max lake and about 2 miles wide. The two belts of lavas extend westward many miles beyond the west edge of Oxford House map-area. Their westward extension in the adjoining Cross Lake sheet was studied by Mr. H. C. Horwood during the field season of 1931. In Oxford House map-area, the Max Lake belt is 2 miles across and the Aswapiswanan Lake area 3 miles across at their widest points. Their width is variable from less than 1,000 feet to the maximum given. To the east, both belts are cut off by granite, and inclusions of lava are abundant in the granite along the projected strike of the belts of lava for several miles east of the east end of Max lake and the middle of Aswapiswanan lake. The Aswapiswanan belt may have originally joined with the Beaverhill Lake area to be described in a following section of this report, the two areas being about 15 miles apart and separated along their strike by an area of granite which locally carries inclusions of lava.

The Hayes River rocks of Max and Aswapiswanan belts include basalt, andesite, and trachyte. Some flows are porphyritic. Sediments are not widespread, and are limited to a few horizons about 100 feet thick of dark and light grey, bedded materials and white, sericitic schists. Some of the sediments carry small, red garnets, and such rocks are probably schistified and partly recrystallized tuffs. The lavas are both massive and schistose. The surface of the area of lavas west of Aswapiswanan lake and south of Max lake is rugged, with narrow, parallel, steep-walled valleys. Rocks are well exposed on the hillsides. The dip of the schistosity of the lavas and sediments is everywhere steep, and the strata have been closely compressed in folding. Dykes of granite and granite porphyry cut the lavas close to the main bodies of granite. No dykes of grey quartz porphyry were seen in these areas. Both the lavas and the adjoining granite are cut by a few narrow dykes of diabase. Veins and stringers of quartz are present along schist zones in the lavas. The quartz and adjoining schist carry sulphides, but no free gold was found in the few quartz bodies examined. Some prospecting was done in these Max and Aswapiswanan belts of lavas in 1926. The gold content of the samples of quartz that were assayed was disappointingly low. These two belts of lavas are somewhat narrower at most points than the areas of similar rocks that elsewhere have been proved to carry valuable ore deposits.

MUNRO LAKE AREA

An area of Hayes River lavas extends for at least 12 miles eastward through Munro lake from the north shore of Colen lake. Its eastward extent beyond Munro lake is unknown, as no canoe routes could be found crossing the country east and south of Munro lake. It is reported, however, that Indians cross this area to Gods lake by canoe in early spring. The forest was burned several years ago in the area east and south of Munro lake, and this makes it a difficult area to traverse inland. Deposits of drift, in the form of ridges of gravel, sand-plains, and ground moraine, are fairly widespread east of Munro lake. The prospecting area is about 4 miles wide. This whole area may not be underlain by lavas, as there may be a number of small bodies of granite in the area between the east end of Munro lake and the long, narrow lake east of the northeast bay of Colen lake. One such body of granite within the lavas is known near the west end of the prospecting area, south of the canoe route from Colen to Munro lake, about 2 miles from Colen lake.

The Hayes River group of Munro Lake area comprises chiefly basalt, andesite, greywacke, and tuff. Poorly developed pillows are abundant in some outcrops of basalt and andesite. Massive types of lava alternate with wide, intervening belts of schist derived from lava and tuff. The massive lava is fine to medium grained, and black to dark grey. The derived schists are greenish grey to white, and consist essentially of chloritic minerals. Sediments are fairly abundant within the lavas and at some horizons are at least 300 feet thick. They comprise well-bedded greywacke, some beds near quartzite in general appearance, other beds of fine-grained, black rocks with slaty cleavage, and layers of bedded schistose materials, probably tuffs, as they carry small, angular, and granulated fragments of what appears to be lava. The surface of some of the tuff beds and of some of the slaty greywacke because of weathering is pitted and very irregular near the water-level of the lakes. Some beds contain hard lumps of recrystallized minerals, giving a knotted appearance to the weathered surface of the rock. The strike of the bedding and schistosity is near east, the dip is steeply south on Munro lake along the north margin of the prospecting area and is steeply north on the lake east of the northeast bay of Colen lake situated along the south margin of the area. The strata, therefore, may be folded into a syncline within the granite.

The Hayes River rocks are cut by many narrow dykes of granite porphyry. Some of these dykes are remarkably continuous along their strike; one dyke about 4 feet wide is exposed along its strike for 3 miles along the south shore of Munro lake. Many of the dykes are irregular in size and may vary in width from less than a foot to over 10 feet within a few hundred feet along their strike. Some dykes branch into two or more narrow, parallel dykes. Others are lenticular in surface plan, one such dyke being 200 feet long and 5 feet across at its widest point. The dykes follow closely the dip and strike of the bedding and schistosity of the Hayes River strata. The rock of some dykes is fine grained and has the general appearance of beds of massive quartzite. Others are porphyritic, with crystals of white feldspar up to a quarter inch long in a dense grey groundmass. Phenocrysts of quartz are not abundant in the dyke rocks. The rock of a few dykes is medium and even granular. Members of the Hayes River group adjoining some dykes are sheared, and stringers and veinlets of quartz occur in the schist, and also in the jointed granite porphyry dykes. Quartz is present also in shear zones within the lavas some distance from dykes. No large body of quartz was seen, and no gold was found in the quartz at the few localities examined. Shear zones up to 6 feet wide, carrying quartz in veinlets and lenses and mineralized with sulphides, were noted at five horizons in the burned area south of Munro lake. The area is not known to have been prospected except in a very general way by trappers.

GODS LAKE AREA

The main prospecting area on Gods lake lies east of Gods Narrows and is 35 miles long and 15 miles across at one point. The rocks are well exposed, except near the east end of Gods lake where the surface is flat and swampy. The main prospecting ground is on the large islands and the mainland for 25 miles east from Gods Narrows.

Strata of both the Hayes River and Oxford groups are represented in Gods Lake area. The Hayes River lavas are the bedrock of the part of the area east of the point on the lake shore about 4 miles east of Gods Narrows. The Oxford sediments lie west of the lavas between these rocks and the granite. The Hayes River lavas outcrop along the crest of a broad anticline whose axis passes through the islands north and west of Elk island. The Oxford sediments are in the south limb of this fold. The dip of the beds and the schistosity is everywhere 70 degrees or greater. The strata are complexly folded along certain narrow zones and this folding is interpreted as being minor crumplings on the limb of the major anticlinal fold.

Black and brownish, greyish weathering basalt and andesite are the abundant types of lava of the Hayes River group in Gods Lake area. A few flows of grey trachyte and dacite occur locally. Sediments are scarce within the lavas where only a few beds of tuff were recognized among the thick flows of basalt. Some of the basalt is porphyritic. Square and rectangular crystals of a white mineral, probably feldspar, and up to 1½ inches long, are abundant in some outcrops of basalt. This type of porphyritic basalt is quite abundant north and east of the narrows at the east end of the wide part of Elk island. Much of the basalt and andesite is massive. Some bands of green chloritic schist occur between the ridges of massive lava. Pillows are exceptionally well developed in some flows of basalt and andesite along the north shore of Elk island.

The Oxford sediments include conglomerate, arkose, cherty quartzite, and dark clay beds. The conglomerate is distributed as a long band, averaging about a half mile across, and lying for most of its length between the Hayes River lavas on the east and fine-grained sediments on the west. Fine-grained, light-coloured, quartzose and dark grey to black, clayey types of sediments are far more abundant than thick-bedded, coarser-grained, arkosic types which occur only at a few horizons within the fine-grained beds. Most of the fine-grained sediments are well bedded, and this feature is distinct on weathered surfaces where thin, alternate layers of dark and light-coloured materials are visible. The sediments are altered to mica schists at some localities, as along the south shore of the second bay east of Gods Narrows. Some beds are intimately drag-folded. Belts of schist, representing shear zones, were noted at a few localities within the Oxford sediments. The fine-grained, cherty sediments of some horizons are altered across widths of 100 feet to greyish white, laminated, intricately drag-folded ribbon schist, parts of which are injected by lenses and stringers of quartz and granite.

Members of the Hayes River and Oxford groups are cut by dykes and bosses of granite, granite porphyry, and gabbro. The bodies of these rocks vary in size from masses less than a foot wide to a half mile across. The whole area of sediments and lavas is surrounded by intrusive granite that extends many miles in every direction. The small, intrusive bodies within the lavas and sediments are interpreted as dykes and bosses extending from the granite which probably underlies the whole area at depth.

Gabbro is abundant locally in the Oxford sediments as narrow dykes along bedding planes and as lenticular and rounded masses up to 300 feet wide. Gabbro may also be present at many localities in the Hayes River lavas, but if the bodies are not large, the gabbro is difficult to distinguish from basalt. Dykes of granite occur sparingly in the Oxford sediments and are localized along the margin of the main granite body. The Hayes River lavas on Elk island and the groups of islands to the west and northwest, however, contain many dykes of granite and granite porphyry. The bodies of porphyry are less than 100 feet wide and they are discontinuous along their strike. Some bodies of granite are up to 2,000 feet wide and 2½ miles long. Eye-shaped bits of dark quartz, from one-eighth to one-half inch long, are characteristic of this granite, and it is typically pinkish grey and massive. Granite of this type is not known to cut the Oxford sediments. It occurs extensively within the Hayes River lavas on the south shore of Gods lake and the adjoining islands, and at a few localities on the islands and north shore of the lake east of the entrance to Gods river. The relation of this granite to the main bodies of granite of the surrounding country is not known.

Gods Lake area has been prospected only in a general way. Local trappers and traders have noted quartz veins and have forwarded a few specimens for assay. The gold content of some of these specimens is reported as encouraging. In 1923, representatives of Anglo-Canadian Explorers spent a short time in the area and sampled a number of quartz bodies, but the assay returns were reported as disappointing. In 1928, a few prospectors while travelling through the area spent a few days prospecting. In the spring of 1928, Northern Mineral Exploration Company is reported to have had a party of prospectors on Elk island for about two weeks. No mineral claims have been staked in the area and for this reason the local residents hesitate to make known the localities where they claim to have found gold. Many shear zones in the lavas carry quartz. Some of the quartz bodies are up to 6 feet wide and at least 100 feet long, but no free gold was found in a hurried examination of the quartz of such deposits. Quartz stringers in other deposits do carry free gold, but there the exposed quartz and schist body is small. Some of the quartz and schist is mineralized with pyrite, chalcopyrite, galena, and arsenopyrite. Dykes of granite porphyry, similar to those in gold-bearing areas elsewhere, are abundant. All belts of schist mineralized with quartz and sulphides and near the dykes of granite porphyry should be investigated carefully. This area would appear worthy of much more detailed prospecting than hitherto has been undertaken.

BEAVERHILL LAKE AREA

Lavas of the Hayes River and sediments of the Oxford group outcrop in an area lying north and northeast of Beaverhill lake, and at least 25 miles long and 4 miles across at one point. This prospecting area trends east and west, the Hayes River lavas lie along its south side followed to the north by sediments of the Oxford group. Rock exposures are abundant in the southern half of the area and the country is hilly, whereas, along the north border, drift is widespread and in this flat, swampy area it is difficult to locate closely the contact between granite and sediments and thereby to determine the north and east limits of the prospecting area north of Goose lake.

The Hayes River lavas include andesite and a few flows of basalt. Beds of tuff and greywacke with slaty cleavage are interlayered with some lava flows showing pillow structure. Wide belts of lava and associated tuff are altered to chlorite and carbonate schist. The Oxford sediments include quartzite, arkose, greywacke, and a narrow band of conglomerate adjoining the Hayes River lavas. The strike and dip of the bedding and schistosity of members of Hayes River and Oxford strata are parallel; they strike east and dip vertically or steeply north. The lavas locally are cut by dykes of grey granite porphyry, white to pinkish aplite, and pegmatite. The granite porphyry dykes are not abundant or widespread. Some of the schist belts contain stringers of quartz, and massive andesite and basalt are cut by quartz veinlets along joint planes. No large body of quartz was seen, and sulphide mineralization in schist is of local distribution. The area is reported to have been prospected hurriedly by representatives of Consolidated Mining and Smelting Company. If important mineral discoveries are made in other nearby areas, the Beaverhill Lake area of lavas and sediments also should be re-examined carefully.

ISLAND LAKE AREA

The west end of Island Lake prospecting area lies about 25 miles south and west of the northeast end of Beaverhill lake. A reconnaissance study of the geology about Island lake was completed in 1927, and a geological map and complete description of this area are published in Part B of the Summary Report of the Geological Survey for 1927. Island lake was again visited in 1931 while studying the geology along the main canoe routes from Beaverhill to Island lake.

In the summer of 1928 twenty or more prospecting parties visited the area for a short time. Free gold was discovered at a number of localities on Confederation island and other islands to the east. All the deposits proved to be small, but some of the quartz carried abundant free gold. Consolidated Mining and Smelting Company and Nipissing Mining Company did some surface work on their discoveries. The majority of the prospectors left early in the summer, but a number, including Messrs. Gordon Raehill, Herb. Cowan, and T. Wass, remained and they report having made discoveries of gold at eight points on islands near the entrance of Sagawitchewan bay and south of Loonfoot island. They also prospected hurriedly an area of Hayes River lavas and sediments on the north side of Red Sucker lake, about 40 miles north of Island lake, and which was mapped in 1927. In this area, a body of white, aplitic, albite-bearing granite was discovered that carried small crystals of cassiterite. Their main gold discovery on Island lake was staked in August, 1931, and assay returns of samples from the shallow pits were so encouraging that early in December, 1931, many entered the district by aircraft to stake ground. These gold occurrences were not visited by the writer, and no information is available at present regarding their size.

The area of Hayes River strata, and hence the favourable prospecting ground about Island lake, is over 70 miles long and varies in width from 1½ to 14 miles. Black andesite, basalt, and grey trachyte and rhyolite are widespread, as are also tuff and cherty quartzite. Other large areas of sediments were included in this group in 1927, but some of these sediments may be younger than all the lavas and, if so, would belong to the Oxford group as developed on Oxford and Gods lakes. Another body of sediments younger than the Hayes River group is designated the Island Lake series. It consists of conglomerate, grit, and quartzite. The dip of the beds of this series is on the average about 45 degrees, and the strata are separated from the underlying steeply dipping Hayes River rocks by a marked unconformity. No sediments of this type or with relations similar to the Island Lake series were seen in Oxford House map-area.

Members of the Hayes River group about Island lake are cut by dykes of gabbro, grey quartz and feldspar porphyry, granite, and pegmatite. The area of sediments and lavas is surrounded by large bodies of intrusive granite and granite-gneiss. The lavas, sediments, and some bodies of quartz porphyry are altered to schists across belts several hundred feet wide, and shear zones carrying vein quartz are widespread. No intrusive bodies were seen in the Island Lake series. All the rocks are crossed by dykes of olivine diabase and quartz diabase. Thus, the main features of the geology of Island Lake area are similar to those of certain areas of Oxford House map-area, and also very like that of some areas within the Canadian Shield wherein valuable mineral deposits have been discovered.

CONCLUSIONS

The prospecting areas about Oxford, Gods, and Island lakes are from 75 to 175 miles southeast of the Hudson Bay railway, and they are difficult to reach except by aircraft. The prospecting territory is limited to long, narrow belts of lavas and sediments that are older than the surrounding widespread granitic rocks. The belts of rocks likely to carry ore-bodies are largely within or near the basins of the larger lakes, consequently much of the favourable prospecting ground is on islands or less than 3 miles inland from the lake shore. Rock exposures are plentiful in some parts of the area, in others, drift deposits are widespread. The lavas and sediments locally are altered to schists and intruded by dykes and other small intrusive bodies of quartz and feldspar porphyry and granite. Small quartz bodies that carry free gold are known in some shear zones. Some large and easily located quartz bodies are barren of gold. Sulphides, including pyrite, pyrrhotite, arsenopyrite, chalcopyrite, galena, sphalerite, and stibnite are distributed throughout the schist at some localities. A large schist body on the east end of Hyers island, Oxford lake, and carrying lenses wherein gold-bearing quartz and chalcopyrite were abundant, was explored by diamond drilling in 1929. The most favourable ground for the occurrence of large, continuous quartz bodies would appear to be those areas where hard, brittle rocks, such as some andesite flows and chert and quartzite beds alternate with thick flows of basalt and other types of lavas and sediments. All schist zones near or in areas where small bodies of granite or dykes of quartz or feldspar porphyry are exposed, should be prospected very carefully. The gold-bearing quartz probably originated from the granitic magma that earlier gave rise to the small bodies of granite and porphyry.

Prospectors should be prepared to spend months in the field and should be equipped to undertake preliminary trenching. Prospectors report that the area can be examined to advantage in the autumn, early winter, and early spring as then there is little snow and the lakes and swamps are frozen, thus facilitating traversing inland.

The deposits may be of a type in which the greater part of the gold is free and is carried in the quartz. If so, to be profitable enterprises, the deposits should be developed on a small scale, and by companies with a low capitalization. If the results of the small scale operation are encouraging, the plant and organization can be expanded as the size and grade of the ore-body warrants.

PELICAN NARROWS AREA, SASKATCHEWAN

By J. Satterly

CONTENTS

Illustration

INTRODUCTION

A geological reconnaissance of the Pelican Narrows 4-mile quadrangle, Saskatchewan, was carried out by the writer and J. R. Marshall during the field seasons of 1929 and 1930. Geological mapping was largely confined to the waterways, where rock exposures are abundant and easily accessible.

The field party owes much to the Hudson Bay Mining and Smelting Company, Limited, for transporting men and supplies from Flinflon to Island Falls, and for generous assistance given at all times. Especially are members of the party indebted to Mr. J. B. Menzies, Mr. E. E. Johnson, and other members of the staff of the Fraser-Brace Engineering Company, Limited, which was engaged in constructing the power plant at Island Falls on Churchill river. To Mr. O. L. Flanagan, the agent of the Hudson Bay Mining and Smelting Company at Island Falls, thanks are due for many courtesies shown. The field assistants in 1929 were J. D. Hughes and H. I. Williams; in 1930, J. S. McDiarmid and J. B. Kines.

The map-area lies between parallels 55 degrees and 56 degrees and meridians 102 degrees and 104 degrees, and is slightly more than 5,400 square miles in area. The southeast corner is about 17 miles north of railhead at Flinflon, Manitoba. Thirty-six miles to the east is the Sherritt-Gordon mine.

The easiest and quickest route to the map-area at the present time is by way of the Flinflon railway as far as "Mile 87" and then by the route of the Hudson Bay Mining and Smelting Company to Island Falls on

Churchill river. The winter route from "Mile 87" is 58 miles in length; the summer route is 72 miles, including a 14-mile road much of which is corduroyed. This road goes to the south end of Mari lake, 1½ miles from the southeast corner of the map-area.

Travel within the map-area is facilitated by the enormous number of lakes. A considerable part of the region can be reached with comparative ease by canoe from the "break-up" in May until about the end of July. Thereafter the water is extremely low in many of the smaller streams and travel becomes arduous. The map will nearly always enable one to locate a route without very much overland travel. Many portages have been cut from the main waterways to the small lakes inland. With the completion of the power house at Island Falls the water-level of Churchill river has been raised 56 feet so that the falls at Asiski and Mukoman rapids no longer exist, and Mussena falls has been reduced to a considerable current.

Fishing is an important industry in the winter months. The most valuable fish caught are sturgeon, whitefish, trout, and pickerel. The total amount of fish caught in the winter of 1926 in Churchill district was 342 hundredweight of sturgeon with a market value of $20,520[1]. In Pelican Lake district the catch was 240 hundredweight valued at $1,320, and of this whitefish was the most important, amounting to 140 hundredweight valued at $1,120. During the summer months considerable pike, sucker, and goldeneye are taken for local consumption.

The fur trade was formerly important, but owing to intensive trapping and repeated forest fires the fur-bearing animals have become very scarce. During the course of the field work a few new beaver houses were seen on rivers and lakes, well off the most travelled routes. Bears, foxes, and otters are not common.

Mallard are extremely numerous in the autumn in shallow bays off Churchill river and on the large lakes such as Sisipuk (Duck) lake. Grouse are quite numerous in favourable localities. Game animals are rare. Moose are not common on the main waterways, but are frequently met in the interior on the smaller streams and lakes. Deer were seen fairly often during the summer of 1930. A few woodland caribou are reported to have been seen in the winter months.

The common forest trees of the area are birch, poplar, spruce, and jackpine. On account of the thin soil covering in many areas the trees are sparsely distributed, stunted, and the average diameter through the butt is 2 to 3 inches. Stands of spruce suitable for pulpwood were not seen, although in favourable localities trees as much as 18 inches in diameter were found. Jackpine from Sisipuk lake was used almost exclusively in the construction of the cabins of the Fraser-Brace Engineering Company's camp at Island Falls.

Large tracts in the eastern part of the area have been fire-swept in the last few years. During the summer of 1929 forest fires were seen on Wildnest, Mari, and Sisipuk lakes as well as on Churchill river, and in 1930 they were abundant in the southwest quadrant of the map-area. Practically the whole district has been burnt over once within the last fifty years and much of the present timber is of second or third growth.

[1]Fisheries Statistics of Canada, 1928, Dominion Bureau of Statistics, Dept. of Trade and Commerce.

Although the potential waterpowers of Churchill river and its tributary, the Reindeer, have been known for some time, it was not until June, 1930, that the first power was turned on from this source. The following figures have been kindly supplied by the Dominion Water Power and Reclamation Service of the Department of the Interior, Canada, and are dated February 23, 1926.

River	Locality	Horsepower at 80 at ordinary minimum flow	Efficiency at ordinary six months flow
Churchill	Island falls	76,000	95,500
	Mukoman to Atik rapids	143,800	180,700
	Kettle falls	21,900	25,100
Reindeer	Atik falls	6,400	8,300
	Steephill rapids	25,700	33,300

The Island Falls site has been developed by the Churchill River Power Company, Limited, a wholly owned subsidiary of the Hudson Bay Mining and Smelting Company, Limited. Power for construction purposes was obtained from a small temporary plant about 13 miles northeast of the Island Falls power site on the channel between Whitton and Sisipuk lakes, between which there is a drop of 42 feet. The horsepower developed there was 2,000.

The power plant at Island Falls has an initial capacity of 44,500 horsepower with provision for a future installation of a total of 86,500 horsepower. Power is transmitted to the Flin Flon and Sherritt-Gordon mines. The head of water at the dam is about 60 feet, and the tail-water varies from 932 to 939 feet above sea-level; flood water-level is at 997 feet, and the top of the dam at 1,000 feet. The combined discharge capacity of the under sluices and spillway on top of the main dam is 95,000 cubic feet a second. The discharge capacity of the main spillway (Dam "A") is 100,000 cubic feet a second.[1] The flow of Churchill river during the summer of 1930 was 33,000 cubic feet a second in June, but only 27,000 cubic feet a second in August.

The most important settlement within the map-area is Pelican Narrows, on the north shore of Pelican lake, where there are trading posts belonging to the Hudson's Bay Company, Reveillon Frères, and a private trader, A. J. Jan. There is also a Roman Catholic mission and school, and some twenty or thirty families of Indians living in cabins in the immediate vicinity.

