Forty-Fifth Annual Report

of the

Ontario Department of Mines

1936

Part III

PROVINCE OF ONTARIO

DEPARTMENT OF MINES

HON. PAUL LEDUC, *Minister of Mines* T. F. SUTHERLAND, *Deputy Minister*

FORTY-FIFTH ANNUAL REPORT

OF THE

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COLOURED GEOLOGICAL MAP
(In pocket at back of report)

Photo by Royal Canadian Air Force

Aerial view of the Lake of the Woods looking northwest across Coney island toward the town of Keewatin.

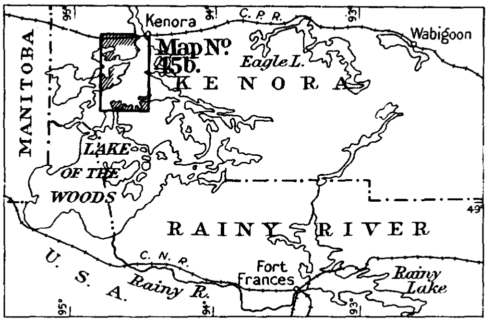
Geology of the North Central Part of the Lake of the Woods

By Jas. E. Thomson

INTRODUCTION

During the summer of 1935, a geological survey was made of the north central part of the Lake of the Woods. This area lies south and west of the town of Kenora on the Canadian Pacific railway. It includes a complete section across the greenstone-sedimentary belt from the granite contact near the Trans-Canada highway on the north to the southern granite contact near Sunset channel, a distance of about 20 miles. The area is bounded on the west by the Shoal Lake map area[1] and on the east by the Bigstone Bay map area.[2] A few of the properties described in this report were examined in September, 1936.

The area contains a number of gold prospects that were developed to a slight extent in the early days of gold-mining activity on the Lake of the Woods,



Index map showing the location of the north central part of the Lake of the Woods. Scale, 60 miles to the inch.

but none produced any appreciable amount of gold. A number of these properties have been examined in recent years, and surface development has been done on some of them. During the summer of 1935 an important gold discovery was made on one of these old properties, known as the Three Ladies mine and now owned by Kenricia Gold Mines, Limited. It is located on the northeast side of Clearwater bay near the Trans-Canada highway. The discovery led to considerable staking and prospecting activity in this vicinity during the latter part of the summer.

The accompanying geological map (No. 45b) covers an area of approximately 350 square miles, but about half of this is covered by water. The Kenora sheet (No. 52E), issued by the Topographic Survey of Canada, is an excellent aerial map of the region and was used as a base map in the preparation of the geological map. The geological data were obtained by first studying the outcrops along the shore line and later by making pace-and-compass traverses about a quarter of a mile apart through the bush. The shore generally presents excellent rock

[1]Leonard Greer, "Geology of the Shoal Lake (West) Area," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, pp. 42-56.

[2]G. G. Suffel, "Geology of the Bigstone Bay Area," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, pp. 57-71.

exposures, worn bare by wave action, and provides an opportunity for detailed examination. The less exposed areas of rock in the bush can be more intelligently interpreted after a study of the shore outcrops.

Acknowledgments

The writer wishes to express his appreciation to the various individuals who provided assistance and information during the summer. Special acknowledgment for many courtesies is due the various mining organizations within the area, the officials of the Ontario Forestry Branch at Kenora, the various lake fishermen who provided transportation, and J. D. C. Smith, mining recorder at Kenora. Able assistance was rendered in the field by Bruce Russell, A. O. Carufel, and W. D. Atchison. Mr. Russell acted as senior assistant and did a considerable part of the geological mapping. Assays and chemical analyses were made by the staff of the Provincial Assay Office.

Access

All parts of the area are easily reached from Kenora or neighbouring villages on the Lake of the Woods. Lake boats and air transport are readily available at Kenora. The Clearwater bay section is adjacent to the Trans-Canada highway and is more quickly reached from this road than by boat. A recently constructed road extends from a point near Keewatin to the east end of White Partridge bay. A canoe route across the Western peninsula is shown on the accompanying geological map.

Previous Geological Work

In 1881 Robt. Bell made a traverse around part of the Lake of the Woods and secured information for a preliminary geological map, which accompanied his report. The first intensive geological study was made by A. C. Lawson from 1883 to 1885. The report, published in 1885, contained a complete topographic and geological map of the Lake of the Woods. It was in this area that Lawson recognized for the first time a series of rocks which he thought were older than the typical Huronian of Sir William Logan, as described in the "Geology of Canada" in 1863. Lawson proposed the name Keewatin for these older greenstones and schists. He also recognized that the granites and gneisses intruded the Keewatin complex and that the gold-bearing veins were located in the vicinity of the contacts between these formations.

Later, a special International Geological Committee examined certain sections on the Lake of the Woods, and published their report in 1905.[1] They found Lawson's description of the formations to be substantially correct. Lawson's map has remained until recent years as the only complete geological map of the Lake of the Woods district. Some minor changes were made to Lawson's map by A. L. Parsons in 1912.

The gold deposits on the Lake of the Woods have been discussed by Lawson, Parsons, Hopkins, Bruce, Thomson, and various inspectors of the Ontario Department of Mines.

In 1929 the immediately adjacent Shoal Lake and Bigstone Bay areas were mapped by Leonard Greer and G. G. Suffel, respectively.

[1]"Report of the Special Committee on the Lake Superior Region," Jour. Geol., Vol. 13, 1905, pp. 95-104.

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The following reports deal with the area and the territory immediately adjacent:—

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G. G. SUFFEL, "Geology of the Bigstone Bay Area, Lake of the Woods," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, pp. 57-71.

JAS. E. THOMSON, "Gold Deposits on Lake of the Woods," Ont. Dept. Mines, Vol. XLIV, pt. 4, 1935, pp. 29-47; "Gold Deposits of the Belt Extending from Manitou Lake to Lake of the Woods," Bull. Can. Inst. Min. and Met., Oct. 1936, pp. 686-701.

C. R. VAN HISE and C. K. LEITH, "The Geology of the Lake Superior Region," U.S. Geol. Surv., Mon. 52, 1911, pp. 144-147.

History and Development

The gold deposits in the Lake of the Woods region have been of interest for a very long time. On the whole, considering the large number of discoveries that have been made over this long period of years, the country has had a rather disappointing mining history. It is recorded that gold-mining operations on the lake commenced as early as 1852, although very little real development was done before 1890. Between 1885 and 1895, during the famous Lake of the Woods gold rush, a large number of discoveries were made. By 1893 there were some 20 gold-mining locations in the neighbourhood of Rat Portage, now the town of Kenora. The most outstanding of these was the Sultana mine, which eventually became the chief gold producer in the area. The gold production of the Lake of the Woods region steadily rose until the peak year of 1899. During this year, it amounted to $421,951 for the Province of Ontario and was chiefly derived from four mines, the Sultana, Regina, Mikado, and Golden Star, all but the last-named being on the Lake of the Woods.

During 1900 a large number of the mines in the region were closed down, thus manifesting the fact that a strong reaction had set in. Some properties were worked intermittently until 1912, when practically all gold-mining operations ceased. The year 1909 witnessed the discovery and initial development of the Porcupine gold fields. These and other areas attracted prospectors and mining interests, and the Lake of the Woods region was practically neglected for many years. The total gold production during the early mining period on the Lake of the Woods is not exactly known. To the end of 1909, however, the aggregate value of the gold production of Ontario was about $2,500,000, of which much the greater part came from the Lake of the Woods.

Within the last few years a marked revival of gold-mining activity has taken place in this part of the province. This has been partly due to the revaluation of gold and the necessity for the re-examination of old properties to determine whether they could be profitably exploited by modern mining methods at the present price of gold. As a result of this exploration new ore bodies have been outlined and some mines are producing gold.

Between 1890 and 1900 a number of gold discoveries were made within the map area and quite a number of small shafts were sunk for exploratory purposes. So far as is known, none of these properties produced any appreciable amount of gold. In recent years most of these old showings have been examined, and in some cases surface stripping and sampling has been done.