The true inhabitants of the area are the Cree Indians, for whom there are four reserves in the southern part of the district, on Wood, Pelican, and Mirond lakes. These people stay on their reserves during the summer months, although a few families travel to and fro between Pelican Narrows,

[1]For further details see Engineering: vol. CXXIX, p. 442.

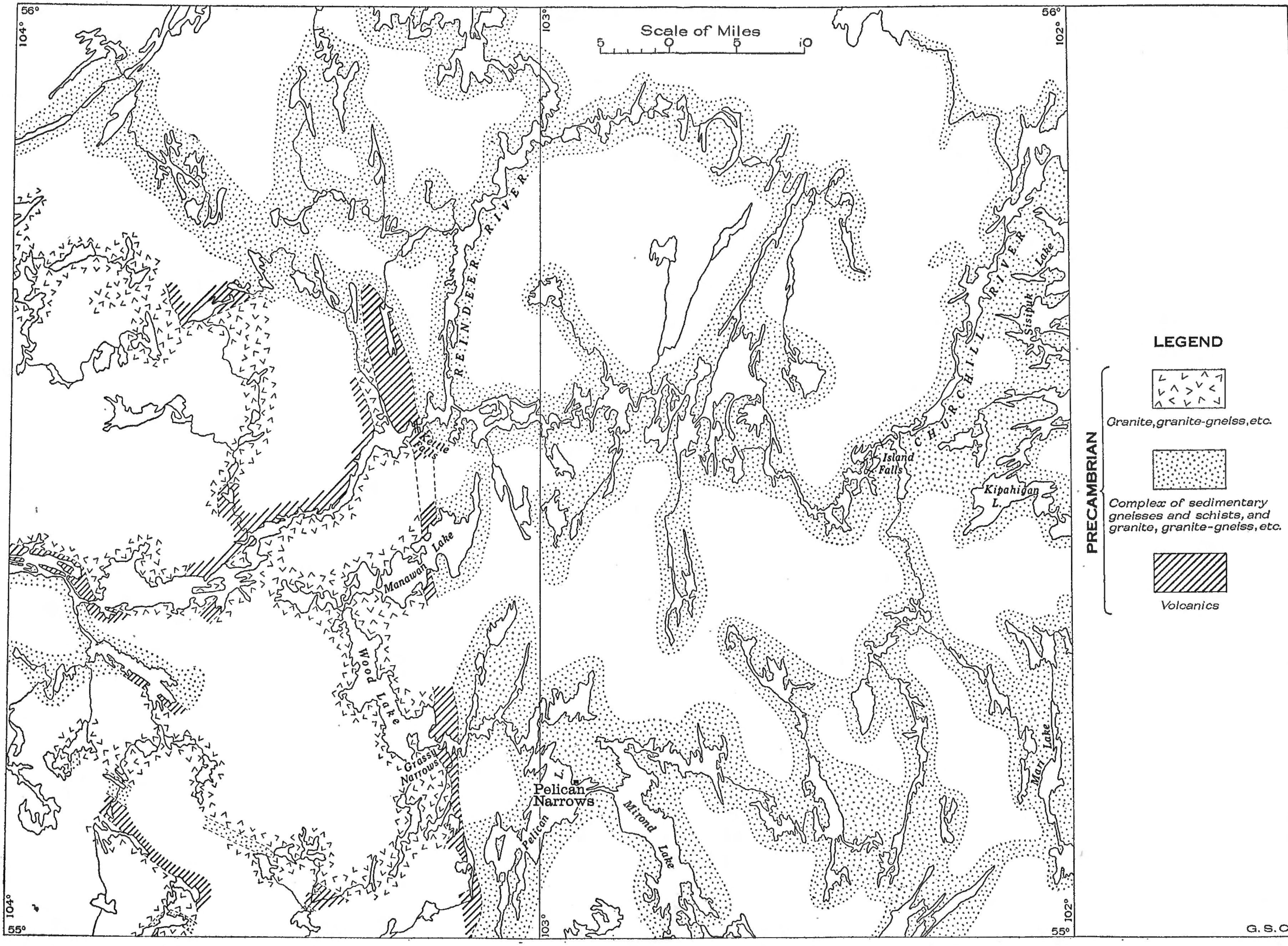

Figure 2. Pelican Narrows area, Saskatchewan.

La-Ronge, or Pukatawagan. During the construction of the power house at Island Falls a number of Indian families encamped on Sandy bay nearby, and a small encampment of cabins has sprung up. It seems likely that the Indians will remain, although there is no longer any work for them at the power plant.

TOPOGRAPHY

The Pelican Narrows area is part of a glaciated peneplain, with an average elevation of 1,100 feet. The flatness of the district is, however, only apparent when viewed from a commanding height; otherwise it is a hilly and rugged country with a local relief of from 20 to 250 feet. It consists of rounded ridges separated by depressions in which occur lakes and, more rarely, swamps. Much of the area has been burnt and in places these fires have resulted in the removal of the thin soil covering.

Sisipuk lake, with an altitude of 919 feet, is the lowest point in the area; it drains into Churchill river to the east of the map-area. The highest points are the hills in the centres of the southwest and northwest quadrants. The lakes there have altitudes of about 1,400 feet and the highest hills nearby are 100 feet. The eastern half of the area slopes easterly 3 feet a mile, as indicated by the fall between the mouth of Reindeer river and Sisipuk lake. The gradient in individual drainage basins varies from 10 to 60 feet a mile, the higher figures applying to the basins in the northwest and southwest quadrants.

On most of the lakes and on the larger rivers the shoreline is of rock. Many of the islands are composed of hard rocks such as pegmatite or granite, or a more resistant type occuring as bands in a less resistant variety. More rarely islands are mounds of morainal material. Rock outcrops inland form rounded ridges rising usually from 30 to 150 feet, but occasionally to 250 feet, above the lakes. In the neighbourhood of Mari lake the relief is lower, and owing to the prevailing low dips (10 to 30 degrees) in the sedimentary schists and gneisses, cuesta-like ridges are seen at intervals on crossing the strike.

The drainage is to the northeast to Hudson bay by Churchill river, or to the southeast to Saskatchewan river by Sturgeon-weir river. Reindeer river is the most important tributary of the Churchill and comes from the north. Three-quarters of the district lies in the drainage basin of the Churchill, and the remaining quarter which includes most of the large water bodies of the district—e.g., Manawan, Wood, Pelican, and Mirond lakes—forms the most northern part of the Saskatchewan drainage basin. At Frog portage there is a shallow channel, with a fall of 10 feet, between Trade lake and waters draining southwards to Wood lake. The divide between the Churchill and Saskatchewan drainage basins at this place is only 18 chains, and in spring or other times of high water Churchill river overflows into the Saskatchewan basin.

GLACIAL AND RECENT GEOLOGY

In Pleistocene time the map-area was covered by the continental glacier that spread out from the east. Glacial striæ are very abundant, and particularly well preserved in the eastern half of the area. In that part of Churchill valley stretching northeast from Island Falls the average of many readings is south 26 degrees west. About Sisipuk lake it is south 50 degrees west. This southwesterly trend continues to Kipahigan lake, gradually swinging from a maximum of south 60 degrees west to a minimum of south 40 degrees west on Kipahigan lake; and on Mari lake the striæ again assume a strike of about south 26 degrees west. The U-shaped section of Churchill river between Island Falls and Mussena marks a change of the ice movement to a southerly trend. Still farther west on Pita, Wintego, and lakes south of them, the strike is again about south 26 degrees west. In the southeast part of the map-area between Wildnest lake and the south arm of Attitti lake, the direction is southwards.

In the western half of the area the general trend of the ice movement cannot be determined owing to great variation in the readings obtained. In the northwest quadrant the readings fall into two ill-defined groups: (a) south 10 to 15 degrees west, and (b) south 20 to 25 degrees west, although occasional readings up to south 40 degrees west were found in localities where the underlying rock structure may have played an important part in directing the movement of the glacier. The general trend in the southwest quadrant is about south 30 degrees west; but near the west shore of Pelican lake readings from south 5 degrees west to south 18 degrees west were obtained.

In the southern part of the area the drift is thin, but in the neighbourhood of Churchill river, moraine and clay form thick deposits. McInnes[1] shows on a map the approximate boundary of the lacustrine clay area. This is substantially correct, except that much of the drift is moraine or sandy material rather than clay.

Near the site of the main dam at Island falls on Churchill river a trench revealed thinly varved clays underlain by 1 to 3 feet of sandy tillite resting on a highly polished and very hummocky rock surface. The direction of the ice movement was south 22 degrees west. In excavating for the main spillway (Dam "A") two tillites and two sections of varved clay were found, so the writer was informed, by an official of the Fraser-Brace Engineering Company. At the time of the writer's visit this occurrence could not be seen. Much of the clay at this place is unbanded, very plastic when wet, and breaks with a conchoidal fracture when dry or nearly so. For the site of the main spillway 30,000 cubic yards of clay were excavated across a distance of about 1,500 feet. Johnston[2] reports that of this distance only about 100 feet in length and to a depth of 15 to 20 feet was permanently frozen.

GENERAL GEOLOGY

The solid rocks are all Precambrian. They constitute three groups: a group of metamorphosed volcanics; a sedimentary-igneous complex; and intrusive granitoid rocks and their hypabyssal equivalents occurring as dykes, sills, bosses, and large batholith-like masses.

The volcanic series is believed to be equivalent to the Amisk series and comprises highly metamorphosed lavas and associated basic intrusives.

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[1] Geol. Surv., Canada, Mem. 30, p. 124.
[2] Johnston, W. A.: Roy. Soc. Canada, vol. XXIV, pt. I, sec. IV, p. 35 (1930). "Frozen Ground in the Glaciated Parts of Northern Canada".

The lavas were mostly andesites or basalts, now largely hornblende schists or amphibolites. In the southwest quadrant altered rhyolites were found. In a few outcrops pillows, amygdaloids, and ropy texture were seen. Sediments, often similar to those found in the sedimentary-igneous complex, occur as thin interbeds in the volcanics.

The sedimentary member of the complex is correlated with the Kisseynew series. The common rock type is a garnet-biotite-plagioclase schist, representing metamorphosed, argillaceous, feldspathic sandstones. Beds of quartzite and conglomerate were found in a few localities, as were also thin bands of impure limestone and peculiar, banded, hornblende-augite-plagioclase rocks. Much of the igneous material in the complex belongs to the later stage of igneous activity, but in a number of localities orthogneisses and basic intrusives that may be older were found. The absence of horizon markers makes it impossible to estimate the thickness of the sedimentary series. It may be very great. Away from the granitoid masses the dips are low, and the sediments are believed to lie in fairly open folds. In areas that have been intensely granitized, and near the granitoid masses, the dips are steep to vertical and overturned folds are believed to exist. The general trend of the fold axes is north and south.

Granitic material is widely distributed throughout the map-area, but only in the western half does it form batholith-like masses. Throughout the sedimentary-igneous complex granitic material is abundant and may be of more than one age. The sedimentary schists and gneisses have, over wide areas, been so granitized that it was found impossible to separate them on the 2-mile scale of mapping used. Areas of sedimentary schists with 50 to 90 per cent of granitic material are fairly common, especially on the part of Churchill river below Island Falls.

The granitic rocks range from intermediate to acid types and comprise potash granite, albite granite, granodiorite, quartz-diorite, diorite, and their pegmatitic and aplitic equivalents. The larger masses fall mostly into the intermediate, and the smaller masses into the acid, class. The batholith-like masses are diorites or quartz diorites. Similar rocks occurring elsewhere in the Precambrian of Canada have been variously described as oligoclase granites[1] or granodiorites[2], and the use of these terms for granitoid rocks, in which practically the whole of the feldspar content is represented by a basic oligoclase, has been recently discussed by Mawdsley.[3]

The potash and albite granites are believed to be younger than the diorites, but no proof was found. At the west end of Sisipuk lake, 5 miles northeast of the end of the portage from Okipwatsikew lake, sedimentary schists with lit-par-lit pegmatite are cut by a small mass of biotite granite which has porphyritic facies grading into a microcline pegmatite. These igneous rocks are cut by a dyke of muscovite pegmatite, but all are believed to be closely related and are probably almost contemporaneous.

The granitic masses are as a rule very massive and examples of well-developed jointing and sheeting were only found in a few localities. The strike of the joint planes, where observed, varies considerably and is apparently only of local importance, as no relationship could be found

[1] Mawdsley, J. B.: Geol. Surv., Canada, Sum. Rept. 1927, pt. C, p. 6.
[2] James, W. F., and Mawdsley, J. B.: Geol. Surv., Canada, Sum. Rept. 1926, pt. C, p. 56.
[3] Mawdsley, J. B.: Geol. Surv., Canada, Sum. Rept. 1928, pt. C, p. 47.

between it and the regional trend of the rocks. On Trade lake, however, the sheeting in the diorite was found to dip and strike in conformity with that of the volcanic series.

The granitization of the sedimentary schists is intimately related to lit-par-lit injections of granitic material. The injection material varies in composition from granite to quartz diorite and may have a pegmatitic, granitic, or aplitic texture. The mode of formation of the lits is well shown in many localities. In the incipient stages of development small crystals of feldspar, which may or may not be linked to one another by narrow stringers of the same mineral, appear at intervals along the planes of bedding, or foliation of the sedimentary schists. These crystals gradually increase in size and number until they coalesce to form a continuous ribbon. This applies particularly to the formation of the pegmatitic varieties. The bands of pegmatite vary from paper-thin to 1 foot in width and occur at intervals of from 1 inch to 1 foot, parallel to the planes of bedding or foliation. Aplitic and granitic varieties have only been found in areas of more intense granitization, where the injection material forms 40 per cent or more of the outcrop. Their mode of origin would appear to be simple "lit" emplacement.

The neighbourhood of Island Falls is a particularly instructive district in which to see the granitization of the garnet biotite schists of the sedimentary series. The sedimentary schists are highly injected by pegmatite and granite as lit-par-lit sills, dykes, and irregular masses. Gradations were found from the sedimentary schists into rocks identical in composition with granites, and field evidence shows that these "granites" were originally of sedimentary origin. Such rocks are hybrids or migmatites.[1]

STRUCTURAL GEOLOGY

Structural determinations in Pelican Narrows area are difficult and somewhat uncertain owing to the general absence of horizon markers. In all the outcrops where structure could be determined foliation and bedding are parallel to one another. In the eastern half of the map-area the prevailing dip in the schists and gneisses is easterly and presumably indicates isoclinal folding. It is generally low, between 10 and 30 degrees, but steepens to vertical in a district in the southeast, between Mari and Mirond lakes. The dip decreases westwards to Mirond land (25 degrees), but is vertical again at the contact of the schists and gneisses with the volcanics west of Pelican lake. In the northeast quadrant of the map-area the dips are generally greater than 45 degrees. The axes of most of the folds recognized trend north or slightly east of north. Minor axes striking approximately east have been recognized in a few localities.

The main structure in the southwestern part of the sedimentary-igneous complex is an anticline between Pelican and Mirond lakes with a north-south axis through Pelican Narrows, and pitches to the north. A minor syncline, also with a north-south axis, lies on its western limb. The above-mentioned anticline dies out to the north and is replaced by another northerly pitching anticline coming in from the west-southwest, and located just west of Wintego lake (an expansion of the Churchill, 12 miles east of the mouth of Reindeer river). A band of augite-hornblende rocks traced for 3 miles indicated this structure.

[1] Sederholm, J. J.: Bull. Com. Geol. Fin., No. 77, p. 316.

In the eastern part of the area the major structural units appear to be synclinal. In the southeast quadrant, in the area of high dips, is a syncline with a north-south axis, pitching to the north. There appears to be a minor anticline parallel to the east limb of the syncline. Small, recumbent folds are not uncommon in it. Northwards the syncline dies out and is replaced by an anticline which curves northeastwards.

In the neighbourhood of Island Falls the intense granitization to which the sedimentary schists have been subjected is accompanied by very complicated folding. The main structure appears to be a syncline pitching to the north with its axis striking slightly east of north, and situated in the centre of the U-shaped part of Churchill river half-way between Mussena and Island Falls. Minor east-west synclinal and anticlinal axes are believed to occur at Island Falls and on Mukoman river.

ECONOMIC GEOLOGY

Up to the present time no copper sulphide deposits of economic significance have been discovered in the area. Pyrite and pyrrhotite mineralization, usually less than 1 per cent, was seen at numerous localities in the sedimentary schists and gneisses, but appeared to favour more particularly the hornblende schists and amphibolites forming part of the sedimentary-igneous complex. The most important discoveries occur in the volcanic series.

Kipahigan Lake

In the bays on the south shore of Kipahigan lake are posts indicating holdings of apparently twelve claims. The country rock is a granitized biotite gneiss of the sedimentary series, with much injected granitic material. The foliation strikes north 35 degrees east, and dips 55 degrees northwest. Several lenticular quartz masses 2 to 3 inches wide, and bands of pegmatite occur parallel to the foliation. At one locality the country rock is sparingly mineralized, over a width of 4 feet, with disseminated pyrite and a very little chalcopyrite. The showing is at the low-water line of the lake, and the heaviest dissemination is beneath the water. No mineralization was observed on the opposite side of the bay.

Beaver Claims

On a lake in latitude 50° 24′ 10″ north and longitude 102° 58′ 50″ west, reached from Wintego lake (on Churchill river), a number of claims have been staked and surveyed, although little or no mineralization was seen except on one claim. On this, the Beaver No. 2, a gossan-stained, drift-covered outcrop 10 to 15 feet high forms a small point on the above-mentioned lake, which is the sixth above Wintego lake. The little work that has been done has revealed around the base of the outcrop a fine dissemination of pyrrhotite throughout a biotite schist believed to be of sedimentary origin. The average sulphide content is about 25 per cent; the pyrrhotite with a little fine pyrite is present as minute grains 0·1 mm. in diameter. No massive sulphides were seen. The exposed length of the gossan zone is 50 feet and it is about 50 feet wide. On the western edge of the gossan zone very dense rocks occur which are believed to be dynamically metamorphosed gabbros. In these pyrrhotite is only present to the extent of 10 per cent, as a fine dissemination. On the west shore of the lake near a group of claim posts, about 600 feet northwest of the outcrop mentioned above, hornblende schists are exposed. They are metamorphosed basic rocks, and are slightly mineralized with pyrrhotite, but the mineralization is not of economic importance.

Conjuring River Claims

Three groups of claims, each of nine claims, occur on and extend west from a small lake in the area of volcanic rocks bordering Churchill river west of Kettle falls. The small lake lies 1·5 miles west-northwest of the mouth of Conjuring river. This river enters a long, narrow bay extending north along the west side of the band of volcanic rocks striking south past Kettle falls. These groups were staked in 1929, and are known as Copper, Copper Mountain, and Druie. Other groups of unrecorded claims have also been staked. On the three groups mentioned, picket lines have been run, but the claims do not appear to have been recorded by the stakers, J. E. Gustafson and Harry Freeman.

The volcanic series on the claims consists of fine and coarse-grained hornblende-feldspar schists representing metamorphosed andesitic or basaltic lavas and basic intrusives. Interbeds of sedimentary schists are present. The general trend of the foliation or schistosity in the rocks is north 20 degrees west with a vertical dip. In places the rocks are cut parallel to the foliation by glassy, white, lenticular quartz veins from a fraction of an inch up to 6 inches wide and 3 inches long. The contact of the volcanic series with the Conjuring River tongue of quartz diorite and diorite lies just to the east of, and parallels, the small lake mentioned above. Near the contact the members of the volcanic series are profusely intruded by pegmatites. No stripping, nor test-pitting, was noted, nor was any mineralization observed in the country rocks.

Kettle Lake

On the west shore of Kettle lake (the expansion of Churchill river extending west from Kettle falls) at a small creek 8 miles northeast of monument K 19, work has been done on a small mineral showing. The country rocks are fine-grained, black, basic schists representing dynamically metamorphosed andesitic lavas. In a shear zone 5 feet in width and parallel to the foliation of the schists, which here trend north and south (astronomic), and dip 75 degrees to the west, much weathered, fine-grained, black, biotite-hornblende schist carries disseminated pyrrhotite across the total width of the zone. Associated with the pyrrhotite is a very little chalcopyrite. No mineralization was seen in the country rock. Two trenches have been made 100 and 150 feet north of the creek, to intersect the above-described shear zone. The trenches trend east 10 degrees south and are about 60 feet in length. From 6 to 12 feet of boulder clay overlies the bedrock at these points. In the trench nearer the creek the shear zone is not so pronounced as at the creek. It has a width of 15 feet. The fine-grained schist is intersected by a network of paper-thin stringers of quartz and calcite. They contain minute quantities of pyrrhotite and possibly some chalcopyrite. A dyke of grey aplite occurs parallel to the foliation of the schists. In the upper trench the shear zone was not observed. The sulphide mineralization shown in these trenches is of no economic significance. Other trenches have been made south of the creek, but no mineralization was seen.

Crooked Lake

At the south end of Crooked lake on the west shore, 6 miles north-northeast of Grassy narrows, work has been done on a small sulphide mineralization in a coarse-grained, garnet-hornblende-biotite gneiss. The hornblende forms stumpy crystals 3 mms. in diameter. This gneiss forms a 4-foot band in the sedimentary-igneous complex. It is a metamorphosed, basic, igneous rock, such as a basalt or dolerite, and was probably a dyke. It is slightly mineralized with pyrite, pyrrhotite, and chalcopyrite in fine, disseminated grains; nine-tenths of the sulphides are pyrite. The exposed length of the "dyke" is 15 feet. The showing is not believed to be of any importance.

Churchill Minerals, Limited

Churchill Minerals, Limited (Govan, Saskatchewan), hold a number of claims on Drinking river in La-Ronge area, 5·6 miles beyond the western margin of Pelican Narrows quadrangle. The claims were staked in July, 1928, but do not appear to have been recorded. A picket line 40 chains long extends south 30 degrees west from the foot of Pitching lake to near the south end of the portage around the rapids and waterfall on Drinking river. Considerable trenching and test-pitting have been done. The rocks are banded hornblende schists representing metamorphosed andesitic rocks, with sedimentary interbeds originally of very impure limestone. From north to south on the picket line, trenches occur at 0, 2, 14, 17·5, 28, 30, 40·5, and 42 chains from the claim posts at the south end of Pitching lake. Sulphide mineralization was seen in some of these trenches.