Topography

The topographical features of the Lake of the Woods have been discussed in detail by Lawson.[1] The north central part of the lake is essentially an archipelago. Its whole expanse is thickly studded with islands varying in size from tiny rocky islets to masses of land of great extent. This section of the lake is rather shallow, and shoals and reefs are numerous. These are marked by buoys along the main channels. There are often marshy tracts in the more sheltered parts of the lake, such as secluded bays or narrows between islands.

The land areas occasionally present a somewhat rugged appearance, especially those parts some distance inland, but the relief is never over 200 feet. The central part of the Western peninsula and the part of the map-sheet lying north of the Trans-Canada highway present the most rugged topographic features. The greater part of the land area is rock outcrop. The shore line almost always reveals rock exposures, and the smaller islands show much bed rock. Large islands, such as Shammis, Crow Rock, and Corkscrew, are partly covered with a mantle of drift in the interior. The central part of the Northern peninsula is largely covered by overburden.

The topographic features of the Lake of the Woods have been controlled to a great extent by the nature and structure of the underlying rock. Lawson[2] has discussed this point in great detail and summarizes it as follows:—

> The dependence of the physical features of the earth's surface upon geological conditions becomes more or less apparent in all regions, when carefully studied, but nowhere could a better illustration of so interesting a truth be found than on the Lake of the Woods. The conditions which obtain in the rocks of the region, and which have had the most active influence in determining the aspect of its geographical features, are those of cleavage, relative hardness and mineral composition, and strike and dip. The strike and dip of the strata control more particularly the direction in which the forces of erosion operate, while cleavage, relative hardness, and composition control rather the measure of rapidity with which these forces may act in the direction determined. These general conclusions . . . may be regarded as an imperfect formulation of the law of erosion in these Archean rocks.

The basin of the north central part of the Lake of the Woods lies almost entirely within the area of Keewatin schistose rocks. The general strike of the formation, rock cleavages, and anticlinal and synclinal axes throughout this area average about N. 80° E. It will be noticed that topographic features such as straits, bays, and islands, tend to be elongated in about the same direction. This is especially the case where the rocks are decidedly schistose or where very resistant bands of these rocks, such as diorite or massive lavas, occur between areas of more schistose rock.

Natural Resources

One of the chief sources of revenue of the area is the summer tourist business. The northern part of the Lake of the Woods has long been famous for its great natural beauty. A large number of summer homes have been built on available locations around Rat Portage bay and southward to the more open stretches of the lake. Since the opening of the Trans-Canada highway many summer

[1]A. C. Lawson, Geol. Surv. Can., Vol. I, pt. CC, 1885, pp. 15-28.
[2]Ibid, p. 18.

cottages have been constructed along the north shore of Clearwater bay. Tourist camps are operated on different parts of the lake during the summer months.

Commercial fishing is carried on extensively. Pike, pickerel, and whitefish constitute the main shipments. Maskinonge, bass, and lake trout are caught by sportsmen in different parts of the lake. Game is fairly plentiful.

There is little lumbering activity in the area. Much of the timber is second growth. The chief forest trees are poplar, spruce, balsam, jackpine, red and white pine, cedar, birch, and ash. The only extensive area of recently burnt over country lies along the north side of Aulneau peninsula from a point near Portage de Bois to a point south of Sunset channel. A limited amount of farming and gardening is done in the northern part of the area.

GENERAL GEOLOGY

The outstanding geological features of the north central part of the Lake of the Woods may be summarized as follows: The consolidated rocks are almost entirely of early pre-Cambrian (Archean) age. The greater part of the area is underlain by Keewatin lavas and pyroclastics, with which are associated small amounts of clastic sediments and iron formation. Sedimentary rocks of Timiskaming age lie stratigraphically above the Keewatin series and are probably separated from it by an unconformity. Both lavas and sediments are steeply folded and are intruded by granites and porphyries, probably Algoman in age. A few diabase dikes intersect all other rocks and are presumably Keweenawan in age. Glacial deposits have covered the bed rock in some localities.

The various formations may be classified as follows, the oldest being placed at the bottom:—

QUATERNARY	
PLEISTOCENE and RECENT:	Boulder clay, sand, gravel, peat.
	Great unconformity
PRE-CAMBRIAN	
KEWEENAWAN:	Diabase.
	Intrusive contact
ALGOMAN(?):	Quartz porphyry, quartz-feldspar porphyry, syenite porphyry, aplite, lamprophyre. Granite, gneiss, granodiorite.
	Intrusive contact
TIMISKAMING:	Conglomerate, arkose, greywacké, quartzite, and slate.
	Unconformity
KEEWATIN:	Acid volcanics:[1] Rhyolite and rhyolite porphyry, sericite schist, carbonated acid lavas and schists. Sediments interbedded with lava flows:[2] Greywacké, slate, iron formation, graphitic chert. Volcanic fragmentals:[1] [2] Agglomerate, tuff, and volcanic breccia. Basic volcanics:[1] Andesite, basalt, and pillow lava; hornblende and chlorite schist; amphibolite, carbonated basic lavas and schists; altered gabbro and diorite (some of which are intrusive into the lavas).

[1]In some parts of the area the boundaries between basic volcanics, the volcanic fragmentals, and the acid volcanics are quite sharply defined; in other parts, the rocks of these groups are so intermingled that they cannot be differentiated on a large-scale map such as the one accompanying this report. In the latter case, the rocks are all assigned to the division representing the commonest rock type found locally. The boundaries of such a division must be rather arbitrarily defined on the geological map as they represent only a change in proportion of the different rock types present.

[2]Where the pyroclastics are fine-grained and laminated, e.g. bedded tuffs, they cannot be distinguished from the sediments. Thus locally these two divisions may merge into one.

Keewatin Series

The Keewatin series are an assemblage of (1) igneous, (2) pyroclastic or fragmental, and (3) sedimentary rocks. The igneous rocks are largely lava flows and may be divided into two main groups: (a) the dark-green basic type and (b) the lighter-coloured acid variety. Thus, for purposes of study and description, the Keewatin rocks fall naturally into four distinct groups. In some parts of the country these ancient rocks have their original characteristics well preserved, but in many places they have undergone an immense amount of alteration due to folding movements and igneous intrusion. These metamorphosed phases of the different rocks are represented by schists, gneisses, coarse-grained amphibolites, and carbonated rocks. In the older maps and reports on the region,[1] the Keewatin rocks have been differentiated in geological mapping largely on the basis of the metamorphic derivatives rather than the original nature of the rocks. In the following discussion the metamorphosed equivalents of the various rock types are grouped with the less altered phases of a group. By doing this, a more reasonable picture of the original distribution and structure of the different groups of the Keewatin complex is presented than would be obtained by regarding the metamorphic rocks as separate units.

The different members of the Keewatin series are irregularly distributed, and there is no evidence that any one group occupies a particular stratigraphic horizon in the complex. For example, the available structural information shows that the pyroclastics are erratically distributed at many different stratigraphic horizons from near the base of the Keewatin series to the very top. The same statement might apply to the relationship of the acid to basic lavas, although in the northern part of the map-sheet a large area of acid lavas is found at the very top of the Keewatin complex. The Keewatin sediments were deposited locally at different horizons within the volcanics.

Basic Volcanics

Lavas.—A large part of the Keewatin series consists of lavas ranging from andesite to basalt in composition. They are typically fine- to medium-grained rocks and generally show some alteration. These altered basic lavas are commonly referred to as "greenstones" in the field. In some cases, they show very little variation over considerable areas.

Pillow lavas are rather widely distributed, but the state of preservation of the pillow structures varies greatly. Amongst the best preserved exposures are (1) those on the south shore of island D. 183 and adjacent islands (located between Clearwater and Ptarmigan bays), (2) those on a small island south of the Western peninsula and half a mile north of Bishop point (see photograph on page 7), and (3) those on islands in Wiley bay (Western peninsula), especially island No. 1,001. Pillow structures are sometimes well developed where one or two isolated flows occur between bands of agglomerate. The largest pillows are about 8 feet in length; all gradations are found from this size to those only a few inches long. This type of flow is apt to be amygdaloidal, the amygdules being especially prominent near the margin of the pillows. It is only on rare occasions that the boundaries between similar flows can be recognized, although the contact between an individual acid and basic flow or a basic flow and agglomerate may be observed quite frequently. Most of the basic flows that exhibit a complete cross-section are from 10 to 25 feet in thickness. Thicker flows occur but are almost always covered to some extent with overburden.