Two chains north of the claim posts on Pitching lake poorly-banded hornblende rocks (volcanics) outcrop at the shore. At the posts test-pitting has revealed a mineralized zone 5 feet wide, overlying an imperfectly-banded, fine-grained, grey to greenish grey rock, representing an impure limestone or marly arkose. The mineralized zone is gossan-stained. It is a pyrrhotite-quartz-hornblende rock in which the pyrrhotite forms 10 per cent and occurs as an irregular network. The first trench (2 chains south along the picket line) is 4 by 20 feet, but is now largely filled with clay. The second trench (14 chains south along the picket line) is shallow. It parallels the strike of the volcanics and exposes dingy, green, fine-grained volcanics with a scattered pyrrhotite mineralization across a width of 10 feet. Locally, pyrrhotite forms 30 per cent. The third trench (at 17·5 chains south) is 59 feet long, trends east 20 degrees south, and extends 45 feet west of the picket line and 14 feet east of it. The rock exposed in the trench is a fine-grained, grey, tremolite-microcline-labradorite schist (an impure limestone) cut by carbonate stringers and in part heavily gossan-stained. Finely disseminated pyrrhotite forms 1 per cent. The trench for 11 feet from its east end is in a rock with eyes of glassy quartz and relicts of the original country rock and holds 50 per cent of very fine-grained pyrrhotite. This pyrrhotite-bearing rock towards the east end passes into a rock containing 20 per cent of pyrite in splashes 4 mms. in diameter. Two smaller trenches occur just to the east, and slightly to the south of the above trench. One of these shows a small part of the 11-foot band of pyrrhotite mentioned above. The overburden in these trenches, consisting of sand and pebbles, has been cemented by limonite, derived from the pyrrhotite by oxidation, forming a pseudo-conglomerate.

The fifth trench (at 30 chains south) runs east 40 degrees south, and extends 70 feet on either side of the claim line. The east end is 20 feet north of the waterfall on Drinking river. The trench is mostly drift filled, but in the eastern 50 feet there is a rock face 12 feet high submerged in water to a depth of 5 feet. The rocks forming the east wall of the trench are imperfectly banded, greenish black hornblende schists. Between points 2 feet and 16 feet from the east end of the trench, the rocks are intensely shattered and crushed. This zone is mineralized by an irregular network of fine-grained pyrite forming 5 to 25 per cent of the rock. In the western 2 feet of this zone chalcopyrite is also present, pyrite and chalcopyrite being in about equal proportions. The total sulphide content in this 2 feet is 20 per cent. The matrix between the sulphides is extremely sheared and crushed, black in colour, and contains quartz and altered minerals. Some reddish calcite is present. At the waterfall the trend of the foliation in the volcanics is north 35 degrees east, and the dip is 45 degrees southeast.

The pits south of the claim posts at 40 chains from the posts on Pitching lake do not reach bedrock. The drift material exposed is a light grey sand.

The sulphide mineralization appears to have replaced bands of impure limestone occurring as narrow interbeds in the volcanics. Sufficient work has not been done to indicate whether the mineralization forms a continuous band from Pitching lake to the waterfall on Drinking river.

Graphite

Graphite is locally abundant in the sedimentary gneisses and associated lit-par-lit pegmatites. It is usually present as a film-like coating on the flakes of biotite. The schists or gneisses in which it occurs weather rusty, and commonly crumble to the touch. One per cent of graphite was found in a pegmatite in the Kisseynew series on the long east bay of Belcher lake. Considerable graphite is present in a very limonitic biotite schist on the west shore of a trefoil-shaped island, 1·6 miles north of the Indian house on Pita lake. These deposits of graphite are, however, not of sufficient extent to be of any commercial value.

RANKIN INLET AREA, WEST COAST OF HUDSON BAY, NORTH WEST TERRITORIES

By L. J. Weeks

CONTENTS

Illustration

INTRODUCTION

For the past three years the writer has been engaged in the mapping and geological investigation of an area situated on the west coast of Hudson bay between the mouth of Ferguson river and Rankin inlet, and extending inland to Kaminuriak lake. The district under examination lies between latitudes 62 degrees and 63 degrees, and longitudes 92 degrees and 96 degrees. The writer wishes to acknowledge the courtesies extended by the Department of Railways and Canals at Churchill, by the Nipissing Mining Company, and by the Hudson's Bay Company at their various posts along the coast. It would be impossible to enumerate the many kindnesses done by Mr. Samuel Voisey of Tavane. Mr. A. W. Derby served very efficiently as assistant in 1929 and 1931. Mr. D. F. Kidd in 1929 and 1930 worked independently of the writer, investigating the area west of longitude 94 degrees. Practically all of the writer's knowledge of that area is derived from Mr. Kidd's work during those two years.

MODES OF TRAVEL

The area lies about 225 miles north of Churchill, Manitoba. This distance may be covered by canoe, boat, airplane, or dog-team. The writer has already discussed small boat navigation as far north as Tavane[1], an inlet in Mistake bay. From Tavane to Marble island the seacoast is well adapted for canoe and small boat travel. The countless islands and deep, wandering bays provide a myriad of havens from the squalls and storms that abound in the autumn and late summer. Shoals are numerous and tidal currents are often strong, more particularly at the narrow heads

[1] Weeks, L. J.: "Mistake Bay Area"; Geol. Surv., Canada, Sum. Rept. 1929, pt. B, p. 172.

of bays. Prospectors wishing to travel under average weather conditions, without too heavy an outfit, would be well advised to use nothing smaller than a 20-foot canoe. For three years the writer has used a 40-foot sloop of the Peterhead type for transporting supplies to the field from Churchill. This has been found entirely satisfactory, as the boat is large enough to weather the usual light storms met in the summer, and is small enough to be beached without damage, and even pulled ashore if necessary. This boat has carried a load of over 10 tons.

Inland the traveller is faced with the problem of finding a craft small enough to portage without much difficulty, and yet large enough to navigate the larger lakes without too much loss of time during windstorms. A modification of the usual 20-foot freighter canoe, utilizing lighter ribs with greater spacing, was designed by prospectors of the Nipissing Mining Company and has been used by the writer both inland and on the coast with considerable satisfaction.

Travel by dog-team is, of course, confined to the winter months. Except under unusual conditions, the trip north from Churchill may be successfully begun as late as May first. In the vicinity of Tavane, land travel by dog-team is generally impossible after the first of June, but sleds may be used on the sea ice as late as July first. Dog feed is usually very scarce along this coast, and any person anticipating travel by this means would do well to make arrangements beforehand.

Although in dry weather a fire can usually be easily made from moss which abounds on the drift-covered areas, yet it is advisable to carry an oil or gasoline stove for cooking.

CLIMATE

Very little data exist on the climate of the region surrounding Mistake bay. Data for one year, in 1928-29, were collected by G. S. Blanchette.[1] To a traveller in the region, the two most important dates in the year are those when the ice leaves the bays, and when the freeze-up occurs in the autumn. For the past three years, the available data for Mistake bay and Churchill, are as follows:

—		Mistake Bay	Churchill
1929	Break-up	July 16	June 22
	Freeze-up	October 10 (began)	
1930	Break-up	July 10	June 10
1931	Break-up	July 16	June 14

From the above it can be seen that, in general, a start can be made from Churchill long before it is possible to reach land farther north. In 1931, the writer anchored in the harbour at cape Eskimo on June 28, the ice having gone out the previous night. This was the earliest break-up that residents there could recollect.

[1] Blanchette, G. S.: "Keewatin and Northeast Mackenzie"; Dept. Int., 1930, pp. 43-48.

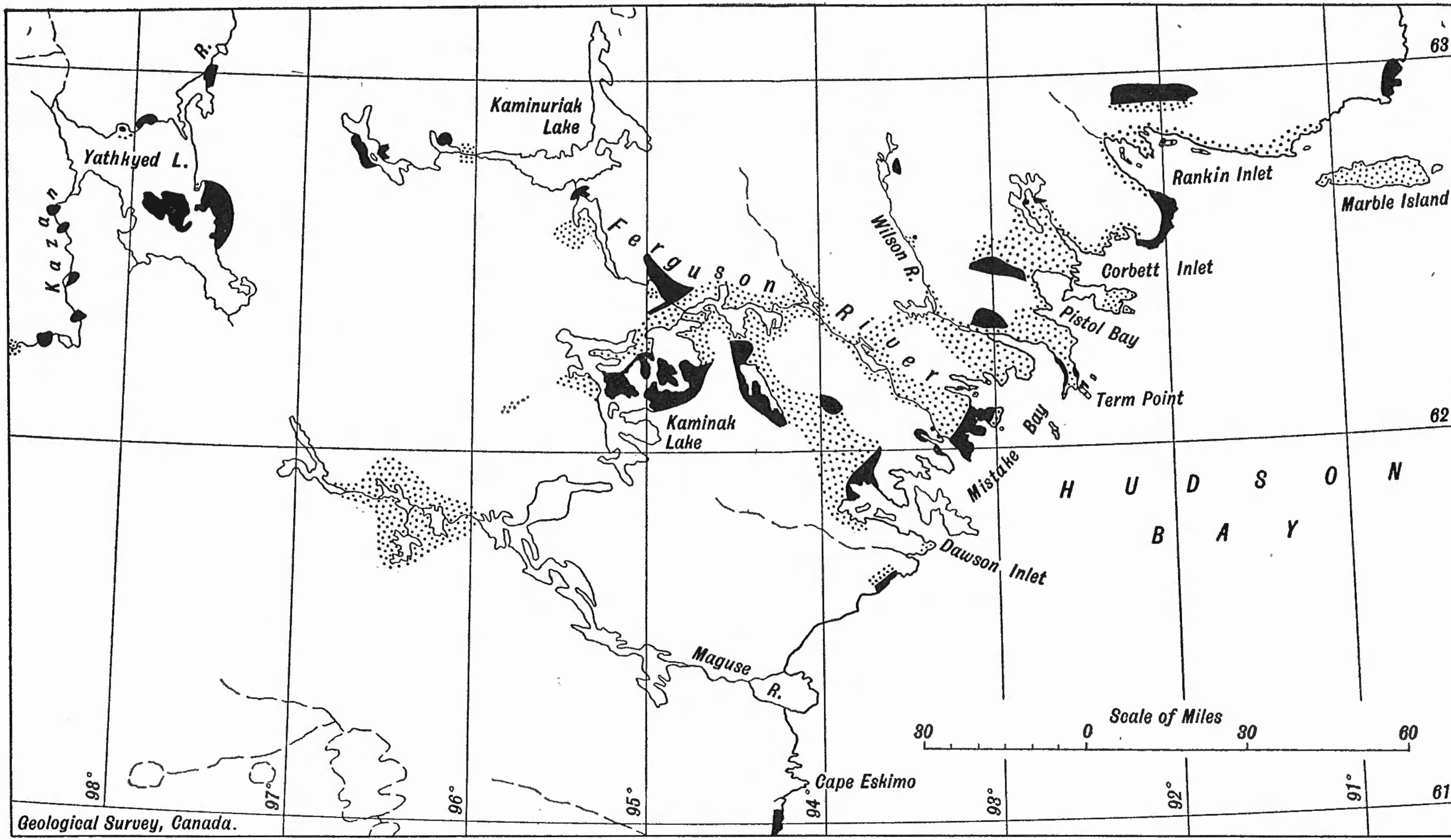


Figure 3. Rankin Inlet area, west coast of Hudson bay, North West Territories. Areas of granite and granite-gneiss shown by solid black, areas of volcanics and sediments by stipple.

J. B. Tyrrell[1] published the known data on Churchill harbour from 1824 to 1894, which he obtained from the "Journals of Occurrences" of the Hudson's Bay Company. This table is summarized below.

——	Open	Closed
Average	June 19	Nov. 18
Earliest	June 5, 1863	Nov. 1, 1837
Latest	July 2, 1866	Dec. 4, 1861 and 1885
Length of average season	Five months	
Longest season	Five months, 18 days	1846
Shortest season	Four months, 8 days	1838

Although winds of hurricane strength are rather rare, calm weather is almost as infrequent. Mr. Kidd found that in the vicinity of Kaminak lake, during July and August, 1930, calm weather prevailed on six occasions and occupied a total of two and a quarter days. During the same months there were two gales and eight periods of strong breeze. In 1931 there were no gales during July and August, and there was calm weather for only five short periods during July.

Temperatures during the summer are not extreme, but accurate data are not available. Temperatures of between 75 and 80 degrees were recorded on seven days in 1930, and on two in 1931. Blanchette did not record a temperature of over 65 degrees in 1929.

The experience of the past three years has indicated that after September 1, although there may be an occasional day reminiscent of mid-July, there are usually overcast skies, high winds, and a temperature hovering around the freezing point.

GENERAL GEOLOGY

Figure 3, accompanying this report, is a compilation of all available geographical and geological data. For the area between the mouth of Ferguson river and Rankin inlet and inland to Kaminuriak lake, almost all the data employed were collected by the writer. He is much indebted to the Nipissing Mining Company for geological data pertaining to a stretch of country reaching from Dawson inlet northwestward to Quartzite lake on Ferguson river and to a small area north of Wilson bay at the mouth of Wilson river; to Dominion Explorers, Limited, for their sketch map of Maguse river and lake, for geological data near the head of this river, and for geological data north of Rankin inlet; and to the North West Territories and Yukon Branch, Department of the Interior, for a copy of a sketch map by A. E. Porsild, of Yathkyed lake and Kazan river on which was placed some geological information. Other geological data are mostly derived from the work of J. B. Tyrrell.

The west coast of Hudson bay and adjacent territories are believed to be predominantly underlain by granites and gneisses, but since 1897 geological maps have shown the presence of a group of rocks of volcanic and sedimentary origin outcropping on the coast of Hudson bay between

[1]Tyrrell, J. B.: "Doobaunt, Kazan, and Ferguson rivers"; Geol. Surv., Canada, Sum. Rept. of Operations for 1896–1897, pt. F, p. 98.

Rankin inlet and Dawson inlet and cut transversely by Ferguson river. This belt was formerly assumed to end a short distance southwest of Ferguson river. Although its limits are still unknown it is now believed to continue at least as far as a small group of lakes at the head of Maguse lake. The general strike of the sediments and volcanics in the vicinity of Kaminuriak lake is a few degrees west of southwest. Similar rocks occur west of Maguse lake. Tyrrell, on his trip down Kazan river, crossed a belt of similar rocks on Kasba and Ennadai lakes for a distance of 70 miles north and south. He reports only two strikes in this area, one north-northeast and the other north 35 degrees east[1]. Thus these two regions, some 275 miles apart, are underlain by similar rocks striking approximately toward each other. Though there is no reason to expect that an unbroken series of volcanics and sediments extends from Rankin inlet to Ennadai lake, yet it is reasonable to expect that areas of these rocks will be found in the intervening country. As is well known, such rock assemblages in other parts of the Canadian Shield are the home of metallic deposits and, therefore, this block of country deserves at least preliminary exploration as a possible mineral producer.

As already indicated the region being explored is, so far as known, mainly underlain by two classes of rocks, both of Precambrian age. One class consists of various types of granite and granite-gneiss, possibly belonging to two distinct periods. The other consists of volcanic and sedimentary strata. A much younger assemblage of sediments may also be present, but so far have been found only to the north of the region, on Baker lake and Thelon river.

VOLCANIC-SEDIMENTARY GROUP

The rocks of this group occupy a very large part of the region. They are of economic importance as they have been found to contain all mineral deposits located to date, and it is believed that any deposits so far undiscovered will be found within the confines of their outcrops.

The only rocks that can be unreservedly classed as volcanics are pillow lavas. These are widely distributed, but are most abundant on the north side of Rankin inlet. Associated with them are many varieties of fine-grained, greenish rocks believed also to be of volcanic origin, some being undoubtedly tuffs. Others, however, may prove to be fine-grained sediments. The lava specimens examined microscopically include various types of andesitic and basaltic composition. Some of the tuffs examined are of a more acidic nature than any flows yet found. Practically all the volcanic rocks are more or less distinctly schistose and exhibit alteration, chlorite being most commonly developed.

The sediments include pure, white quartzites, more impure quartzites, greywacke, conglomerate, shale, and limestone.

The white quartzites are ripple-marked and are nearly pure silica. They occur in all parts of the district. Probably the largest single area is on Marble island. Relationships with the surrounding greenstone complex are very difficult to find. Near the head of Rankin inlet is a small exposure of pinkish white quartzite, slightly conglomeratic with quartz pebbles. It is located upon a small point in a circular bay, and is almost surrounded

[1] Op. cit., pt. F, p. 121.

by cliffs of dark green, volcanic rock. Inland from the tip of the point, the white quartzite changes abruptly to an impure quartzite containing abundant chlorite, followed by a thin band of grey quartzite, and finally by what are probably waterlaid tuffs. The above succession is in descending order. These data indicate that this body of quartzite at least, was laid during a period of volcanism. In other localities quartzite has been found a short distance from rocks of a volcanic nature, but without giving any definite clue to their relationships except that they apparently strike in the same direction.

Conglomerate and greywacke have a large areal extent. The pebbles in the coarser varieties are of both sedimentary and igneous rocks, those of igneous rocks being much more common. Many pebbles are of quartz and others are of fine-grained intrusive rocks. On the south side of the peninsula between Pistol bay and Corbett inlet, a fine-grained conglomerate holds pebbles of granodiorite.

Small exposures of laminated shales have been found in the area. One small island in Quartzite lake on Ferguson river is underlain by limestone.

GRANITE AND GRANITE-GNEISS

Two types of granitic rocks are found in this area. One type is massive or only faintly gneissic and in numerous localities has distinctly intrusive relationships with members of the volcanic-sedimentary group. These granitic rocks in composition lie between granite and granodiorite. A few bodies of aplite found in the district are considered to belong to this type.

The second type consists of well-banded granite-gneiss and nowhere has it been possible to establish its relationships with the volcanic-sedimentary complex. This gneiss was found by Tyrrell to be the predominant rock along Chesterfield inlet and the north shore of Baker lake. Though in places it is difficult to distinguish from the massive granites undoubtedly intruding the volcanic-sedimentary complex, it may be older than the volcanics and sediments. As already stated, granitic pebbles occur in some of the conglomerates, a fact indicating that earlier granitic rocks existed and, furthermore, the widespread quartzites imply the former presence of quartz-rich rocks such as granites.

In addition to the two great groups of rocks just described, there are many small bodies of intrusive rocks occurring as dykes and small bodies of rudely oval cross-section. At one locality, diabase dykes were observed cutting granite, but elsewhere the minor intrusives cut volcanics and the less quartzose sediments. They were not observed penetrating the purer quartzites. The rock types represented are: diabase, gabbro, feldspar porphyry, quartz diorite porphyry, pyroxenite, and lamprophyres.

GLACIAL DRIFT

A great deal of the land surface is covered with glacial drift. In places either along the coast or inland, a shoreline for stretches as long as 10 miles is wholly of drift, without a single outcrop of bedrock. In contrast with this, there are localities such as the north shore of Rankin inlet and Term point, where very little drift is present and that only in small basins between large bedrock outcrops.

The shorelines of lakes and the coast in predominantly drift-covered terrain are characterized by long, sweeping curves running in a direction slightly east of southeast. Shoal water may extend for over a mile to the southeast of drift-covered points, whereas parallel to these points of land, deep water is in many places only 100 yards from shore. It is possible to walk northwest or southeast for miles seeing long lakes on each side, and only detouring for small ponds. Should a change in the course be made to northeast or southwest difficulties immediately occur. To reach a point 4 miles distant, a walk of 8 miles would not be unusual. Practically all exceptions to these generalizations are due to the presence of some resistant rock such as quartzite.

ECONOMIC GEOLOGY

Cyril Knight Prospecting Company

This property is on the southern shore of Johnston bay, an inlet on the north shore of Rankin inlet. It was discovered in 1928 by Oscar Johnston, a prospector in the employ of this company. In 1930, a steel boat was shipped over rail to Churchill, and was used to bring a diamond drilling outfit and crew to the property. Mr. John Drybrough was in charge. Two thousand feet of drilling was planned, but was not all accomplished, mainly on account of difficulties in drilling through frozen ground. A very ingenious water-heater was built out of materials at hand by the chief of the drill-crew, and by forcing warm water to the drilling surface below ground, depths were attained that would have been impossible otherwise. Drybrough has given an account of the work accomplished and of the general geological features of the localities.[1]

The ore consists of copper and nickel sulphides carrying traces of platinum and occurring near the base of a lenticular mass of serpentinized basic intrusive.

The rocks underlying the nearby country are of both volcanic and sedimentary origin. On the south side of the peninsula that is bounded on the north by Johnston bay and about 1½ miles from the prospect, is a band of quartzite striking roughly northwest. To the north of this are many exposures of sheared greywacke and conglomerate. To the east and southeast of the prospect are relatively high knobs of basic rock probably of volcanic origin. The intrusive with which the ores are associated is almost completely serpentinized. In some thin sections it undoubtedly appears to be an altered pyroxenite. This body strikes roughly east, dips south, and is given a thickness by Drybrough of 200 to 300 feet. Every thin section of this rock shows blebs of sulphides, which apparently increase in number with proximity to the bottom of the body.

Drybrough estimates that the diamond drilling has shown ore amounting to 120,000 tons with an average content of 1·22 per cent copper, 4·62 per cent nickel, and 0·11 ounce platinum a ton.

[1] Drybrough, John: "A Nickel-Copper Deposit on Hudson Bay"; Can. Inst. Min. Met. Bull. No. 277 (March, 1931).

Other Prospects

The Nipissing Mining Company located, and prospected to a small extent, a mineralized shear on Term island. This shear runs at right angles to the intrusive contact of granite with basic volcanic rocks and about 100 feet from the contact contains free gold. At this point an open-cut was made, roughly 10 feet in depth and 20 feet in length. The materials from the cut were hand picked and about 1,100 pounds were shipped out for treatment. The gold occurred in quartz and silicified greenstone, and was accompanied by pyrite and chalcopyrite. The exposures do not show any free gold at present.

Considerable prospecting has been done by various mining and prospecting companies, on the south side of the peninsula between Corbett inlet and Pistol bay, inland west of Pistol bay, and on the northwest side of Rankin inlet. Staking has been done in all these localities. The outcrops drawing attention were, in each case, silicified shear zones carrying sulphide minerals. No information is available as to the results of any assays that may have been made. Traces of free gold are reported to have been obtained by panning crushed rock from the upper parts of Ferguson river.

All occurrences that to date have aroused interest in this area appear to be quite near to, and probably associated with, rather small intrusions of granite, feldspar porphyry, or basic rocks. In general these small intrusions seem more numerous about Rankin inlet, inland west of Corbett inlet and Pistol bay, on the south side of the peninsula between Pistol bay and Corbett inlet, and along parts of the Ferguson River system. Doubtless with further work other localities having these characteristics will be found.

REGIONAL DESCRIPTIONS

The following are brief descriptions of the geology of the subdivisions of the map-area, prepared for the use of any person entering the country.

RANKIN INLET

On the north side of Rankin inlet, bedrock is remarkably well exposed; on the south side drift predominates. From the eastern of the two islands along the north shore, almost to the head of the inlet, is a nearly unbroken succession of pillow lavas with a few beds of quartzite. On the south shore of the northern of the two main bays at the head of the inlet, fine-grained sediments and conglomerates are associated with the lavas, and the whole is intruded by serpentinized pyroxenite. Pillow lavas occur along the south side of the large point in the head of the inlet, as far west as the northwestern extremity of a large island close to shore. In the next bay to the northwest is a string of islands and peninsulas underlain by a coarse basic intrusive; this rock also occurs on the mainland to the west of Rankin inlet. The southwest shore is fringed with a belt of basic intrusive similar to that found on the islands. Inland a short distance are somewhat altered greenstones. Farther east is a contact with granite that extends along the coast to a point 4 miles west of the mouth of Corbett inlet.