[1]A. C. Lawson, op. cit.
A. L. Parsons, Ont. Bur. Mines, Vol. XX, pt. 1, 1911, pp. 158-178.

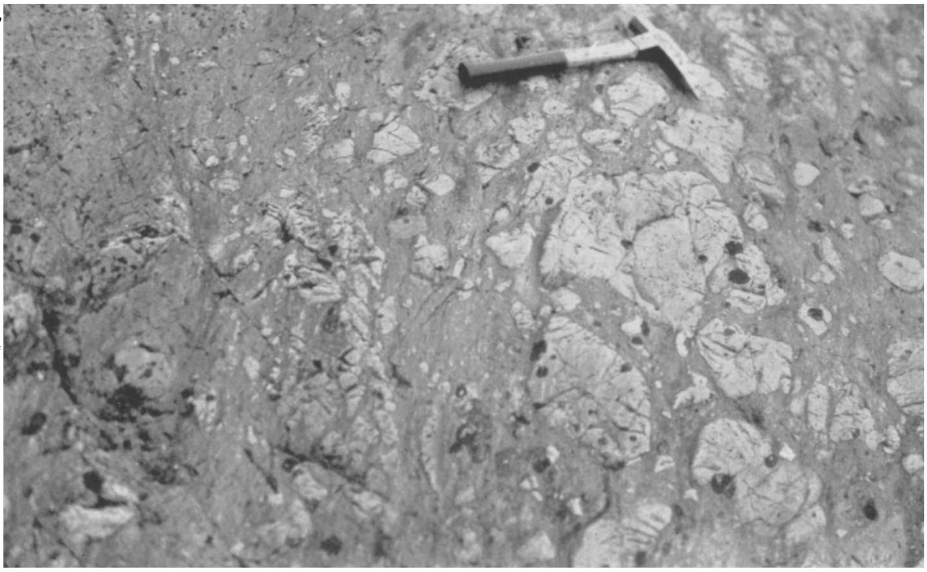
Lava flows with well-preserved pillow structures afford an excellent criterion for structural determinations. When the necessary observations are accurately made there can be absolutely no doubt of the attitude of these flows. A section across three successive basaltic flows at a well-exposed point on the south shore of island D. 183 between Ptarmigan and Clearwater bays might be taken as an example. The top of these flows is characterized by a narrow brecciated zone that passes downward into pillow structures. These have a characteristic outline due to the fact that the later formed pillow fits into the surface irregularities of the one below it, especially into the triangular space between two older pillows. In some cases the zone of pillows extends across most of the flow, while in other cases the lower part contains fine- to medium-grained lava.

Exposure of pillow lava on a small island south of the Western peninsula and half a mile north of Bishop point.

In a number of places within the greenstone complex there are small areas of basic rock with a coarse dioritic texture that are closely associated with the fine-grained lavas. In many cases this coarse-textured rock grades laterally into typical lava, in which case it is interpreted as being the central part of a flow, which cooled more slowly than the margin, resulting in a coarser crystallization of the constituent minerals. In a few instances this dioritic phase of a flow grades into lava with pillow structure. However, rocks which have a similar appearance but intrude the lavas and associated agglomerate and tuff are also found in the area. These are discussed under the heading of "Basic Intrusives." It is always difficult to distinguish the intrusive from the extrusive rock in the field, and impossible in the case of isolated outcrops. In the accompanying geological map these coarse-textured rocks have not been differentiated from the basic lavas for the reason that no intrusive contacts could be found. The distribution of the larger areas is roughly designated by the symbol "1e."