CORBETT INLET

On both sides of the narrow indentation at the head of the inlet, outcrops are very numerous; many are fine-grained pillow lavas and most of the others are chloritic rocks. There has been considerable shearing in this locality, and large quartz veins are common. Small pockets or lenses of copper and iron sulphides are present. Considerable magnetic disturbance was noted at various points. From the mouth of this indentation, along the north shore of Corbett inlet to its mouth, the country is predominantly drift covered. Near the entrance alternate outcrops of granite and basic rocks occur. From reports by some prospectors who traversed the point of land between Corbett and Rankin inlets, it seems that granite may have a considerable extent inland and may lie only a short distance north of Córbett inlet along its whole extent.

PENINSULA BETWEEN CORBETT INLET AND PISTOL BAY

This peninsula is deeply serrated, is about 15 miles long, and is joined to the mainland by an isthmus 120 feet wide at high tide. For 7 miles from its eastern tip very little drift is found; for the remaining 8 miles very few outcrops are found. Near its eastern tip outcrops are mostly pillow lavas associated with somewhat sheared, fine-grained, basic rocks. These are cut by dykes and masses of dioritic feldspar porphyry and pyroxenite. On the southern side of the peninsula near the house belonging to Pork, an Eskimo, considerable mineralization is found apparently associated with dykes and masses of feldspar porphyry. This consists of veins and masses mostly of pyrite, but with some pyrrhotite and copper sulphides. Gangue material is mostly quartz, with some carbonate in places. Of the few exposures in the western part of the peninsula, the majority are conglomerate and greywacke. Some shearing has occurred and in places considerable mineralization, mostly pyritic.

PISTOL BAY AND TERM POINT

The east shore of Pistol bay to within about 6 miles of Term point is mainly of drift, but in the vicinity of the point the country is almost devoid of drift. Two bands of quartzite occur in, respectively, the northwest and southwest corners of upper Pistol bay. The quartzite in the northwest corner is associated with rocks probably of volcanic origin. Near the southwest corner greywacke and conglomerate are cut by a mass of much altered diabase. Two narrow bands of granite bound Term point on the northeast and west sides. On the tip of the mainland and on the largest island southeast of it, are outcrops of a coarse-grained, altered intrusive, apparently a pyroxenite. This rock cuts a group of supposedly volcanic rocks having a few pillow lavas among them. Several rather pronounced shears are visible. Term island, the southeastern extremity of which is Term point, is largely staked by the Nipissing Mining Company, and a mineralized shear near the contact between the volcanic rocks and granite on the northeast side of the island has yielded some gold. A quartz vein containing small amounts of molybdenite occurs on the mainland about a mile west of the passage separating it from Term island.

INLAND BETWEEN PISTOL BAY AND CORBETT INLET

A canoe route follows a chain of lakes from the northwest corner of upper Pistol bay to Cameron river, and down the river to Corbett inlet. The trip involves sixteen portages, except possibly during high water on Cameron river when five may be unnecessary. The rocks along the route are predominantly of volcanic origin, cut by numerous small stocks of granite and by a large dyke of much serpentinized basic intrusive. The southern part of the chain of lakes crosses a large intrusion of granite, believed to extend to within a few miles of Whiterock lake on Wilson river. Mineralization is found in this locality and some staking has been done, but it is believed that none of the claims has been retained. Cameron river flows through a largely drift-covered terrain. The most northwesterly exposures seen are of granite. These may be small stocks or a large area of granite may exist in this direction.

MISTAKE BAY

With the exception of the two points of land on each side of its entrance, the bay into which Wilson river empties is largely surrounded by drift-covered country. The few exposures are fine-grained sediments and greywacke. Green schists, probably volcanic, form a bold point and a group of small islands on the west side of the entrance.

Good rock exposures occur along the shores and islands of the next large bay to the south. Its north shore and islands are mainly of pillow lavas and tuffs. A belt of granite which extends to the mouth of Ferguson river cuts these rocks on the south shore. Near the contact with the granite at the southeastern entrance to this inlet, the volcanic rocks are much sheared and display a great deal of pyritic mineralization. On the eastern extremity of this point, the volcanics are almost in contact with a band of quartzite striking southwest for some 2 miles to the point where it is cut off by the above-mentioned granite.

WILSON RIVER

This waterway is easy to ascend as far as the second lake, from which a route follows two long lakes to Sixmile, the first large lake on Ferguson river. This route affords the easiest and most rapid method of reaching the upper parts of Ferguson river. Descending the latter river, however, it is quicker and easier not to take this portage route. Between the mouth of Wilson river and the second lake, the rocks along the north side of the route are predominantly quartzite and impure sediments, whereas pillow lavas, green schists, and some sediments outcrop on the south. The two long lakes forming the route to Ferguson river run at right angles to the general trend of lakes in this country. This is due to a long band of hard quartzite striking southwest on their north shore.

FERGUSON RIVER

Rock exposures are plentiful on lower Ferguson river, but areas of drift miles in length are also present. Near the mouth of the river is a rather large body of granite. Up the river, numerous dykes, stocks, and small bodies of granitic material testify to the proximity of the main mass. Sediments and schists outcrop along with rocks whose origin is strongly suspected to be volcanic. Mineralization, mostly pyritic, is found in numerous places, and traces of gold were reported by prospectors of one mining company who worked this stream.

Quartzite lake is a large expansion of Ferguson river a short distance east of Kaminak lake. Along its northwest side extends a belt of quartzite varying in width from 3 miles to less than ½ mile. This belt has been traced 10 miles southwesterly from the head of Quartzite lake. Northwest of the quartzite lies a large body of granite. Outcrops of quartzite have been observed by the writer from airplane at a number of points along approximately the same strike, the most distant point being 34 miles from the head of Quartzite lake. The eastern part of this lake is underlain by volcanics and sediments. Near its outlet, a deep bay runs some 5 miles southward and has granite outcropping at its extreme head. This probably is part of a mass known to exist to the south on Kaminak lake.

Kaminak lake is roughly 34 miles long in a direction slightly west of south. The large belt of quartzite already mentioned extends for about 8 miles along the northwest shore of this lake. For some 10 miles southerly from the outlet, the lake shores are underlain by volcanics and sediments, cut by small masses of feldspar porphyry. At the second narrow point in the lake, about 10 miles from the outlet, granite cuts these rocks and is known to extend at least 10 miles farther.

The available information regarding Ferguson river above Quartzite lake is from the work of J. B. Tyrrell; from reports of two prospectors who proceeded a short distance up the river; and from observations of the writer who flew over this territory in 1931. Tyrrell mapped the country from the western end of Kaminuriak lake to Quartzite lake as underlain by granite, with a small mass of diabase near the head of Kaminuriak lake. About 8 miles above Quartzite lake a considerable area of greenstone was located by prospectors in 1929. The writer saw this from airplane in 1931 and in addition located an area of considerable size, lying a short distance west of the first large lake south of Kaminuriak lake, apparently underlain by quartzite and basic rocks.

GREAT BEAR LAKE-COPPERMINE RIVER AREA, MACKENZIE DISTRICT, NORTH WEST TERRITORIES

By D. F. Kidd

CONTENTS

Illustrations

INTRODUCTION

The Great Bear Lake-Coppermine River area lies between latitudes 66 degrees and 68 degrees and longitudes 116 degrees and 118 degrees and includes the country lying east of McTavish arm of Great Bear lake and north to the vicinity of the mouth of Coppermine river. Hunter bay, which is the best aircraft base in the area, is on the east side of McTavish arm near the head. Labine point and Echo bay, which were the scenes of considerable prospecting activity in 1931, lie 35 miles south of Hunter bay, in the southwest corner of the area.

Most of the area was photographed for mapping purposes in 1931 by the Royal Canadian Air Force and a map is now in course of preparation.

This report is based on geological field work carried on for two months in 1931. The shore and islands from Labine point to the head of McTavish arm were geologically explored and seven mineral deposits were examined. A rapid reconnaissance was made of part of Sloan river, which enters Hunter bay from the northeast. F. T. Jolliffe and G. M. Furnival acted capably as field assistants. Acknowledgment is hereby made of courtesies and assistance extended to the writer by everybody encountered in the area.

WEATHER CONDITIONS

At Great Bear lake in ordinary seasons ice leaves the river mouths early in June, is clear of small bays, June 20 to July 1, and the main body of the lake can be navigated by July 15 to 30. One year it was clear on

July 5. Night frosts commence August 15 to 25. Summer weather changed to low clouds, snow, and rain in the latter part of August, in 1931. Ice begins to form on bays September 15 to 30, and boat travel on main lake ends about September 30.

On the Mackenzie River system the ice leaves Great Slave lake June 1 to 25, but Athabaska and Slave rivers open some time before. Mackenzie river between Simpson and Norman is also clear about one month before Great Slave lake is passable. Liard river and tributaries break up before the Mackenzie. Great Bear river usually opens later than the Mackenzie at Norman; it is said to be passable for powered craft at the end of May, but ice from the lake may make it dangerous until early in July. Ice cliffs are a hazard. There is much variation from season to season. Expert travellers might perhaps travel earlier or later than indicated.

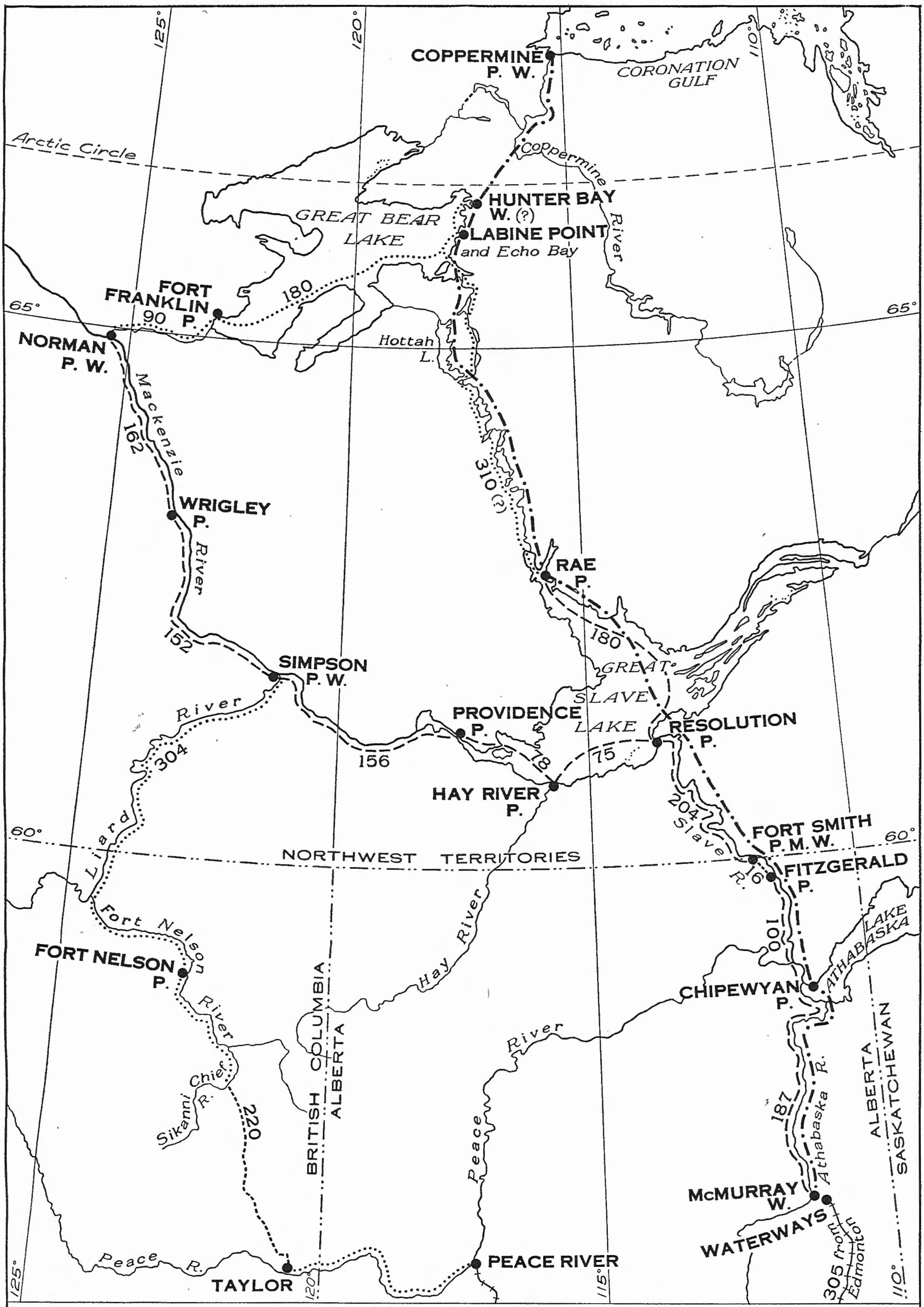
ACCESS BY AIR

Break-up and freeze-up at railhead and Great Bear lake control access. Aircraft on skis can usually operate from Waterways from December until early in April. On Great Bear lake they can operate on floats from about the end of June until early in September. The lake cannot be reached by aircraft by the usual route from early in April until July and from early in September until December. Darkness at Great Bear lake hampers winter flying. So far as known Canadian Airways, Edmonton, and Spence-McDonough Air Transport, Edmonton, are prepared to carry passengers and freight.

ACCESS BY WATER

Main Mackenzie Route. Mackenzie River Transport, Beaver House, Edmonton, operate steamer services from Waterways to Norman and Aklavik, and there are other services on this route. There are two sections, the "Upper River", from Waterways to Fitzgerald, and the "Lower River", from Fort Smith to Norman and Aklavik. Between Fitzgerald and Fort Smith is a 16-mile motor road past rapids. In 1931 services were operated to Rae and Fort Nelson. There was no regular service on Great Bear lake, but A. W. Boland, Fort Franklin, handled traffic with a motor scow and motorboat. Rooms and board can be obtained at Waterways, McMurray, Fitzgerald, Fort Smith, Resolution, Simpson, and perhaps other places.

Liard Route. This route is from Dawson Creek, on the Peace River branch of Northern Alberta railways, overland through Fort St. John or Taylor to Sikanni Chief river at Conroy creek, a distance of 215 miles; thence by canoe or small boats down the Sikanni Chief, Fort Nelson, Liard, and Mackenzie rivers to Norman. A winter road to Conroy creek exists, but arrangements must be made for caching feed along the route and building boats. Outfits should cross by sleigh before March 15. Pack horses can use the route in summer. There are no bad rapids. Norman can be reached several weeks earlier than by Great Slave lake, but this advantage may be slight, owing to ice on Great Bear lake. Further information can be had from the Fort St. John Board of Trade.



ROUTES TO

GREAT BEAR LAKE AND NORMAN

NORTHWEST TERRITORIES

Scale of Miles

100 50 0 100 200

—·—	*Main aircraft route*	┼┼┼┼	*Railway*
— — —	*Summer steamer route*	P.	*Trading post*
....	*Boat, scow, or canoe route*	M.	*Mining recording office*
-------	*Portage*	W.	*Wireless or telegraph*
152	*Approximate distance in miles between points*		

Geological Survey,
Department of Mines, Canada, 1932.

Publication No. 2301

Canoe Route from Rae. This route was travelled south from Great Bear lake up Camsell river and down Marian river in 1930 by A. C. Cumming, of the Department of the Interior. There are forty-four portages, and sixteen rapids that were run. Seven of the portages are one-quarter to three-quarters mile long.

OUTFITS

Parties entering the region should not depend on getting supplies of any kind at Great Bear lake. Natives or dogs are probably not procurable at the lake. The trading posts carry limited supplies, but probably cannot meet large, unusual demands. In March temperatures of 50 degrees below zero and stormy weather are probable. Wood is present in most of the area. The summer weather is cool, calm, and clear, with occasional severe storms, but heavier clothing than that used in Ontario is required. Small sectional and special types of canoes can be taken in by air. Larger canoes could probably be delivered by boat at Hunter bay by August 1. Fish are plentiful. Geological reports and maps and geographical maps are, or will shortly be, obtainable from the Geological Survey, Canada, Department of Mines; Topographical Survey, Department of the Interior; and Geographical Section, Department of National Defence.

PHYSICAL FEATURES

The district along the east side of Great Bear lake has the appearance of a deeply dissected, rolling upland with an abrupt drop along the lake shore. This upland seems to decline gently to the north, as the hills on Richardson island at the southeast corner of the lake appear to reach about 1,500 feet above lake-level, those at Labine point rise to 1,000 feet, and those near Hunter bay probably do not exceed 700 feet. In a traverse of 50 miles east from Echo bay on Great Bear lake a maximum elevation of 1,350 feet above the lake, or 1,750 feet above sea-level, was noted. The dissected upland topography extends at least this far.[1] The hills near the lake shore are very rugged and cliffs fringed with large talus slopes are numerous (*See* Plate I). The shore of this part of the lake is much indented and many of the numerous bays are fiord-like.

Northeast of Hunter bay the relief is considerably less than to the south, but the divide between Sloan and Coppermine rivers is probably over 500 feet above Great Bear lake and may be considerably more.

The northwest part of McTavish arm has low shores, the ground rising from the lake with a gentle gradient (*See* Plate I), in places broken by escarpments, to an elevation of 1,600 feet above the lake or 2,000 feet above sea-level at a point 17 miles north of the lake.[2] This country has a subdued, rolling topography in which a few streams have cut youthful gorges along their courses to the lake.

North of Dismal lakes and east to Coppermine river a regular escarpment topography is developed in rocks of the Coppermine River

[1] McDonald, R. C.: Personal communication.
[2] McDonald, R. C.: Personal communication.

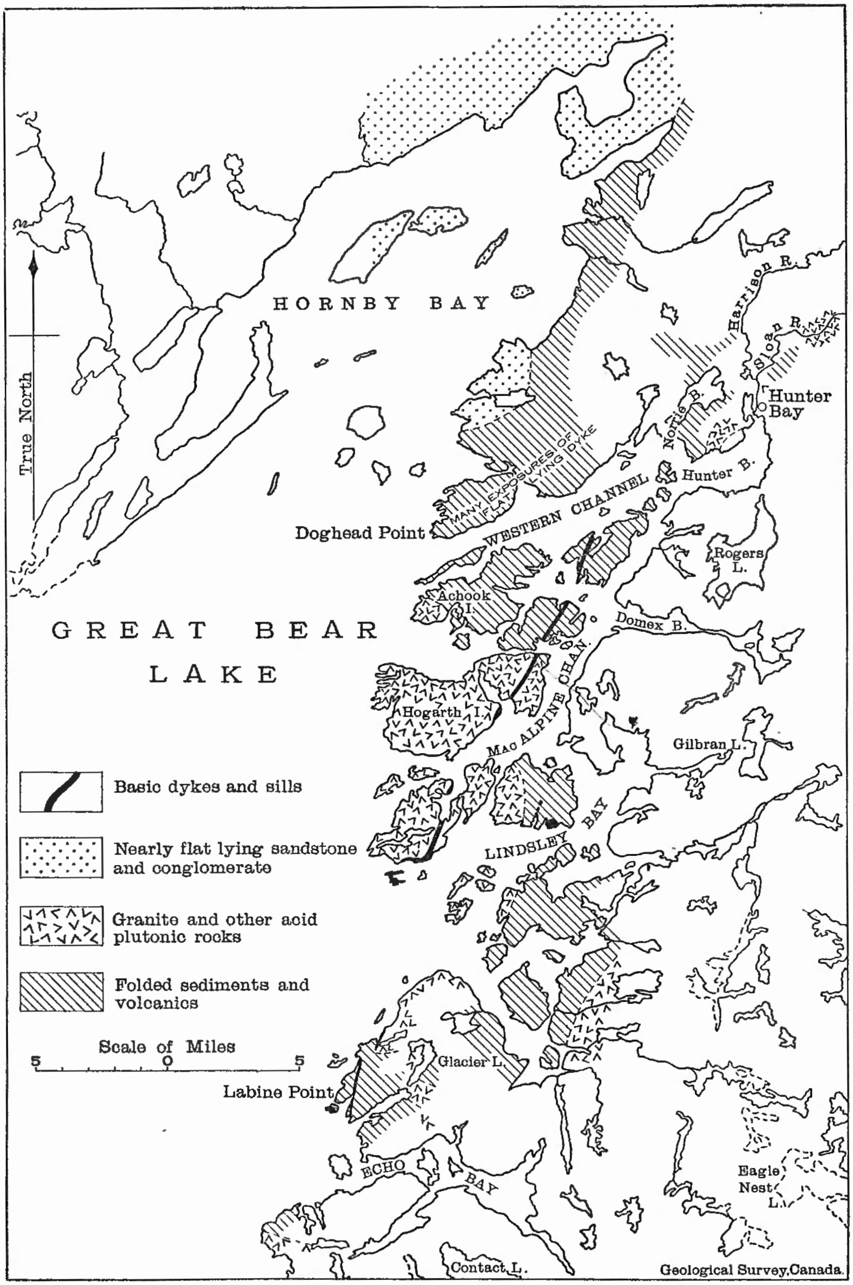


Figure 4. East side of Great Bear lake, North West Territories.

series, which here trend northwest and dip northeast at low angles. The hills are arranged in line and some rise 700 feet above the adjacent ground. The steep southwest, and gentle northeast, slopes are a striking feature.

South of the western part of the western Dismal lake the topography is irregular, with several large hills.

CLIMATE, TIMBER, AND WATERPOWER

The climate is characterized by a long, cold winter and a short, cool summer. There appear to be some climatic differences between the north and the south slopes of the Arctic Ocean-Great Bear Lake divide. Lower winter temperatures are experienced at Great Bear lake than on the Arctic slope, and in summer more low clouds, fog, and rain are experienced on the northern slope than on the southern. Temperatures as low as −78° F. have been recorded at Great Bear lake.[1]

Timber sufficiently large for cabin construction is found in places throughout the southern part of the area, but along the upper part of Sloan river it is very small and scrubby. On the high ground north of the head of McTavish arm timber is only found in small clumps in sheltered places; north of Dismal lakes it is absent.

It is difficult to appraise the possibilities for waterpower development without a knowledge of the minimum stream flow, which may be exceedingly small. Sloan river in part of its lower course flows for several miles with a steep gradient in a V-shaped valley, though there are no large falls. The last rapid on this river has a sudden drop of 13 to 14 feet and, in summer, the volume is considerable (*See* Plate I). A river entering the west side of McTavish arm near the head, flows in a steeply walled gorge for some distance and might be a source of power if there is any winter flow. White Eagle falls near the mouth of Camsell river, at the southeast corner of Great Bear lake, are reported to have a drop of nearly 50 feet in almost a quarter of a mile[2] and to have a considerable volume of water in summer.

GENERAL GEOLOGY

The limited amount of field work yet done precludes making any detailed statement of the general geology. Preliminary work shows a group of sedimentary and volcanic rocks that have been intruded by granitic and other intrusives. A series of little disturbed sandstones and conglomerates is probably younger than these rocks. Cutting all are basic dykes and sills and a system of large quartz veins.

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[1] Norrie, J. P.: "Great Bear-Coppermine Area"; Can. Min. and Met. Bull. No. 227 (March, 1931).

[2] Bell, J. Macintosh: "Great Bear Lake to Great Slave Lake"; Geol. Surv., Canada, Ann. Rept., N.S., vol. XII, pt. C, p. 19 (1902).

Table of Formations

Quaternary	Silt, clay, gravel, morainal material
Unconformity	
Precambrian (?)	Basic dykes and sills; large quartz veins
Intrusive contact	
Precambrian (?)	Little disturbed sandstone and conglomerate
Unconformity ?	
Precambrian (?)	Granite and other acid plutonic rocks
Intrusive contact	
Precambrian	Sedimentary and volcanic complex

SEDIMENTARY AND VOLCANIC COMPLEX

These rocks have not been subdivided, though they probably constitute at least two major series. They comprise tuffs, conglomerates, arkoses, sandstones and quartzites, agglomerates, some flows, banded, fine-grained sediments (in part probably of volcanic origin), cherts, lean iron formation, limestone, and dolomite. In addition there are areas of rocks of obscure origin, possibly altered acid volcanics. The distribution of this complex is shown on Figure 4.

A thickness of several thousand feet of conglomerate and conglomeratic sandstone is found in Lindsley bay 8 miles northeast of Labine point; and this band has been traced for 10 miles in a northerly direction to the narrows in McAlpine channel. It may extend in the opposite direction as far as Echo bay. In Lindsley bay it is bordered on the west by a few hundred feet of chocolate-coloured, somewhat ferruginous sediments, and on the east by basic volcanic rocks with some sediments. East of these are massive, red, cherty rocks.

The rocks of the peninsula between Hunter bay and the main part of McTavish arm, and most of the rocks on Sloan river as far as McLaren lake, are massive, fine-grained, purple, brown, or red in colour, with scattered grains of feldspar, quartz, epidote, and, in places, other minerals. In places, rock fragments and remnants of bedding indicate that they are of clastic origin, probably volcanic ash rocks. In most places, however, their origin is obscure.

In the vicinity of Labine point and eastward to Glacier bay, and in places on the shore of that bay, is a group of volcanic and fine-grained sedimentary rocks whose equivalents have not definitely been recognized elsewhere. They consist of fine-grained, olive green, grey, and brownish red, banded sediments, in places ripple-marked, with interbedded volcanic material, consisting of tuffs, agglomerates, and some flows. Some beds in the sediments are dolomitic or calcareous. Part of the hill between Labine point and Glacier bay is composed of a massive, fine-grained, felsitic, porphyritic-textured rock with scattered crystals of amphibole.

GRANITE AND OTHER ACID PLUTONIC ROCKS

These rocks have been found in two large areas and in several scattered smaller areas. One area of granite with granodioritic phases near the border is exposed in the southwestern islands of the group between Labine point and Hunter bay. At Dowdell point, south of Echo bay, is exposed the northern edge of a granite mass that is reported to extend south along the shore for 20 miles to Richardson island. East of the head of Lindsley bay, north of Labine point, a mass of granitic rocks is exposed. It is several miles in extent and may be the western part of a fairly large massif. Numerous small areas have been found, as shown on the map, but have not been completely delineated. Some syenitic phases may be present in all these granite bodies, but they have not been distinguished. Though all these intrusive bodies have been provisionally grouped together they are not necessarily contemporaneous.

Other granites may exist, or may have existed, in the area, as granite pebbles have been found in places in some of the conglomerates of the complex of sedimentary and volcanic rocks.

LITTLE DISTURBED SANDSTONES AND CONGLOMERATES

These rocks have been found mainly north and west of the head of McTavish arm. They have variable strikes, and dips of as much as 10 degrees, but on the whole are little disturbed. Neither the base nor the top of the formation has been seen. The exposed beds are brown and vari-coloured sandstones, often strongly crossbedded, overlain by massive conglomerates, in turn overlain by more sandstones. The pebbles in the conglomerate are dominantly white quartz and chocolate, purple, and red, cherty rocks similar to those found in the complex. Granite pebbles have not been found. The section of these beds examined has a thickness of about 1,000 feet. These rocks may possibly be correlated with the Coppermine River series occurring 80 miles to the north.

BASIC DYKES AND SILLS AND LARGE QUARTZ VEINS

Cutting all these rocks are basic dykes and sills and large quartz veins. The dykes and sills have been grouped because of lithological similarity. Their age relative to that of the quartz veins is not known.

The basic dykes and sills are very numerous and are of all sizes, the maximum being 150 feet in width and 20 or more miles in length. They are fresh-looking, hard, greenish grey to greenish black, medium to fine-grained rocks, usually exhibiting good columnar jointing. The few thin sections of these rocks examined show them to have the mineralogical composition of a norite or, as at some places, a diabase.

One of these bodies is a nearly flat-lying dyke which has been traced for 20 miles in the islands southwest of Hunter bay and in the peninsula west of that bay. This dyke cuts granite and the rocks of the complex. It has a maximum dip of 30 degrees and exhibits numerous rolls. In the peninsula west of Hunter bay it has, because of its low dip, a considerable areal extent. A sill, in places 200 feet thick, intrudes the fine-grained, banded rocks at Labine point. Other smaller bodies, too numerous to detail, are scattered through the area.

A number of very large quartz veins occur in a belt several miles wide trending parallel and close to the east shore of Great Bear lake from Labine point to Hunter bay. At Hunter bay the belt swings slightly to the east and from there it extends northeast to McLaren lake and for an unknown distance beyond. One vein (locally called the Sloan dyke) passes near the settlement at Hunter bay and has been traced for 7 miles, the width generally being several hundred feet. There are many other veins comparable in size. They enclose near their borders fragments of the country rock and have usually considerably altered them. The walls are not sharp, but instead a network of veins in the wall-rock forms a transitional zone from the main body to the country rocks. In places the veins contain considerable specular hematite and at a few places other metallic minerals.

QUATERNARY GEOLOGY

The region has been glaciated, the direction of movement, as shown on the higher summits, being almost directly from the east. At the present time in certain parts of the area the existence of small valley glaciers is almost possible. In 1931 snow banks in certain narrow valleys had not entirely melted at the end of August, when night frosts had again commenced.

Boulder clay and other morainal material are relatively scant in the area east of McTavish arm. They occupy the hollows between the hills, but the hollows are not large. The only definite morainal belt seen was traced for 8 miles in a west-northwest direction across the south end of McLaren lake. West of the northern part of McTavish arm and north to within a short distance of Dease river, boulder clay is reported to be extensively distributed, concealing the bedrock over large areas.[1]

Banded post-glacial silts and clays are found at places in the valley of Sloan river and occupy several square miles in the last 5 miles of the valley and in the lower part of the valley of the tributary, Harrison river. The upper surface of these deposits is nearly flat and has a considerable slope to the south. The silts and clays overlie boulder clay and a thickness of at least 100 feet is exposed in high banks along Sloan river.

Gravel beaches and sand-plains are present along the west shore of the northern part of McTavish arm (Plate I). A single large beach here has a length of 9 or more miles and a width of $\frac{1}{4}$ mile, and is composed of fragments of sandstone from the underlying sandstone series. The upper edge of this beach at one place is 497 feet above the present lake-level and the lower edge is 343 feet. Other beaches, some 500 feet above

[1] McDonald, R. C.: Personal communication.

the lake-level, are found along this shore. Along the east shore of McTavish arm, due to the more rugged contour of the land, gravel beaches are not large though they are numerous. Here, beaches have been found nearly 500 feet above lake-level. The relative ages of the gravel beaches and the Sloan River silts are not known. The beaches and silts may be contemporaneous.

The soil mantle is, on the whole, light. Over large areas on the east side of McTavish arm bedrock is continuously exposed.

STRUCTURAL GEOLOGY

The limited amount of field work yet done has not afforded much definite evidence regarding structures. The band of conglomerate in the complex in the vicinity of Lindsley bay, and which has been traced for 12 miles in a north-south direction, may indicate the general trend of the stratified rocks.

There appears to be structural control of some physiographic features. Linear depressions of all sizes are numerous and long, narrow lakes and chains of lakes are prominent features. Many of these depressions nearly parallel the east shore of Great Bear lake and may be indicative of faulting along this shore. One such depression is McAlpine channel, which follows a straight line from Hunter bay south-southwest for 20 miles. Very many small faults, with throws of a few feet, were seen.

ECONOMIC GEOLOGY

GENERAL STATEMENT

The mineral deposits so far discovered in the area are classified as follows:

(1) Copper deposits
  - (a) In large quartz veins
  - (b) In volcanic rocks of the Coppermine River series

(2) Silver and pitchblende deposits
  - (a) Pitchblende deposits with silver
  - (b) Silver deposits

The copper deposits in quartz veins occur at Hunter bay. One deposit which is provisionally grouped with these lies 20 miles north of Dismal lakes in a vein cutting the Coppermine River series. The second class of copper deposits are found in a large area of the Coppermine River series north of Dismal lakes and west of Coppermine river. The silver and pitchblende deposits have been found in the vicinity of Labine point and Echo bay, 35 miles south of Hunter bay.

COPPER DEPOSITS IN QUARTZ VEINS

The system of quartz veins in which copper deposits have been found extends from the vicinity of Echo bay north to Hunter bay and from there, along perhaps a slightly more easterly direction, to McLaren lake and for an unknown distance beyond. The copper deposits have been found only at Hunter bay. The factors controlling their localization here are not known. It may be, however, that copper deposits are not confined to this one locality.

The mineralization in these deposits consists of bornite, chalcopyrite, chalcocite, and famatinite (Cu_2S, $4CuS$. Sb_2S_3) in varying proportions, with very minor amounts of pyrite. The mineralization in the quartz veins is along zones or bands whose positions were probably controlled by fracturing.

Consolidated Mining and Smelting Company Group, Hunter Bay

This group of claims lies 5 miles northeast of the settlement at Hunter bay. It is reached by ascending Sloan river for 5 miles to a small basin at the foot of several miles of rapids. Two small rapids are portaged in making this ascent, the lower one, on the north bank, the upper one on the south. From the basin at the foot of the long series of rapids a rough foot trail leads northeasterly for 1½ miles to a small pond on the claims, along the west shore of which some pits have been sunk.

Near the pond the prevailing rock is a medium-grained, red granite. This is cut by a large quartz vein which crosses diagonally a small bay at the south end of the pond, and strikes 35 degrees. A cross-section of the vein at this place shows, from west to east: 325 feet of a network of small quartz veins in granite; 360 feet of nearly solid quartz; 310 feet concealed under drift and the pond; and on the far shore outcrops of granite with small quartz veins. Due to the great size and irregular edges of the quartz veins its dip has not been determined.

Copper mineralization has been found in the outcrops of the vein near the pond. The mineralization consists of bornite and chalcocite with subordinate amounts of chalcopyrite, famatinite, hematite, and siderite. In August, 1931, four pits had been sunk at intervals along a distance of 420 feet north and south (magnetic). The mineralization exposed in the different pits, commencing with the northernmost, is as follows:

Pit No. 1: 2 feet sparsely mineralized with chalcocite and bornite.

Pit No. 2: 2 feet abundantly mineralized with chalcocite, bornite, and famatinite.

Pit No. 3: 34 feet of chalcocite and bornite in scattered blebs.

Pit No. 4: 6 inches of chalcocite and bornite at one place, and smaller amounts at two other places.

In a small pit 1,300 feet to the north of No. 1 pit, sunk in the vein near its southeast edge, a fracture zone a few feet wide and striking with the vein is exposed. At this point a width of 6 feet across the strike of the zone is very sparingly mineralized with chalcocite and bornite. The mineralization rapidly becomes less to the north. At a distance of 1,500-2,000 feet south of the pits, near the shore of the pond, a pit has been dug in the side of a rusty knob on the vein. In it abundant chalcopyrite is exposed across a width of 5 feet.

Polaris, Vega, and Star

These claims are on the north shore of Hunter bay 2 miles west of the mouth of Sloan river. They are part of a group of claims.

The claims are crossed diagonally by a large quartz vein (*See* Figure 5) known as the Sloan dyke. This vein has a general strike of 50 degrees and is nearly vertical. It has been traced from the lake shore northeast for 7 miles. The width in places is several hundred feet. Two other veins, converging somewhat to the south, lie 600 and 1,500 feet, respectively, northwest of the "Sloan dyke". The Sloan vein is bordered on the west by red granite and on the east by massive, fine-grained, brown to purple rocks of the complex, and carries numerous scattered grains of feldspar, quartz, epidote, and other minerals. Along both borders of the vein the rocks are considerably altered for as much as 100 feet in places. There are shattered zones in the vein itself.

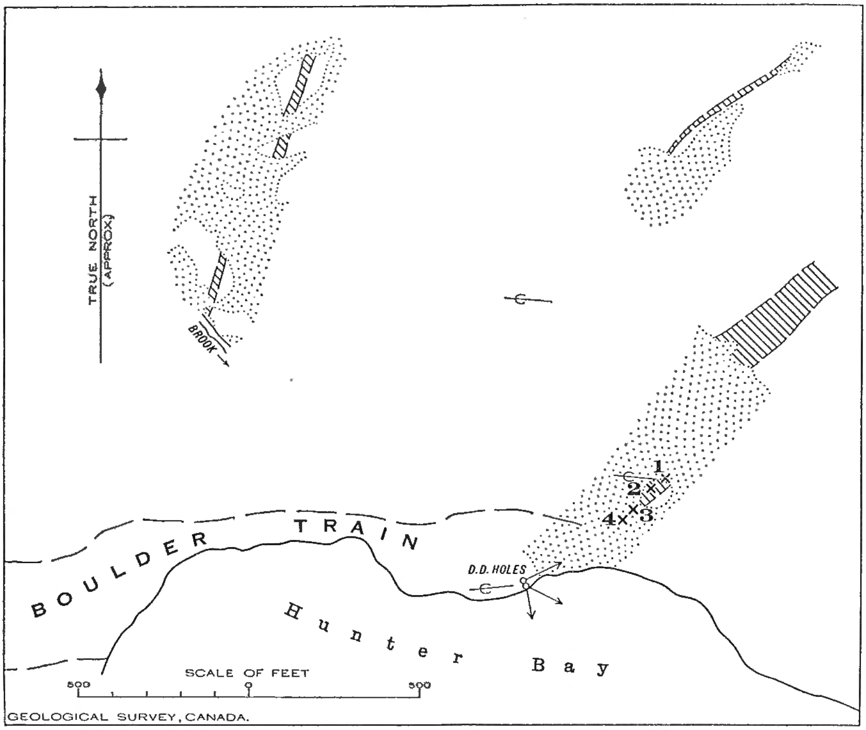

Figure 5. Parts of Polaris, Vega, and Star claims, Hunter bay, Great Bear lake, North West Territories. Outcrops of veins shown by pattern of ruling; areas of drift in their immediate vicinity by stipple; and trenches by crosses.

A mineralized band in the vein has been found in an isolated outcrop near the lake shore and has been traced by four pits to within 200 feet of the shore. Further work here has been prevented by the deep overburden. The three northern pits show a band of chalcopyrite-bornite mineralization, bordered on the west by altered and chloritized granite and on the east by intensely altered rocks of the complex. The chalcopyrite tends to be more abundant in the western part of the vein and the bornite in the eastern part. The mineralization in the different pits is as follows, the pits being numbered from northeast to southwest:

Pit No. 1: A few specks of chalcopyrite at one place.

Pit No. 2: 15 feet with occasional specks of bornite and chalcopyrite, followed to the east by 14 feet with scattered blebs and areas, some ½-inch wide, of bornite and chalcopyrite.

Pit No. 3: Little material exactly in place is visible, but some fragments as much as 2 feet wide contain abundant bornite.

Pit No. 4: Caved; there are no exposures.

The lake shore near the vein and for several thousand feet to the west is a moderately sloping boulder beach with only occasional rock outcrops. For 2,000 feet west of the vein many of the boulders are of quartz and some contain bornite and chalcopyrite. These boulders are found only on the west side of the vein and have been transported from their original position in the vein by glacial ice, which in this region moved almost directly from east to west. Mapping of the north and south limits of the train of mineralized boulders (*See* Figure 5) disclosed a sharp boundary on the south and probably a fairly sharp one on the north. Knowing the direction of ice movement and the positions of the north and south limits of the boulder train it can be inferred that many of the mineralized boulders were derived from a part of the vein south of the last outcrop, a part concealed by drift and, farther south, by the lake. This inference was tested in 1931 by diamond drilling from a rock outcrop on the lake shore west of the vein. Four holes were put down to intersect the vein (*See* Figure 5). The first hole directed at a 45 degree angle to intersect it at right angles, ran into an open cavity at 82 feet from the collar. A second hole in the same direction, at a 60 degree angle, intersected 96 feet of bornite-chalcopyrite mineralization beginning at a point 141 feet from the collar. The true width cut is not known, as the hole is unsurveyed. Much of the mineralization, particularly in the upper (west) part, consists of occasional, irregular blebs of chalcopyrite. Two other 60 degree holes, directed to cut the vein diagonally at points, respectively, north and south of the first intersection, encountered greatly fractured rock at depths in the hole of 221 and 235 feet, respectively. These difficulties had not been surmounted at the time of the writer's visit. All four holes started in fresh granite, then passed for a considerable distance through greatly altered granite, and then through fractured rock. It is thought that the three holes that did not intersect mineralization may have almost reached the vein.

The development work to August, 1931, has indicated a band of bornite-chalcopyrite mineralization in the large quartz vein, a band with a length of 150 feet, and a possible extension of 350 feet to the south, to the drill hole intersection. The definite southern limit of mineralized boulders in the boulder train may indicate the position of the southern termination of the inferred stretch of mineralization in the vein.

The quartz vein, mentioned as lying 600 feet northwest of the Sloan vein, in its southernmost exposure shows a lens, 2 feet wide and 25 feet long, which is sparingly mineralized with chalcocite and bornite.

B Group Claims

These claims are 19 miles north of the narrows between Dismal lakes and approximately 45 miles west-southwest of the mouth of Coppermine river. A lake about 4,000 feet long at an elevation of between 700 and 1,000 feet above sea-level is used as an aircraft base.

The deposit here, though it is not in one of the large quartz veins and lies 90 miles from the other two deposits, is provisionally grouped with them because of certain features all have in common.

The hills at this place rise to 700 feet above the adjacent valleys and have steep southwest slopes and moderate northeast slopes. Outcrops are numerous in the hills, but relatively scarce in the intervening valleys.

The discoveries on these claims are along the northeast slope of one of these hills and overlook a broad valley. This hill is composed of basaltic flows of the Coppermine River series, the northeast slope being almost a dip slope. On the southwest slope, where the flows can be seen in cross-section, they are 25 to 100 feet thick, fine-grained at the top and bottom, and somewhat coarser grained in the middle. The tops of the flows, and in places other parts, are vesicular or amygdaloidal. The amygdules decrease in size and increase in numbers from the middle to the tops of the flows. They contain several minerals, among which are quartz, epidote, and orthoclase.

A linear depression striking 295 degrees (magnetic) and in places 50 feet wide, has been traced for 3,000 feet along the north base of the hill described. It is largely drift filled, but in a few places a quartz-carbonate vein with a visible width of 25 feet is exposed. Ten test pits have been sunk in this draw; some of them expose a quartz vein with bornite-chalcopyrite mineralization; the others show nothing, having never reached bedrock or being now caved. The basaltic flows that form the wall-rocks on the northeast side of the vein are, for a width of as much as 50 feet, fractured and in places cut by small quartz veins that apparently branch at slight angles from the main vein or zone.

The mineralization in the vein is dominantly massive bornite with, in places, chalcopyrite and covellite, and the gangue is quartz and a yellow carbonate mineral. The quartz frequently exhibits crustiform and banded structures with alternate milky and glassy bands. The quartz is probably of more than one age, as it is found veining bornite and also containing bornite seams. Bornite mineralization has been found in the following pits, commencing with the most westerly. The assay values have been kindly furnished by Northern Aerial Minerals Exploration, Limited.

Pit No. 8A: In the west end of this trench, a 15-inch vein of quartz, buff carbonate, and abundant bornite, strikes diagonally away from the main zone and narrows sharply.

Pit No. 8: This is 300 feet south of pit 8A. Some fragments of bornite lie on the dump. The only exposures are of the east part of a vein of massive quartz.

Pit No. 7: This is 95 feet south of pit No. 8. A breadth of 11·5 feet of the east part of a vein was exposed, displaying abundant bornite with some chalcopyrite; the western part was buried under muck. The company reports that a cross-section of 14 feet 11 inches along the north side of the trench averaged 47·13 per cent copper, and one of 12 feet along the south side averaged 46·99 per cent copper.

Pit No. 6: This pit is 40 feet south of pit No. 7. On the north and south walls a band of nearly solid bornite varying from 3 to 4 feet in width and dipping steeply to the west is exposed.

Pit No. 5: This is 40 feet south of pit No. 6. One foot 6 inches of abundant bornite mineralization, bounded for a short width on the east by quartz, is exposed. The walls of the remainder of the pit have slumped. The company reports an average of 44·65 per cent copper across a width of 9 feet 11 inches.

Pit No. 4: This is 90 feet south of pit No. 5. No exposures. The company reports 35·04 per cent copper across a width of 2 feet and in another band, 7 feet east, 25·57 per cent copper over a width of 4 feet 2 inches.

It is stated that bornite float has been found at several places in and near the linear depression in a length of 2,000 feet.

Other discoveries of copper sulphides on this group of claims are referred to in the following section.

COPPER DEPOSITS IN THE COPPERMINE RIVER SERIES

These deposits fall into several types: *(a)* native copper in the amygdaloidal or vesicular tops of certain flows; *(b)* tiny specks of native copper distributed through a flow or flows; *(c)* sheets of native copper in cracks in the basaltic rocks; and *(d)* chalcocite and carbonates filling fissures and fracture zones in the basalt. A large number of claims have been staked on copper deposits of these types, but only two occurrences have been examined.

A Group

On the A group of claims on the upper slopes of the hill, 1¼ miles northwest of the workings already described, four trenches have been dug in a small, rocky and grassy flat in which chalcocite-bornite float is present. In the two central pits, 25 feet apart, a nearly pure mixture of chalcocite and bornite in interlocking fragments almost in place is present over a width of 3 feet. In the end trenches the mineralization is less abundant. The gangue is quartz and a white carbonate mineral. One thousand feet to the south in the nearest exposures along the apparent strike, no signs of shearing or veins were seen.

Two thousand feet northwest of this working a small pit has been sunk in the middle of an area 50 by 20 feet in which chalcocite-bornite float is abundant. None of it can be seen in place in the pit.

D Group

These claims are situated on the hills at the west end of Burnt Creek valley and are estimated to be 8 miles west of the junction of Burnt creek with Coppermine river. The claims were staked for Northern Aerial Minerals Exploration, Limited.

The rocks in the vicinity are the basaltic flows of the Coppermine River series. They are cut by a zone of fracturing which where exposed is as much as 8 feet wide and strikes in its southern part approximately north but swings somewhat to the west in its northern part. The zone of fracturing is exposed in a cliff 20 feet high, overlooking the valley of Burnt creek. It is a breccia of basaltic fragments cemented by a white carbonate, which in places carries abundant chalcocite. The walls of the zone are vertical and sharp and the fragments are abundant. G. G. Duncan reports that an average of four channel samples across a width of 8 feet gave 9·96 per cent copper[1]. Approximately 650 feet south along the strike of the zone, across a drift-covered flat, a small trench exposes a width of 7 feet of lower-grade mineralization; and 150 farther south, a trench exposes a width of 8 feet of mineralization similar in grade to that of the exposures in the cliff. In the other direction mineralized float can be traced for 450 feet, and at a distance of 800 feet a narrow depression extending several hundred feet farther along the strike probably indicates the extension of the zone. Mineralized float is reported to have been found in two small pits sunk in the middle of this depression at a distance of 1,200 feet north of the cliff exposure.

PITCHBLENDE AND SILVER DEPOSITS

The pitchblende (radium bearing) and silver are found in shear and shatter zones in altered rocks near their contact with intrusive granite. This granite, or its parent rocks, is probably the source of the mineralization. At the Labine Point deposit, however, an adjacent basic sill cannot as yet be eliminated with certainty as a possible source of the later stages of the mineralization. The Labine Point pitchblende and silver deposit, the only deposit examined in detail, has proved to be of a very complex character, with a large number of minerals present.

Cobalt, Cobalt Extension, and Roy Groups

These claims are on Labine point, the northwest point of Echo bay. They extend from the point for 3½ miles north along the shore and as much as 1½ miles inland. The claims were staked for Eldorado Gold Mines, Limited, at various times from May, 1930, to 1931, by G. A. LaBine and others.

The rocks in the vicinity of Labine point belong to the complex. They consist of fine-grained, banded sediments, volcanic agglomerate, perhaps some flows, and impure limestone, all considerably metamorphosed. Granite occurs along the west side of the point and on the tips of small points and on off-lying islets for several miles north of the point, the main body apparently being under the lake to the west. A small, aplitic dyke from this granite extends partly across Labine point. The granite has caused baking and granitization of the sediments to such an extent that over large areas the bedding has been completely obliterated, and a mottled pink and greenish grey, massive, fine-grained rock has resulted. Magnetite, frequently accompanied by biotite, is very widely distributed in the rocks of the point. Iron sulphides, mostly pyrite, occur in places disseminated through the rocks and in weathering have formed large gossans, in which limonite and gypsum are abundant. A basic sill, in places 200 feet thick, intrudes the sediments and volcanics and outcrops on the island at the south end of the point, and on the next point to the east, one-quarter of a mile away. It is found again on the lake shore 1¼ miles north of the point.

[1] Duncan, G. G.: "Exploration in the Coppermine River Area, Northwest Territories"; Can. Inst. Min. and Met., Bull. No. 227 (March, 1931).

Examination of thin sections of the altered banded rocks on the point shows aggregates of tiny interlocking grains with granulitic texture, commonly sodic plagioclase, but in some instances quartz. In some sections there are indications of clastic origin. Secondary magnetite and green or brown biotite are present in most sections examined. Other minerals

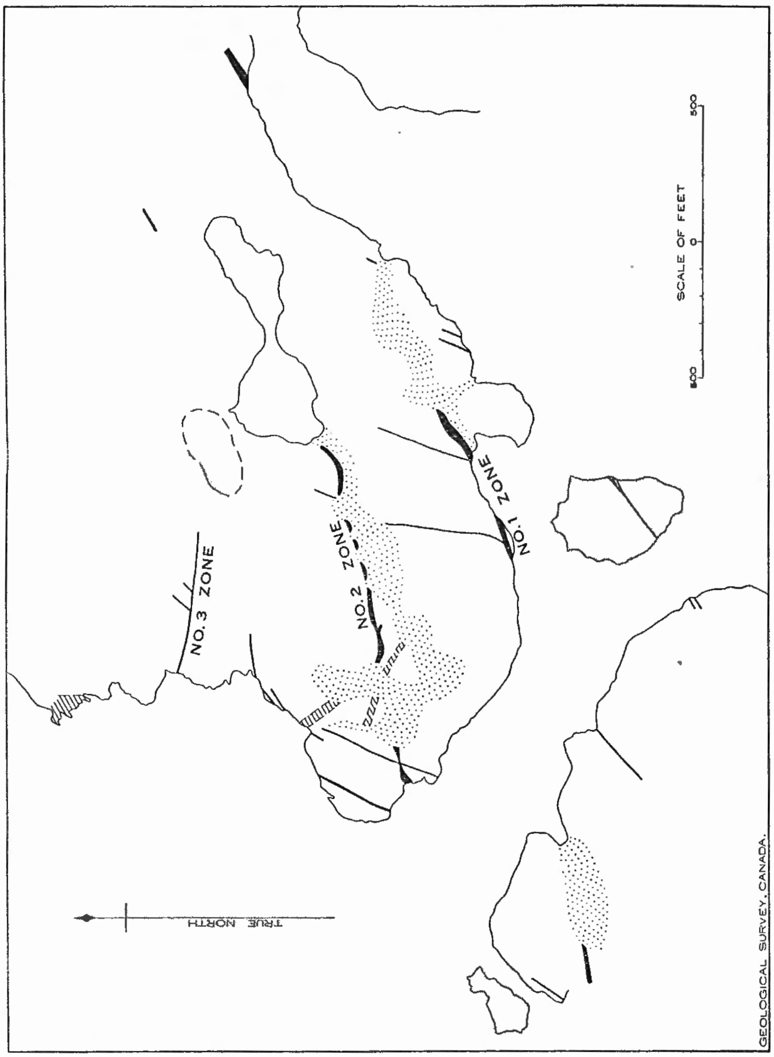

Figure 6. Cobalt group of mining claims, Labine point, Great Bear lake, North West Territories. Drift-covered areas shown by a pattern of stipple; granite and aplitic bodies by ruling; and shear zones by solid black.

identified in different sections are chlorite, epidote, garnet (probably grossularite), a carbonate mineral, and in one section albite in a veinlet. A thin section from the basic sill, from the outcrop on the lake shore north of Labine point, shows the rock to have the composition of a quartz norite.

Sufficient of the bedding in the Labine Point rocks remains to show that there is a general north strike and westerly dip, with numerous local variations. The sill intruding these rocks, on the island at the end of the point, dips to the southwest, but on the point one-quarter of a mile east it dips to the east with the sediments there. The intervening bay apparently lies on an anticlinal axis.

The pitchblende and silver are found in shear and shatter zones, traversing the altered rocks of the point (*See* Figure 6). Development work has been done on three zones, numbered 1, 2, and 3, from southeast to northwest. They strike in a general east-northeast direction, converging somewhat in that direction. All three zones have a general steep dip to the northwest. The width of the shatter zones is irregular, from 1 foot to 50 feet. No. 1 zone has been traced for 1,000 feet, partly in shallow water along the lake shore, and has a possible extension of 1,200 feet to the north and 1,400 feet to the south. No. 2 zone has been traced, with one gap of 350 feet, for 1,400 feet from the lake shore to a small pond under which it disappears. The pond and a small swamp extend along the strike for 1,200 feet, and in the exposures beyond this the zone has not been recognized. No. 3 zone has been traced from the lake shore for 600 feet, beyond which it has not been definitely recognized. A fourth zone still farther west is reported to carry pitchblende.[1]

In the middle zone, the metamorphism by the granite has been more intense than in the adjacent rocks or zones.

In addition to the main zones, there is a second set of fractures trending slightly east of north. They are generally occupied by rather regular quartz and carbonate veins, some of which are 3 feet wide. Many of these veins branch from the main shear zones. The west end of the middle (No. 2) zone is intersected by a north-south vein, but there is little, if any, displacement. Lastly, there are other small veins with various strikes and which do not belong to either system.

In all the three main zones, quartz has been introduced cementing a breccia of country rocks, or forming a stockwork where the movement of the rocks has not been so extensive. In the first and third zones it is the main filling, but in the middle zone it is less prominent, particularly in the eastern part. Specular hematite is locally abundant in No. 1 zone. A yellow, iron-bearing carbonate mineral and dark brown siderite are widespread, and the former is in places abundant.

The pitchblende is present in the zone as: (1) sinuous, persistent veinlets $\frac{1}{8}$ inch to 1 inch wide with mamillary surfaces; in many instances, several veinlets rudely parallel one another and are closely spaced; (2) colloform masses in a matrix of dark quartz; and (3) angular fragments in a quartz matrix. The pitchblende in the veinlets is distinguished by its high specific gravity (6 to 9), mamillary surfaces, grey to black colour, radial fracture, and usually by its associated alteration products with brilliant orange, yellow, and green colours. The second and third varieties of pitchblende do not show the mamillary surfaces or the typical fracture, are dark brown with a glassy lustre, and have a much lower specific gravity.

[1] Spence, H. S.: "Occurrences of Pitchblende and Silver Ores at Great Bear Lake, N.W.T."; Mines Branch, Dept. of Mines, Canada, Memorandum Series No. 51 (October, 1931).

Native silver has been found as: (1) masses of wires in a reddish brown, manganese carbonate gangue; (2) plates and leaves, in some places with carbonate, between the surfaces and in cracks of mamillary pitchblende; and (3) plates in fractures and tiny wires scattered through only slightly fractured wall-rock.

In addition to pitchblende and silver, a variety of minerals have been found in the shear zones. They include arsenopyrite, magnetite, hematite, pyrite, limonite, chalcopyrite, bornite, covellite, tetrahedrite, native copper, malachite, azurite, galena, cerussite (?), sphalerite, argentite, ruby silver (?), skutterudite ($CoAs_3$), nickeliferous skutterudite (?), cobaltite, rammelsbergite ($Ni\ As_2$) (?), erythrite (cobalt bloom), annabergite (nickel bloom) (?), native bismuth, and two unidentified minerals. Barite is reported to be present.[1]

Pitchblende was introduced into the zones at an early stage in the mineralization. It mostly occurs on the northwest or hanging-wall side of the fracture zone, and in places there has been some movement subsequent to its emplacement. Where it is intimately associated with quartz (varieties 2 and 3) it is present as massive lenses which tend to occur where there are slight changes of strike in the zones. Arsenopyrite, bornite, tetrahedrite, sphalerite, chalcopyrite, galena, covellite, and native silver are all later than pitchblende, and most of them have been found in cracks in it. Pyrite is found as clusters of residual grains in massive chalcopyrite. Bornite is usually partly replaced by chalcopyrite. Argentite has been identified only in a single specimen, where it is associated with covellite, tetrahedrite, and galena. The presence in minute amounts of one of the ruby silvers (proustite or pyrargyrite) is suspected. Only a few specks of native copper have been seen.

In all three main zones, and in some of the other fractures, a rather definite, late mineralization stage of cobalt-nickel minerals, chalcopyrite, native bismuth, quartz, and an iron-bearing carbonate mineral, is found. The mineralization occupies sharply defined fissures with widths no greater than a few inches. These veins have selvages of cobalt-nickel minerals on which have grown quartz crystals, on many of which in turn have grown crystals of chalcopyrite. In places these crystals line a vug, but frequently what would have been the cavity is filled with a carbonate in which are scattered grains of native bismuth. This mineral has so far always been found with the cobalt-nickel minerals.

Up to September, 1931, three pits had been sunk on the eastern part of No. 3 zone, fourteen pits along No. 2 zone, and one pit on No. 1 zone. In addition, a considerable amount of careful surface prospecting has been done.

In the No. 1 zone, one pit 22 feet long and said to be 13 feet deep has been sunk at the lake shore, but is flooded. Eleven inches of solid pitchblende is said to extend along the bottom of the pit for most of its length. Three hundred and fifty feet east along this same zone, a lens of pitchblende 6 inches wide is visible. Much of the zone intervening is under the lake.

In the No. 2 zone, pitchblende has been found at a number of places and is present in most of the pits. At some other places yellow surface

[1] Spence, H. S.: Op. cit., p. 5.

stains may indicate its presence. Much of the pitchblende in the zone is mixed with dark quartz (varieties 2 and 3) and is in lenses, some of which are 21 inches wide and 40 or more feet long. Channel samples were taken across the widest parts of some of these lenses of quartz and pitchblende. The assays follow:

	1	2	3	538
U_3O_8 (per cent)	15·94	22·78	10·74	31·68
Radium (calc.) (mg. per ton 2,000 lbs.)	41·44	59·22	27·92	82·36
Silver (troy oz. per ton 2,000 lbs.)	11·69	43·25	24·84	1·44
Gold	Trace	Trace	Trace	Trace

Sample No. 1. Across maximum width of lens (1·75 feet) in trench 800 feet from west end of No. 2 zone.

Sample No. 2. Across a width of 0·65 feet of same lens as represented by sample No. 1, but 7 feet to the east.

Sample No. 3. Across a width of 0·65 feet of the same lens as represented by samples Nos. 1 and 2, but 7 feet east of No. 2.

Sample No. 538. Across maximum width of lens (1·45 feet) of glassy pitchblende in trench 600 feet from the west end of No. 2 zone.

The veinlets of mamillary pitchblende found in the eastern part of No. 2 zone are of much higher grade. Assays giving as high as 70 per cent U_3O_8 have been obtained from grab samples.

In No. 3 zone pitchblende has been found in two of the three pits sunk. In the westernmost a single, persistent, ½-inch veinlet of pitchblende is present; in the next pit, 40 feet west, there is a lens of siliceous pitchblende 9 inches wide; in the third pit no pitchblende is visible.

Estimation of the quantity of pitchblende in these three shear and shatter zones is not as yet possible. In the course of sinking test pits approximately the following tonnages were cobbed out and sacked:

No. 1 zone: pit 22 feet by 4 to 6 feet and 13 feet deep, 8 tons sacked.

No. 2 zone: pit 30 feet long and 3 to 6 feet deep, at lake shore at south end of zone, 1½ tons sacked.

No. 3 zone: 800 feet north from lake shore (pit from which samples 1, 2, and 3 were obtained), pit 36 feet by 6 feet and 6 feet deep on east side, 10 feet deep on west side, 10 tons sacked.

A small, further amount was sacked from other places in No. 2 zone. Larger amounts were stock-piled at a pit 500 feet from the lake shore. The amounts of pitchblende obtained from these pits probably represent what can be obtained from the apparently richer parts of the zones.

Abundant native silver has been found in the eastern part of No. 2 zone. It has also been found at two other places in No. 2 zone and in small amounts in several small veins on the claims. In the summer of 1931, silver had not been found in No. 1 or No. 3 zones, but further work on No. 1 zone in the autumn is said to have disclosed some native silver at the lake shore. The amount of silver visible in the six pits at the east end of No. 2 zone in August, 1931, is summarized below, the pits being numbered consecutively from east to west.

Pit No. 1 is 35 feet long across the zone; southern 22 feet has no exposures. In north part there are 36 inches of fractured rocks with tiny seams of native silver in some fractures. Silver is abundantly disseminated in the rock along the south edge of the fractured zone.

Pit No. 2 is 50 feet west of pit No. 1. Silver is visible at intervals over a width of 8 feet, and is abundant over a width of 6 inches near south side of this 8-foot stretch.

Pit No. 3 is 40 feet south of pit No. 2. For 6·7 feet on west side and 5·3 feet on east side of pit, scattered wires and fronds of silver are present with manganese carbonate and wall-rock.

Pit No. 4 is 20 feet south of pit No. 3. The rock has not been blasted, so any silver present is not readily visible.

Pit No. 5 is 20 feet south of pit No. 4. For a length of 6 feet, which has been blasted, a width of 12 inches, pinching somewhat at the ends, holds plentiful native silver, possibly 40 to 50 per cent.

Pit No. 6. The centre of this pit is 40 feet south of pit No. 5. At east end over a width of 4 feet large wires of silver occur at intervals.

Chalcopyrite is the most important copper mineral in the deposit. In No. 1 zone it is found in places as masses, some as large as 1 foot by 6 feet. In the western part of No. 2 zone, for a length of 80 feet and a variable width in places as much as 20 feet, chalcopyrite is sparingly disseminated with galena and magnetite. Cobalt, nickel, and bismuth, found in scattered small veins at various places, are not believed to be of commercial importance under present conditions.

Echo Bay Group

These claims adjoin the Cobalt and Roy groups of Eldorado Gold Mines on the northeast. The workings are one mile northeast of the head of the small bay on the east side of Labine point, and are 400 to 650 feet above Great Bear lake. A rough foot trail extends from the head of this bay to the workings. The claims were staked in 1930 for Consolidated Mining and Smelting Company.

A pronounced cleft in the hills extends east-northeast from the head of the bay east of Labine point. One mile from the bay the cleft is bordered on the south by a ridge of rusty-weathering rocks. These in places are fine-grained, grey, and show traces of bedding striking north (magnetic) and dipping steeply east. Over a large part of the ridge, however, the rocks are massive, fine-grained, grey and greenish grey, and usually contain abundant disseminated magnetite or sulphides, usually pyrite, but in places arsenopyrite; the rocks have a granulitic ground of feldspar with lesser amounts of actinolite, chlorite, colourless garnet, zoisite, and, in one section, tourmaline.

The rocks are extensively fractured and in places sheared. Along the northern slope of the ridge, zones of shearing and fracturing have been exposed in a series of pits (Figure 6). These pits may expose one continuous zone, an *en échelon* arrangement of zones. The mineralization in the pits consists of galena and chalcopyrite with, in places, abundant bluish black manganese alteration products, and magnetite, pyrite, and arsenopyrite. The data for the different pits, numbered consecutively from north to south, are summarized below.

Pit No. 2: 5 feet of disseminated galena, some blebs of chalcopyrite.

Pit No. 3 is 60 feet south of pit No. 2. It consists of two adjoining pits with manganese alteration products in narrow shear zones.

Pit No. 4 is 120 feet south of pit 3. A band 2 feet wide dips 30 degrees southeast, with disseminated steel galena and some chalcopyrite. Arsenopyrite, disseminated pyrite, and manganese alteration products occur on each side of the band.

Pit No. 5 is 70 feet south of pit No. 4. Two narrow, nearly vertical shear zones 7 feet apart have abundantly disseminated galena and chalcopyrite between them.

A second zone of shearing, 600 feet west of the first, extends along the ridge near the crest and has been traced by means of five pits for 400 feet. One, in places two, seams from 1 to 12 inches wide and 8 feet or less apart, have been found in four of these pits. The seams contain erythrite, a cobalt-nickel mineral, in arborescent forms, some native silver and perhaps argentite, and crushed massive chalcopyrite. On each side of and between the seams disseminated galena and smaller amounts of chalcopyrite have been found. Abundant, bluish black, manganese-weathering products are present in all the pits.

Bonanza Group

These claims are on Dowdell (Sixty-six) point, the south point of Echo bay, 6 miles south of Labine point. They were staked in May, 1931, by G. A. LaBine, E. C. St. Paul, and others, for Eldorado Gold Mines.

The contact of intrusive biotite granite with older volcanic rocks crosses the claims from east to west and bisects the point, the granite occupying the southern part of the point and the volcanics the northern part. Native silver has been discovered in shear and fracture zones at two localities on the claims. The eastern one is 2 miles east-southeast from the end of the point. At this place, in the south face of a low bluff, a steeply dipping zone of shearing and fracturing, in places 6 feet wide and striking 65 degrees (magnetic), has been traced for 300 feet. It cuts siliceous volcanic rocks and lies 300 feet north of their contact with the granite, here appearing to strike parallel to the contact. Sparsely disseminated chalcopyrite, bornite, and galena have been found at intervals, together with some native silver associated with a carbonate mineral. A small amount of erythrite, also, was visible. Four hundred feet southeast (magnetic) from the end of the first-mentioned zone the rock is somewhat sheared and a lens of bornite, 2 feet long and 1 inch wide, containing some native silver, is exposed.

One-half mile west of the two described mineralized zones a third zone of fracturing can be traced for 300 feet along the north side of a shallow depression. It disappears under a small lake at the west end. This fracture zone strikes 10 degrees (magnetic) and has a visible maximum width of 30 feet. The fractured rock is massive, fine-grained, bluish black, and contains a large amount of hematite. It is cut by veinlets of specular hematite. On the south side of the depression is an area a few hundred feet wide in which fine-grained, banded rocks are exposed. Beyond this the rock is biotite granite. For several hundred feet north of the depression and fracture zone the rock appears to be a basic phase of this granite. Some of the fractures in the zone are filled with light green to brown carbonate. At three places in the first hundred feet of the zone, measuring southwesterly from the small lake, native silver was found projecting from the weathered surface. It is present as wires in carbonate, and in the hematitic rocks. At one place over an uncovered area 3 feet in diameter it was abundant. At the time of the writer's visit (July, 1931) no work had been done.

One-half mile east of the end of Dowdell point a depression striking 87 degrees (magnetic) extends for 1,500 feet or more. It parallels the strike of bedded rocks that here and there in the vicinity of the depression are calcareous. At one place on the north side of the depression a lens of mixed sulphides (bornite, chalcocite, covellite, sphalerite?, tetrahedrite)? 10 inches wide and 8 feet long is present.

Other Deposits

Several other deposits with silver or pitchblende have been reported from some of the many claims staked in Echo Bay district in the late summer of 1931. These discoveries have not been examined.

Eldorado Gold Mines reports that 3,800 feet northeast of the northern end of the No. 2 zone on the Cobalt group, in the gulch leading northeast from the head of Labine Point bay, native silver to the amount of from 30 to 147 ounces to the ton has been found across a width of 22 feet. Disseminated pitchblende has also been reported from this place. Silver has been reported 330 feet north of this in another trench. One mile farther along the strike other discoveries of pitchblende are said to have been made.

Northern Aerial Minerals Exploration Company report the discovery, 8 miles southeast of Labine point, of a shear zone in "syenite" with pitchblende and native silver. Other discoveries in the same area have been reported by other claim owners.

ADVICE TO PROSPECTORS

In prospecting for copper the large quartz veins appear to be the most favourable, though other rocks should not be entirely overlooked. Where accessible and visible from the air these veins have been in large part superficially prospected by men who have been in the district since 1930.

The positions and characters of the deposits of silver and pitchblende so far found indicate that the vicinity of the contacts of granite with older rocks is the most favourable ground to prospect. The shear zones, in some of which mineralization has been found, are usually marked by linear topographic depressions, and such places are worthy of close attention, especially near granite contacts. Large areas of granite lie south of Dowdell point near Echo bay and for an unknown distance eastward, and in the southwestern islands of the group between Echo and Hunter bays. Granite is also exposed on the east side of Lindsley bay and may be the western edge of a large body. It must be kept in mind, however, that the contacts of all masses of granite may not be equally favourable. The silver and pitchblende mineralization may be associated with one granite body and not with other masses. The different granite bodies have not yet been shown to be of one age. The influence of structural features, such as the shape of the granite contact (salients and bays), in controlling the position of shear zones, should where possible be worked out, and the knowledge applied to other places. If all the mineralization is related to the granite then it seems probable that where mineralization occurs it will extend to greater distances in zones of pronounced shearing and fracturing than where the rocks are less extensively fractured. The silver is mostly in very fine grains and at some places, even where abundant, can only be seen on careful examination with a hand lens. Though all the deposits examined are in shear zones, silver is said to have been found at one place in a large iron gossan and such, and other, places should not be overlooked.

METALLIFEROUS MINERAL POSSIBILITIES OF THE MAINLAND PART OF THE NORTH WEST TERRITORIES

By C. H. Stockwell and D. F. Kidd

CONTENTS

INTRODUCTION

With the advent of commercial aircraft transportation and the development of the Hudson Bay route, a very large part of the North West Territories south of the Arctic has been made accessible and has become of interest to prospectors. This report briefly outlines some of the salient facts relating to the economic geology of this great area. The mineral deposits of Great Bear Lake region and those of Rankin Inlet district on the west coast of Hudson bay are dealt with in two other reports in this volume and, therefore, will be only briefly referred to here.

GENERAL GEOLOGY

An irregular line running northwesterly from the Saskatchewan boundary and passing west of lake Athabaska and through Great Slave and Great Bear lakes, divides the region into two great geological provinces. To the west of this line the country is underlain by sedimentary strata of Palæozoic and later ages, to the east, the rocks, so far as known, are all of Precambrian age. The mineral possibilities of these two great areas are quite unlike. In the western area known metalliferous deposits are few, but oil and gas[1], coal[2], gypsum[3], and salt[4] deposits do occur. In the eastern area, with which this brief report is concerned, metalliferous deposits have been found at widely separated localities, and, presumably, many more will be found.

The eastern area is an immense quadrangle extending from the north boundaries of Saskatchewan and Manitoba to the Arctic, and from the basins of Great Slave and Great Bear lakes east to Hudson bay, a quadrangle whose north-south dimension is approximately 600 miles and whose breadth from west to east is more than 1,000 miles in the north. It has been geologically explored only along a few main routes, but the information thus obtained makes plain that the area is occupied by Precambrian rocks and that, broadly speaking, the main geological features are like

[1] Hume, G. S.: Geol. Surv., Canada, "Oil and Gas in Western Canada," pp. 113-128 (1928).
[2] Camsell, C., and Malcolm, W.: Geol. Surv., Canada, Mem. 108, "The Mackenzie River Basin", pp. 99–104 (1921).
[3] Op. cit., Mem. 108, pp. 106-107.
[4] Op. cit., Mem. 108, pp. 125-130.

those of other, better known parts of the Canadian Shield. The oldest rocks are assemblages of sediments and volcanics. The areas of these rocks are cut and surrounded by granitic and gneissic rocks which occupy by far the greater part of the region. Younger than most of the granitic rocks are local developments of sedimentary rocks, some much younger than others.

The ancient assemblages of sediments and volcanics vary in character from district to district, but as a rule are much altered. In general they resemble the schistose rocks which in the southern part of the Canadian Shield form the Keewatin volcanics and the associated ancient sedimentary groups and in which most of the valuable mineral deposits there known have been found. Since these rocks in the North West Territories seem to be the counterpart of those to the south both as regards the kinds of rocks present and their relations with the invading igneous rocks, there is no known reason why they, too, should not be the sites of valuable mineral deposits. Areas of these rocks are known to exist: (1) southwest from Rankin inlet along the Hudson Bay shore and inland to the southwest for a great unknown distance; (2) northwest of Baker lake which lies west of Chesterfield inlet, Hudson bay; (3) at two places on Kazan river which enters Baker lake from the southwest; (4) on parts of the north and south shores and on some of the islands of Great Slave lake; (5) on the east shore of Great Bear lake; (6) near Point and Redrock lakes on Coppermine river; and possibly (7) west of Bathurst inlet. So far, in Rankin Inlet area some small gold deposits and a nickel-copper deposit have been found (*See* pages 42 and 43); in Great Slave Lake area some apparently small gold, copper, and galena deposits and some low-grade iron ores have been found; in Great Bear Lake area some spectacular deposits of native silver and radium-bearing pitchblende, and some copper deposits have been found (*See* pages 55 to 68).

The granites and gneisses of the southern parts of the Canadian Shield have usually been found to be relatively barren of mineral wealth, and, therefore, it is likely that those of the northern region will also prove to be relatively barren.

The youngest groups of strata, those that so far as known are younger than any of the granitic bodies, are extensively developed in several districts. In the eastern part of Great Slave lake they consist of at least two groups of sediments and volcanics relatively unaltered though penetrated by dykes and sills. Large areas of relatively undisturbed sediments are found on the shores of Baker, Schultz, and Aberdeen lakes with long tongues extending southwest to Dubawnt lake and west for a long distance up the valley of Thelon river. In some areas of the youngest of all, the sediments are accompanied by extensive developments of basaltic flows carrying native copper. Areas of such rocks have been described from Coppermine river and from Bathurst inlet on the Arctic coast. Other areas seen by white men occur east of Bathurst inlet, and on the east side of Boothia peninsula, north of Hudson bay. Still other areas are reported to exist on Prince of Wales island, northwest of Boothia peninsula; in central Victoria island several hundred miles northwest of Bathurst inlet; and on the Princess Royal islands still father to the northwest.

DESCRIPTIONS OF MINERAL OCCURRENCES

GOLD

West Coast of Hudson Bay

Free gold in quartz in a shear zone has been found on Term island, south of Rankin inlet, west coast of Hudson bay. At other points along this coast and inland, sulphide-bearing, silicified shear zones in the ancient volcanic-sedimentary assemblage have been found and investigated as possibly holding gold (*See* page 43).

Yellowknife River Area

Yellowknife river, flowing from the north, enters a bay about midway along the northeast shore of the North arm of Great Slave lake. The rocks along the shores of Great Slave lake in the vicinity of Yellowknife river and upwards along the river for at least 10 miles belong chiefly to the ancient volcanic-sedimentary complex. Mineral deposits in Yellowknife River area were reported as early as 1898 when two samples, said to have been obtained from within a radius of 10 miles of the mouth of Yellowknife river, were sent to the Geological Survey for assay. One of these was of quartz, in parts coated with hydrated peroxide of iron, and was found to contain neither gold nor silver. The other consisted of a weathered crystalline dolomite carrying some iron pyrites and a very little brown zinc blende and was found to contain 2·158 ounces of gold to the ton of 2,000 pounds and 0·408 ounce of silver to the ton of 2,000 pounds[1]. In 1899 a sample of quartz with a little crystalline dolomite, carrying small quantities of stibnite, was collected by R. Bell from a vein on Browns mountain, Yellowknife bay, and was found to contain neither gold nor silver[2].

More recently quartz veins have been staked on the Gold, Star, and Walsh Lake groups of claims and sulphide replacements deposits have been staked on the Murphy-Bell, and Duck Lake groups. The Star, Walsh Lake, Murphy-Bell and Duck Lake groups were staked in 1928 and 1929 on behalf of the Atlas Exploration Company and have since been allowed to lapse.

The *Gold group* comprises four claims on the northwest side of Yellowknife river near its mouth. At a point about 1,000 feet from the river is an irregular-shaped area about 50 feet long and 20 feet wide in which are many quartz stringers and veins the largest of which is 3 feet thick at its widest part and pinches out in a length of 15 feet. The stringers and veins occur in schist and most of them are elongated about parallel to the cleavage of the schist, but some cut across it in various directions. A considerable amount of rusty weathering carbonate forms patches and stringers in the quartz. Small amounts of arsenopyrite and copper stain also occur in the quartz. The schist is generally not visibly mineralized, but in some places contains scattered crystals of arsenopyrite.

[1] Geol. Surv., Canada, Ann. Rept., vol. XI, pt. R, pp. 32-33 (1901).
[2] Geol. Surv., Canada, Ann. Rept., vol. XII, pt. R, p. 42 (1902).

A chip sample of the quartz veins and schist containing a somewhat greater than average proportion of arsenopyrite was assayed with the following results: gold 0·20 ounce a ton of 2,000 pounds and a trace of silver[1].

The *Walsh Lake group* comprises six claims on the east side of Walsh lake 2 to 3 miles from its south end. Walsh lake lies about 1 mile north of a point on Yellowknife river 2 miles above its mouth. At a point about 500 feet from the shore of the lake a mineralized zone 10 feet wide and 20 feet long occurs in quartzose schist. The zone strikes northeast and dips vertically, about parallel to the strike and dip of the schist. The zone ends rather abruptly to the northeast and is covered to the southwest. An open-cut, with a maximum depth of 8 feet, extends across the width of the mineralized zone. On the southwest side of the open-cut and one foot from the southeast wall of the zone is a body of sphalerite mixed with small amounts of galena and quartz. The body is 4 feet long, vertically, is 1 foot wide in the middle, narrows slightly toward the top, and narrows to 3 inches wide at the bottom of the open-cut. Elsewhere in the open-cut and on the surface of the outcrop of the zone many masses and veinlets of quartz occur in the schist, the latter forming most of the material. Most of the quartz is barren-looking, but some of it contains arsenopyrite which occurs as scattered crystals and as masses up to 3 inches across. The quartz also contains small amounts of sphalerite and galena. Most of the schist does not contain visible sulphides, but some of it contains scattered or closely spaced crystals of arsenopyrite and small amounts of galena and sphalerite. A chip sample judged to represent approximately the average composition of the mineralized zone in the open-cut contained 0·10 ounce of gold and 3·12 ounces of silver to the ton of 2,000 pounds[2]. A picked sample of nearly solid galena, apparently from this deposit, was found by the owners of the property to contain $1.80 in gold a ton and 17·2 ounces of silver a ton.

The *Murphy-Bell group* comprises eight claims on the south side of a small bay at the east side of the south end of Walsh lake. Sulphide deposits outcrop on the west shore of the south end of the bay, on a small island at the south end of the bay, and on a hill 1,000 feet northeast of the south end of the bay. The deposits occur in sedimentary schist, the cleavage of which strikes northeasterly and dips about vertically.

The deposit on the west shore of the south end of the bay outcrops as a limonite-stained area about 60 feet wide and about 150 feet long and is elongated about parallel to the strike of the schist. A cross-trench, averaging about a foot deep, has been dug across the 60-foot width. The southern 20 feet of the trench is in almost solid pyrrhotite. The pyrrhotite in some places contains a few quartz stringers and a few shreds and bands of schist up to an inch wide. Schist with small amounts of pyrrhotite, pyrite, and quartz is exposed in the remaining 40 feet of the trench. The pyrite occurs as scattered crystals, lenses, and stringers over a width of 2 feet. The pyrrhotite forms small stringers and lenses in the remainder of the schist. Most of the pyrrhotite stringers parallel the cleavage of the schist, but a few cut it. The quartz forms small lenses and stringers

[1] Assay by A. Sadler, Mines Branch, Dept. of Mines, Canada.

[2] Assay by A. Sadler, Mines Branch, Dept. of Mines, Canada.

in association with the pyrrhotite and the pyrite. A chip sample across the 20 feet of nearly solid pyrrhotite and across the 2 feet of pyrite in schist contained no gold and a trace of silver[1].

The deposit on the island outcrops as limonite with some iron sulphide, in schist, over a length of about 50 feet. It is on the strike of the deposit just described and is about 150 feet from it.

The deposit on the hill northeast of the south end of the bay outcrops as a limonite-stained area about 50 feet wide and about 250 feet long and is elongated about parallel to the strike of the schist. In three cross-trenches the schist is seen to contain disseminated pyrrhotite, generally in less amount than in the deposit on the west shore of the south end of the bay.

The *Star group* comprises one claim on the south shore of the west arm of a bay at the south end of lake Prosperous and one claim on the north shore of the same arm. Lake Prosperous is an expansion of Yellowknife river, 7 miles above its mouth. At a point 100 feet from the south shore of the arm and a few hundred feet from the west end of the arm are three irregular-shaped outcrops of vein quartz in sedimentary schist, which strikes east and dips steeply south. The quartz outcrops are in line with one another and occur over a total length of about 150 feet. The quartz outcrops are separated from one another on the surface by glacial drift, but probably form a continuous vein. The largest of the outcrops is 50 feet long and 20 feet wide. Its north side is in contact with schist and the contact dips at an angle of 85 degrees to the south. The schist for a distance of 2 to 3 inches from the contact contains scattered crystals and stringers of arsenopyrite. The quartz is glassy and generally barren-looking, but in a few places contains sparsely disseminated grains of arsenopyrite and a very small amount of galena. A chip sample of the quartz and mineralized schist contained no gold and a trace of silver[2]. No sulphides were seen in the other two outcrops.

The owners of the property report that another quartz vein occurs near the south shore of the arm of the bay. It is reported to be 2 feet wide and to have been traced for 900 feet along its strike and to contain in one part a band of galena 2 inches wide. A picked sample of the galena assayed $1.20 in gold a ton and 23·2 ounces of silver a ton. The owners of the property also report that an irregular body of quartz, 20 feet in average width and traced for 500 feet along the strike, occurs on the north side of the arm of the bay. The quartz is said to contain pyrite and galena at several places.

The *Duck Lake group* comprises ten claims on the north side of Duck lake. This lake empties by a short stream into Yellowknife bay 7 miles south of the mouth of Yellowknife river. A mineralized zone outcrops on the north shore of the lake near its west end. The mineralization consists of iron sulphides disseminated through slightly schistose pillow lava over a width of about 100 feet. Another mineralized zone occurs on the north shore of the lake 1 mile northeast of the deposit just described.

[1] Assay by A. Sadler, Mines Branch, Dept. of Mines, Canada.
[2] Assay by A. Sadler, Mines Branch, Dept. of Mines, Canada.

Iron sulphide is disseminated through lava and forms tiny stringers cutting lava. A chip sample across a width of 30 feet contained no gold and a trace of silver[1].

QUARTZ VEINS ON WILSON ISLAND

Wilson island, Great Slave lake, is 23 miles long in an easterly direction and averages about 2 miles wide. Its west end is 46 miles north 20 degrees east from Resolution. Forty-six claims have been staked on the west end of the island and along the south shore of the main body of the island for a distance of 11 miles from the west end.

The rocks on which the claims have been staked are chiefly white, grey, and pink quartzites with smaller amounts of arkose, sedimentary schist, and brown-weathering, limy quartzite. The quartzites are cut by a few basic dykes. The limy quartzite occurs chiefly along the north side of the island, the arkose outcrops at a few localities on the south shore, and the schist is interbedded with the arkose and limy quartzite. Schistose conglomerate interbedded with arkose is exposed in Blind bay, a deep bay on the south side of Wilson island, and on a few small islands just south of Wilson island and near its west end. The sediments are irregularly folded in some places, but most commonly strike east and dip from 60 to 80 degrees to the south or are vertical. The tops of the beds face north. The sediments are probably pre-granite in age, for they are correlated on lithological grounds with sediments, on Iles du Large, which are intruded by granite.

One of the claims, called the Big Moose, is ¾ mile from the west end of Wilson island and was staked by R. H. Wilson in September, 1916. Another claim, called the Big Bear, adjoins the Big Moose on the east and was staked by C. P. McTavish in September, 1916. Both claims were subsequently taken over by Aurous Gold Mining Company and were still in good standing in June, 1931. A well-constructed cabin has been built in Safety cove, 2 miles from the west end of the island, and a cabin has been partly completed on the Big Moose claim. Old workings on the Big Moose claim consist of two shafts, about 100 feet from the south shore, and a few open-cuts.

The material on the dumps at the shafts is quartzite. The quartzite is fractured and the cracks are stained with red iron oxide. Southwest of the shafts and close to the shore of the island a vein is exposed in a series of open-cuts along the strike of the vein for a distance of 250 feet. The vein varies from 1 to 6 inches wide, strikes easterly, and in one open-cut dips 65 degrees to the north. The vein is of milky quartz mixed with a small amount of specularite and, in one open-cut, with a very small amount of pyrite. A chip sample of the vein material taken at various localities along the strike contained 0·04 ounce of gold a ton of 2,000 pounds and a trace of silver[2]. East of the shafts is a test pit showing a quartz vein 3 feet wide with one wall not exposed. The quartz is milky, is much fractured, and the cracks are stained with red iron oxide. A chip sample across the 3 feet contained no gold and a trace of silver[3]. West of the

[1] Assay by A. Sadler, Mines Branch, Dept. of Mines, Canada.
[2] Assay by A. Sadler, Mines Branch, Dept. of Mines, Canada.
[3] Assay by A. Sadler ,Mines Branch, Dept. of Mines, Canada.

shafts a few small quartz veins carry small amounts of specularite. A few quartz veins and lenses up to 3 feet wide occur north of the shafts. Some of these veins and lenses carry a small amount of red feldspar. Many quartz stringers and lenses occur in a zone about 30 feet wide and 200 feet long close to the south shore of the island and near the east boundary of the Big Moose claim and probably extending into the Big Bear claim.

In 1921 Hume[1] examined the island, which was then known as Caribou island. He describes veins across the part of the island west of Safety cove. He took some samples which, on assay, showed no gold, and explains that he may have overlooked the particular prospect where the Aurous Gold Mining Company obtained gold.

Other claims were staked on the island in 1919, 1921, and 1926 and have been allowed to lapse. Some claims were restaked as late as 1930. Many quartz veins and stringers occur along the shoreline where the claims have been staked. Some of these veins contain red feldspar, carbonate, and specularite.

OTHER OCCURRENCES, GREAT SLAVE LAKE

In the east arm of Great Slave lake, many of the islands and certain stretches of the main shore are occupied by two groups of sedimentary strata all younger than the granites. The older group consists of sandstone, shale, limestone, etc., with interbedded acid and basic volcanic flows. It is cut by irregular bodies and sills of rocks of a variable composition, generally approaching that of a syenite. The younger group is chiefly of conglomerate and sandstone. Both groups are cut by dykes and sills of diabase. In these rocks mineralization has been noted here and there.

On the north side of a small island 4½ miles slightly south of west of "P rock H 22"[2] sandstone of the older group is cut by a vein that strikes east, dips about vertical, and is exposed along its strike for a length of 100 feet. The vein has a maximum thickness of 4 feet and pinches out at its west end. The vein material is chiefly quartz containing considerable quantities of specularite and pyrite. Buff carbonate is also present in the vein. A chip sample of the vein material was found to contain no gold and a trace of silver.[3] On the east end of an island 6 miles north 35 degrees east of Taltheilei narrows brecciated sandstone and quartzite are injected by many quartz-carbonate stringers containing disseminated chalcopyrite. At one locality in the mineralized area quartz and carbonate with disseminated chalcopyrite and a few masses of quartzite occur over a width of 15 feet. A sample of the 15-foot zone was assayed and found to contain 0·71 per cent of copper, no gold, and a trace of silver.[4] On the west shore of Pethei peninsula at a point 2 miles northeasterly of Taltheilei narrows greatly contorted sandstone is cut by a vein of carbonate and quartz varying in widths between 10 and 50 feet. Generally no sulphides are visible, but in one place there is a small amount of disseminated chalcopyrite. This exposure may possibly be a continuation of the vein material on the island to the northeast of the narrows. On the southwest

[1] Hume, G. S.: Geol. Surv., Canada, Sum. Rept. 1921, pt. B, pp. 76-78.
[2] A reference point marked by a numbered metal plate in rock outcrop; *See* Eastern Sheet Great Slave lake, Topographical Survey of Canada, Dept. of Interior.
[3] Assay by A. Sadler, Mines Branch, Dept. of Mines, Canada.
[4] Assay by A. Sadler, Mines Branch, Dept. of Mines, Canada.

end of an island 3 miles south of "P rock H 1" an oolitic hematite bed 10 feet thick is cut by stringers of chalcopyrite in some places and at one locality is brecciated and the fragments are cemented with carbonate mixed with a small amount of chalcopyrite. On a small island 7 miles southeast of "P rock B 9" a considerable amount of copper stain and many quartz stringers occur in quartzite over an area about 100 feet across. Small amounts of chalcopyrite were noted in the rocks of the older group at nine other localities. Barite veins, the largest of which is about 3 feet wide, were noted at about half a dozen localities in the same group.

Carbonate veinlets with disseminated chalcopyrite cut syenite at a point 1¾ miles east of "P rock C 16" and at the southwest end of Et-Then island. In conglomerate and sandstone which are the youngest sediments of the district, small amounts of chalcopyrite were observed in quartz stringers at four localities. On the east side of an island 4 miles northeasterly of Taltheilei narrows a few quartz-carbonate stringers about ½ inch wide occur in joint cracks in diabase. The stringers contain a few scattered grains of bornite and pyrite.

In addition to these occurrences Lausen[1] reports copper mineralization at five different places in the east arm of the lake. A brief summary of his account of these occurrences follows. Near Pekanatui point quartz veinlets in schist contain calcite, barite, specularite, pyrite, and chalcopyrite. North of the entrance to Murky channel veinlets of bornite and chalcocite occur in syenite. About 3 miles up Murky channel malachite was found as thin films traversing fractures in chlorite schist. At one place along the north shore of Stalk lake[2] a thin film of malachite occurs along fractures in dark brown argillites. In an embayment on the south shore of Tochatwi bay and north of the east end of Portage inlet a thin film of chalcopyrite crystals in a gangue of barite occurs on the face of a large talus block of diabase.

Some earlier records of mineralization from the Precambrian rocks of Great Slave lake are as follows. At one locality on the north shore of the bay west of the narrows between Christie and McLeod bays thin plates of chalcopyrite occur in joint cracks in greenstone which gave rise to green copper stain and cobalt bloom.[3] On the northwest side of McLeod bay, small, interrupted gash veins and stringers of calcspar occur in gneiss and granite and some of them contain nuggets of chalcopyrite.[4] An assay of quartz, stained and, in parts, coated with hydrated peroxide of iron, from a large vein on the west side of East bay, showed neither gold nor silver.[5] An assay of schist with quartz, more or less thickly coated with hydrated peroxide of iron, carrying some coarsely crystalline galena from between Resolution and Rae, about 40 miles from Resolution, showed no gold and 16·012 ounces of silver to the ton of 2,000 pounds. The galena amounted to 41·2 per cent by weight of the whole.[6]

Some occurrences in pre-granite rock areas follow. Small amounts of galena, pyrite, and chalcopyrite occur in quartz stringers and enclosing

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[1] Lausen, Carl: Can. Min. and Met. Bull. 1929, pp. 391-392.
[2] More commonly known as Stark lake.
[3] Bell, R.: Geol. Surv., Canada, Ann. Rept., vol. XII, pt. A, p. 108 (1902).
[4] Bell, R.: Op. cit., pt. A, p. 108.
[5] Geol. Surv., Canada, Ann. Rept., vol. XII, pt. R. p. 42 (1902).
[6] Geol. Surv., Canada, Ann. Rept., vol. XI, pt. R, p. 32 (1901).

rocks on an island ½ mile north of Wilson island and 12 miles from its east end. Small amounts of disseminated chalcopyrite associated with fluorite and carbonate occur in quartz stringers near the first portage on Thubun river which enters Great Slave lake at a point 8 miles east of the mouth of Taltson river. Pyrite is fairly plentiful in quartz veins on some small islands south of the east part of Wilson island and on the north shore of Blind bay. On the south shore of Great Slave lake at a point 17 miles east of the mouth of Taltson river many quartz stringers occur in schist across a width of 4 feet and both the quartz stringers and the schist, over this width, contain disseminated pyrite and a small amount of chalcopyrite.

A small vein cuts granite on the north end of a small island 1½ miles southeast of "P rock M.E.22" on the northeast side of the north arm of Great Slave lake. The vein strikes slightly west of north, dips vertically, is exposed for about 120 feet along its strike, and varies from 1 inch to 1 foot wide. The vein material is chiefly of quartz and sphalerite in about equal amounts. A few specks of chalcopyrite are disseminated through the quartz and at one locality in the vein there is a small amount of galena.

SILVER AND PITCHBLENDE

An account of the deposits of pitchblende and native silver is given on pages 61 to 68.

GALENA

On the Arctic Coast

Galena was found by members of the Canadian Arctic Expedition 1913-16, at Galena point 10 miles southeast of cape Barrow on the west side of the entrance to Bathurst inlet. J. J. O'Neill reports on this as follows:

"At Galena point, in Bathurst inlet, granite outcrops and is much weathered and has disintegrated to a depth of a few inches. Near the middle of the point, about 200 yards back from the beach, galena occurs in three places. At one place a small pocket of pegmatite, 6 inches in length, contains white feldspar, quartz, some muscovite, and on one side, 2 inches of galena. The two other occurrences are lenticular veins 9 and 20 feet in length, respectively, and about 3 inches in width, composed of milky quartz carrying a little galena. No more galena was seen in the northern part of the point although narrow veins of quartz are numerous."[1]

A discovery of argentiferous galena was reported to have been made in 1931 at Detention harbour a few miles west of Galena point. Claims were staked for the Pederson Whaling Company. The extent of the deposit is not known. Available maps show the rock at this place to be granite.

Galena float is reported from cape Flinders on the east side of Bathurst inlet and it has been picked up on the lower part of Coppermine river.

Lead and Zinc Deposits near Pine Point, Great Slave Lake

As far as known lead and zinc deposits occur only in the Presqu'ile dolomites of Middle Devonian age. The most important deposits are on property of the Northern Lead Zinc, Limited, 10 miles south-southwest of

[1] O'Neill, J. J.: Repts. of Can. Arctic Exp. 1913-18, vol. XI, Geology and Geography, pt. A, p. 47.

Pine point. A deposit of less importance occurs 7 miles southwest of Pine point. Small deposits of lead and zinc have been found at intervals over an area about 15 miles from east to west and 10 miles from north to south in the vicinity of Pine point.[1]

Some prospecting for lead and zinc has been carried on in Presqu'ile dolomites on the northwest shore of the western part of the lake, but it is reported that only unimportant amounts of these minerals were found. The Presqu'ile dolomite is about 375 feet thick at Nintsi (Windy) point[2] and is at least 255 feet thick on the property of the Northern Lead Zinc, Limited.[3]

The Northern Lead Zinc, Limited, property may be reached over a wagon road about 13 miles long, from Dawson landing on the shore of the lake about 3 miles east of Pine point and about 20 miles southwest of Resolution. The deposits were visited by R. Bell in 1899[4],by Cameron in 1916[5], and were described in 1929[6], 1930[7], and 1931[8] by J. Mackintosh Bell.

The deposits outcrop, at an elevation of about 200 feet above the lake, on a nearly flat upland largely covered by glacial drift and swamp. In the immediate vicinity of the deposits the drift in many places is only a few feet thick, but in places is as much as 40 feet thick. Dolomite outcrops on the sides of sink-holes and on low, flat areas at the level of the drift or rising only slightly above it. The low, flat areas of dolomite are irregular in outline, but are generally elongated in a direction slightly north of east. The depth of the ground water table is generally about 75 feet, but in some places it is only 10 feet below the surface. Sink-holes are numerous and have been formed subsequent to the deposition of the drift.

The dolomite is generally massive but in a few places is bedded. The beds are flat or dip at angles of 5 to 10 degrees. The structure is difficult to determine, but in places the dolomite is probably gently domed. Thin-bedded, dolomitic limestone, in places associated with argillaceous lenses, has been found in shafts and drill holes and apparently occurs in narrow layers which are more conspicuous towards the bottom and top, where it is fossiliferous.[9]

The massive dolomite is coarse to fine grained. The coarse dolomite is usually grey, but some is brown; the grey dolomite in some places is mottled with white. The fine-grained dolomite is generally brown, but a greyish type is also present. Pores and cavities occur in both the coarse and the fine-grained dolomite. The pores are small spaces between the faces of crystals which make up the rock. The cavities are larger openings from a fraction of an inch to a foot or more across and have irregular, curved, or angular outlines. The cavities are lined with very coarse, white dolomite forming curved rhombohedral crystals from $\frac{1}{4}$ to $\frac{1}{2}$ inch across. Similar coarse, white dolomite also forms veinlets cutting the grey and

[1] Bell, J. Mackintosh: Econ. Geol., vol. XXVI, p. 617 (1931).
[2] Cameron, A. E.: Geol. Surv., Canada, Sum. Rept. 1921, pt. B, p. 13.
[3] Bell, J. Mackintosh: Econ. Geol., vol. XXVI, p. 615 (1931).
[4] Bell, R.: Geol. Surv., Canada, Ann. Rept., vol. XII, pt. A, pp. 104, 108, and 109 (1901).
[5] Cameron, A. E.: Geol. Surv., Canada, Sum. Rept. 1921, pt. B, pp. 35-36.
[6] Bell, J. Mackintosh: Can. Min. and Met. Bull. 1929, pp. 1141-1157.
[7] Bell, J. Mackintosh: Geol. Surv., Canada, Econ. Geol. Series No. 8, pp. 219, 224 (1930).
[8] Bell, J. Mackintosh: Econ. Geol., vol. XXVI, pp. 611-624 (1931).
[9] Bell, J. Mackintosh: Econ. Geol., vol. XXVI, p. 615 (1931).

brown dolomite. In some places the coarse, white dolomite is associated with sulphides; the dolomite is in part earlier and in part later than some of the sulphides and it is probable that both were deposited from the same solution. In many places, however, no sulphides are associated with the coarse, white dolomite. The grey and brown dolomites formed earlier than the white dolomite and may or may not be related in origin to the solutions that deposited the white dolomite and the sulphides.

Sulphide deposits are known to occur chiefly at four localities: A, B, C, and D.[1]

Locality A is in the southeast part of the Melville claim. Sulphides are exposed on the walls of a sink-hole, in test pits, and in a shaft 21 feet deep. The exposures indicate mineralization over a roughly circular area 280 feet by 220 feet. The sink-hole, which is on the south side of the area, is a crescent-shaped depression 280 feet in diameter. The concave side of the sink-hole faces north.

Locality B is about 1,000 feet south of locality A. It is in the eastern part of Paragon 1 claim and extends across some fractional claims into the western part of Paragon 3 claim. Many churn drill holes, generally at intervals of 50 feet, have shown lead and zinc mineralization in a western area and in an eastern area. The two areas almost touch one another and further exploration may show that they are connected. From the results of the drilling it may safely be inferred that lead and zinc mineralization occurs in the western area almost continuously over an area 600 feet long in an easterly direction and 100 to 300 feet wide, and, in the eastern area, over an area 400 feet long in a northerly direction and 300 feet wide at the south end and 50 feet wide at the north end. Sulphides also occur in a shaft 35 feet deep, in many test pits, and on a few surface outcrops. Only a few small sink-holes occur on the mineralized areas.

Locality C is about 900 feet easterly of the east end of locality B. It is on and near the boundary between Paragon 3 and Paragon 4 claims. Sulphides are exposed on the walls of a large sink-hole, in a shaft 76 feet deep, in a few open-cuts, and on natural exposures, all of which indicate a mineralized area roughly circular in shape and measuring 300 feet by 270 feet. The large sink-hole, which is on the north side of the area, is a crescent-shaped depression 300 feet in diameter. The concave side of the sink-hole faces south. Many smaller sink-holes occur in the mineralized area and are scattered over a distance of 200 feet south of it.

Locality D is about 2,600 feet slightly north of east of locality C. It is in the southeast part of Gwynn claim. Sulphides occur on the walls of a large sink-hole which forms an almost complete circle about 260 feet in diameter, and in test pits and a shaft 51 feet deep within the limits of the sink-hole. Many drill holes, generally about 50 feet apart, have been put down within and around the sink-hole. From the results of the drilling it may safely be inferred that lead and zinc mineralization occurs almost continuously over a roughly circular area about 400 feet in diameter. Another large sink-hole, roughly circular and about 120 feet in diameter, lies about 200 feet slightly west of north of the sink-hole just mentioned.

[1] In writing the following description of these localities, a detailed map made by the Northern Lead Zinc, Limited, was freely used.

Lead and zinc minerals occur in loose fragments in the sink-hole and in a shaft 15½ feet deep in the centre of the sink-hole. Drill holes at intervals of 50 feet on the west, north, and east sides of the sink-hole, and at irregular intervals between the two sink-holes, showed no lead and zinc mineralization or only small quantities of it.

The eastern boundary of lead and zinc mineralization of the eastern area at locality B is fairly well defined by drill holes which showed no important values in lead and zinc. In general, however, not enough drilling has been done to show the boundaries of the large mineralized areas at either B or D localities, although several scattered holes outside of the areas show little or no values in lead and zinc. The drilling has nowhere eliminated the possible existence of mineralized masses less than 50 feet across. The deepest churn drill hole is 255 feet and the average depth of all of them is about 100 feet. Lead and zinc values were absent or negligible in the bottom of most of the holes, indicating that the horizontal dimensions of the deposits are greater than the vertical dimensions. Some of the deposits, at least, are located on the probable domes already mentioned.

The sulphides in the deposits are sphalerite, galena, and pyrite. These are in part altered to limonite, smithsonite, and probably cerussite and are associated with grey, brown, and white dolomite, calcite, and small amounts of quartz and sericite.[1] As seen in natural exposures, in open-cuts, and in shafts, the sulphides, white dolomite, calcite, and alteration products occur as fillings of cracks and cavities in grey and brown dolomites and the sulphides occur as complete or partial replacements of the grey and brown dolomites. The replacement deposits form irregular masses and occur along and across beds. In the drill holes[2] beds of low mineralization may separate successive beds of ore and ore is not limited to surface croppings. Assay values of lead, zinc, and silver have been published in the three articles by J. Mackintosh Bell. The silver values are negligible.

In the veinlets and open cavities there is some irregularity in the order of deposition of the sulphides, but pyrite is generally followed by galena and sphalerite. As shown in the drill holes pyrite is generally most abundant on the top, except where removed by erosion. Beneath the pyrite, galena and sphalerite are generally mixed in various proportions, but near the bottom sphalerite usually predominates over galena. On natural exposures, the sulphides are locally fresh but are generally partly or almost completely oxidized. In depth[3] highly oxidized beds are found below those that show no obvious oxidation and the deposits are oxidized in places down to a depth of 100 feet. The large sink-holes are formed chiefly as a result of decomposition of pyrite.

Taltson River

Taltson river flows from the south and enters Great Slave lake about 35 miles northeasterly from Resolution. About 20 miles from its mouth the river splits into two main channels, the eastern of which is known as

[1] The presence of quartz and sericite have been reported by J. Mackintosh Bell.: Econ. Geol., vol. XXVI, pp. 619, 623 (1931).
[2] Bell, J. Mackintosh: Econ. Geol., vol. XXVI, p. 618 (1931).
[3] Bell, J. Mackintosh: Op. cit., p. 618.

Snuff channel. About eighty claims have been staked near Snuff channel about 10 miles from its mouth. Most of the staking was done in 1930, but one claim, the Hope claim, was staked about ten years previously. The claims have been staked on low granite hills and intervening swampy depressions.

On the Bull Moose claim, staked in February, 1930, by George Kaine, a vein occurs on a small granite hill about 450 feet north of the southeast corner of the claim. The vein is exposed over a length of 40 feet, strikes northwest, and dips 80 degrees southwest. Over most of its length it is 2 inches to 6 inches wide, but on the top of the hill it widens over a length of 10 feet and attains a maximum width of 15 inches. The wider part of the vein is a mixture of milky quartz and galena in about equal amounts. An assay of a chip sample of this part of the vein showed no gold and 0·81 ounce of silver a ton of 2,000 pounds.[1] The remainder of the vein is of milky quartz with disseminated galena and buff carbonate.

Four or five closely spaced veinlets cut granite at a point about 150 feet northwest of the vein just described. The veinlets strike northwest, are exposed along the strike for 15 feet, and are up to 4 inches wide. The veinlets are of milky quartz containing in some places buff carbonate, galena, and small amounts of sphalerite, fluorite, and calcite.

Another claim, the Ruth claim, adjoins the Bull Moose on the west and was staked by Letha Kaine in February, 1930. On the Ruth claim there is a quartz-galena vein about the same size as the first described vein on the Bull Moose claim.

Mr. George Kaine reports that many other galena showings occur in the area for a distance of 9 miles to the east. Some of these are said to be larger than those described above.

COPPER

The discoveries of copper deposits on Hunter bay, Great Bear lake, and in the vicinity of Dismal lakes, are described on pages 55 to 61.

Bathurst Inlet

The Canadian Arctic Expedition, 1913-16, found copper-bearing rocks in Bathurst inlet, on the Arctic coast. These were examined by J. J. O'Neill and the following description is condensed from his report.

The copper-bearing rocks in Bathurst inlet apparently occupy an area separate from Coppermine River area. The part of the Bathurst Inlet area examined is oval-shaped, extends about 50 miles northwest-southeast, and has a maximum width of about 25 miles, and a total area of about 1,000 square miles. This area includes more than one hundred and fifty islands of various sizes in Bathurst inlet, Banks peninsula, the western mainland, and a strip 5 or 6 miles wide extending along the coast from Arctic sound to Moore bay. The thickest section seen consists of about 950 feet of basaltic amygdaloids.

[1] Assay by A. Sadler, Mines Branch, Dept. of Mines, Canada.

The copper-bearing formation belongs to the Coppermine River series, and is a series of basic lava flows with a few thin beds of tuffaceous conglomerate and ash. The beds dip in various directions at an average angle of about 6 degrees, forming a shallow basin, or basins.

Native copper was seen on almost every island in the area, as well as on the mainland. The distribution of the metal is remarkably uniform throughout any single flow. A rock section over 450 feet thick, on Banks peninsula, showed copper through about 350 feet of the total thickness. The native copper occurs in three forms. (1) As minute flakes scattered throughout the dense groundmass of the basalts. This copper occurs over the whole area of more than 1,000 square miles and practically through the whole exposed thickness of the formation. Analyses of forty-five representative samples show that the values range between $\frac{1}{100}$ and $\frac{1}{4}$ of 1 per cent. (2) As irregular grains and small masses filling, or partly filling, the branching gas cavities near the surface of the basalt flows. The amygdaloidal portions of the flows range from a few inches to several feet in thickness and in places contain several per cent of copper, whereas in other places the amygdules are filled with other minerals. The amygdaloidal portions are commonly exposed only along cliffs, which, however, are in many places screened by talus. Under these conditions it was not possible when merely conducting a reconnaissance, to judge of the relative extent and importance of the amygdaloidal copper. (3) In fissures and shatter planes not confined to any particular horizon in the basalt flows. This mode of occurrence is important in some areas where the basalts have been considerably shattered and are now traversed by a network of thin fissures occupied by plates of native copper or by vein material containing a small amount of native copper.

In addition to native copper, sulphides of copper occur in the district and appear to be worthy of investigation. Chalcocite and covellite have been found replacing dolomite which underlies the copper-bearing rocks. Besides the sulphides which replace the dolomites, there is a considerable amount of chalcopyrite and some chalcocite, disseminated through some of the large sills or dykes of diabase that traverse the region. A grab sample of one such occurrence was found by analysis to contain 1·18 per cent of copper.

Coppermine River

These deposits were first reported on by A. Sandberg in 1912. The information is incorporated in the report of the Canadian Arctic Expedition, 1913-16.[1] Other reports on this area have been published by Gilbert,[2] Duncan,[3] and Norrie[4] in 1930-31. Two deposits examined in 1931 are described on pages 59 to 61.

Forty to fifty miles above the mouth of Coppermine river a series of basaltic flows with interbedded conglomerate crosses the river, striking east and dipping 8 to 12 degrees to the north. Along the river the exposed width is 16 miles. These rocks, part of the larger group known as the Coppermine River series, extend east of the river for some unknown distance

[1] Canadian Arctic Expedition, vol. XI, "Geology and Geography", pt. A, p. 56 (1924).
[2] Gilbert, Geoffrey: "Copper on the Coppermine River, Canada"; Ec. Geol., vol. 26, No. 1 (Jan.-Feb., 1931).
[3] Duncan, G. G.: "Exploration in the Coppermine River Area, Northwest Territories"; Can. Inst. Min. Met. Bull. No. 227 (March, 1931).
[4] Norrie, J. P.: "Great Bear-Coppermine Area"; Can. Inst. Min. and Met. Bull. No. 227, (March, 1931).

less than 75 miles, and terminate against granitic rocks. West of the river they extend to Dismal lakes, and for an unknown distance beyond, the strike changing to northwest. The basaltic flows are underlain by a series of dolomites, and overlain by the upper members of the Coppermine River series, red sandstones and shales, with perhaps a few flows.

Native copper has been found in the basalts at a number of places west of Coppermine river and north of Dismal lakes. It occurs: (1) as minute flakes in massive basalt; (2) in the amygdaloidal tops of some flows; and (3) as sheets, in some places ⅛-inch thick, in cracks in the basalt. The first two of these types are said to be probably of low grade and the third of minor importance by itself.[1]

The sulphides of copper, bornite, chalcocite, covellite, and chalcopyrite, associated with quartz and carbonate minerals, have been found in shear and fracture zones or veins which traverse the basalt. Two deposits of this kind are described on pages 59 to 61 and may perhaps be considered as qualitatively representative of a number of deposits that have been discovered during the last two years and some of which have been described.[2]

Other Copper Deposits

No descriptions have been written of the other reported areas of copper-bearing rocks, those east of Bathurst inlet, on the east side of Boothia peninsula (Agnew river), on Prince of Wales island, in central Victoria island, and on Princess Royal islands.

SEDIMENTARY IRON DEPOSITS, GREAT SLAVE LAKE

Specularite iron deposits occur in pre-granite rocks and oolitic iron deposits occur in the sedimentary-volcanic series which overlies the granite and pre-granite rocks. None of the iron deposits is of economic value.

The specularite deposits, as far as known, occur chiefly on a small group of low islands, known as Iron islands and situated 35 miles north 15 degrees east from Resolution. The islands extend in a north direction over a total distance of 4,000 feet. Six claims were staked on the islands in July, 1928, on behalf of the Atlas Exploration Company.

The islands consist chiefly of quartzite which generally strikes slightly north of east and dips 30 degrees southeasterly. Within the quartzite are beds of specularite composed chiefly of quartz and micaceous specularite and generally containing a few disseminated flakes of chlorite. The cleavages of the specularite and chlorite are about parallel to the bedding of the quartzite.

On the south island and about 300 feet from its north end is a bed of specularite. It is about 35 feet thick, strikes and dips parallel to the

[1] Duncan, G. G.: Op. cit., pp. 375-6.
[2] Duncan, G. G.: Op. cit.; Gilbert, Geoffrey: Op. cit.

quartzite, and outcrops along its strike almost continuously from one side of the island to the other over a length of about 1,200 feet. A chip sample across the bed was analysed with the following results.[1]

	Per cent
Insoluble	88·9
Insoluble Fe_2O_3	20·43
Soluble Fe_2O_3	9·23
Total Fe_2O_3	29·66

Across the northwest corner of the south island is another specularite bed about 35 feet thick dipping about 30 degrees south. It appears to have about the same composition as the bed just described. The specularite bed grades north into quartzite containing a small percentage of specularite.

At the west end of the middle island is a specularite bed about 30 feet thick and dipping about 30 degrees south. Some layers in the bed contain considerably more specularite than others, but the average composition appears to be about the same as that of the first described specularite bed. This bed is underlain on its north side by quartzite which contains two specularite beds. One of these is 1 foot thick and the other is 20 feet thick.

On the southeast shore of the middle island is a bed of specularite with an exposed thickness of about 2 feet and probably containing a somewhat higher percentage of specularite than the bed first described. At the east end of the same island is another outcrop of specularite which is probably a continuation of the bed on the southeast shore of the island.

The west and north parts of the north island, which is roughly circular and about 800 feet across, are composed very largely of quartzite containing specularite. The percentage of specularite varies considerably at different localities, but on the average is considerably lower than that of the first-described locality. The bedding of the quartzite on this island strikes and dips irregularly.

Specularite-rich beds and lenses up to 2 feet wide occur in quartzite on a small island ¾ mile east of the south end of Iron islands and in argillaceous quartzites 2 miles southwest and 3 miles northeast of Basile bay.

Oolitic hematite beds are best exposed at several localities along 5 miles of shoreline on the east side of a narrows 5 miles north of Utsingi point. The hematite beds occur in red and black shales which are associated with volcanics. The sediments strike north and dip from 5 degrees to 15 degrees to the east. Some of the hematite beds are only a foot or less thick, but several exposures, all probably parts of a single bed, show thicknesses of 10 to 30 feet of oolitic hematite associated with hematite-rich shales and jasper. The iron content is no doubt quite low. Oolitic iron deposits up to 20 feet thick occur at several other localities on the lake.

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[1] Analysis by A. Sadler, Mines Branch, Dept. of Mines, Canada.

OTHER FIELD WORK

Geological

H. C. Horwood. Mr. Horwood, under the supervision of J. F. Wright, commenced the geological study and mapping of Cross Lake 4-mile quadrangle (latitudes 54° to 55°, longitudes 96° to 98°), Manitoba.

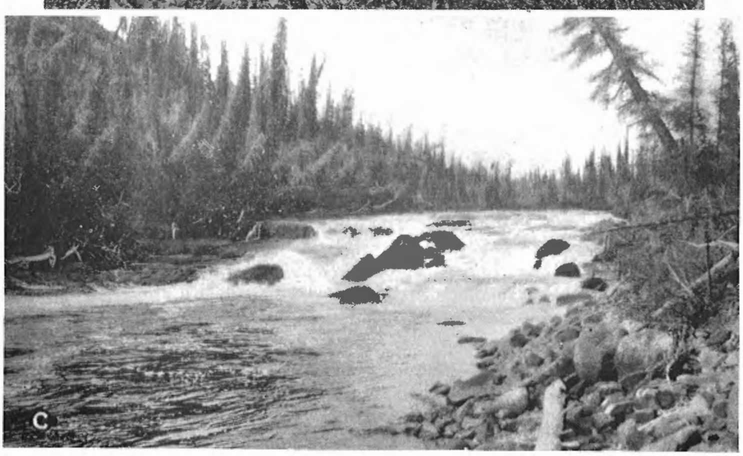
C. H. Stockwell. Mr. Stockwell concluded a geological exploration of the eastern part of Great Slave lake, North West Territories.

Topographical

R. C. McDonald. Mr. McDonald carried out control surveys for areal mapping in the region extending east from Great Bear lake, North West Territories.

A. Labine Point bay, east side of McTavish arm, showing hills 400 to 500 feet above lake and general rugged topography.

B. Raised beaches on west side of McTavish arm near the head.



C. Chute in last rapid on Sloan river.

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The annual Summary Report of the Geological Survey is issued in parts, referring to particular subjects or districts. This year there are four parts, A, 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.