Occasionally the basic volcanics are fragmental in character. These fragmental lavas are flow breccias and have probably been formed by the shattering of the outer crust of a flow while the interior was still molten. The fragments are of various sizes and have a composition similar to the matrix (see photograph below). The fragments may be angular or partially rounded. The latter variety has possibly been produced by either movement in the flow or reaction of the rim of the fragment with still molten lava. The lava matrix is uniformly fine-grained; this distinguishes the flow breccia from the agglomerates, described below, which have a matrix of variable grain size and finely fragmental character.

Metamorphosed Basic Lavas.—The greater part of the basic lavas have undergone some alteration. The rock produced by this alteration is dependent upon the type and degree of metamorphism to which the lavas have been subjected. The partially altered greenstone sometimes contains a certain amount of talc, and this soft material forms a poor grade of soapstone. Shearing stresses during the folding of the rocks in the region have locally transformed the basic lavas to chlorite and hornblende schists. Rather narrow bands of fissile chlorite



Basaltic flow breccia, Ash bay.

schists are developed between areas of massive, competent greenstone. These sheared zones probably designate the location of ancient faults along which much movement took place. Zones of intense shearing are found along the south shore of Fox island (south of the Northern peninsula) and on small islands between Whiskey and Mather islands (southeast of the Northern peninsula).

In the vicinity of the granite-greenstone contact along the north shore of Aulneau peninsula, the lavas are intensely deformed and are now largely represented by chlorite and biotite schists, which are highly laminated and intruded by *lit par lit* injections of granitic material. At some horizons, however, the greenstones have undergone recrystallization rather than shearing, and a coarse-grained, massive amphibolite has been formed.

In a few places throughout the area the greenstones have been carbonated locally. These carbonated zones are characterized by outcrops with a reddish-brown gossan due to the weathering of iron-bearing minerals. Hot solutions that carried considerable amounts of carbonates and silica have evidently permeated these areas.

Volcanic Fragmentals

A large part of the area is underlain by fragmental rocks of extremely varied texture, composition, and origin. They consist of agglomerates, massive and stratified tuffs, volcanic breccias, and schistose equivalents. These are intimately associated with all other rock types in the Keewatin series and are interbedded with acid and basic lava flows. The ratio of pyroclastics to lavas varies greatly in different parts of the map-sheet. In some localities there are widespread areas of agglomerate containing only an occasional lava flow. The large band of agglomerate that extends across the northern part of the map area south of the Trans-Canada highway exemplifies this condition. The other extreme shows bands of agglomerate or tuff only a few feet in thickness interstitial between great areas of lava flows. Sometimes the intermixture of these rocks is so complex that only detailed mapping on a small scale would show the true relationships.

Typical agglomerate consists of fragments of light-coloured material, sometimes porphyritic in texture, in a matrix that is generally fine-grained, but occasionally rather coarsely tuffaceous. When the rock is schistose, the fragments are usually elongated parallel to the regional schistosity, but in the massive type they may be quite angular. The fragments show a great range in size, shape, and composition. Some are rhyolite or rhyolite porphyry; others of vesicular texture are probably bombs. Occasionally they are basaltic in composition. On island 94 P., north of Scotty island, the agglomerate contains large angular chert fragments. Throughout the area the agglomerate is predominantly acid in nature and consequently light-grey in colour. Much of the finer-grained part might well be named rhyolite tuff. Such a band extends from Oliver island to Crow Rock island and Wiley bay. This band is very massive and quite acid in composition, and is characterized by large amounts of tuffaceous material, which resembles a quartz-feldspar porphyry in hand samples. This material is distinctly stratified in many places, in which case it was undoubtedly water-laid. Gradation in grain size across individual beds may be clearly distinguished.

The tuffaceous rocks show much variation. In places coarsely fragmental agglomerate grades into fine-grained tuff, which is well sorted and distinctly sedimentary. It is impossible to distinguish this tuff from an ordinary bedded greywacké. At some points, e.g. the shore of the Western peninsula immediately north of Luella island, narrow bands of agglomerate are interbedded with stratified tuffaceous beds 2 to 4 inches in thickness. Often the tuff contains quartz and feldspar crystals in a cherty or rhyolitic matrix and may or may not contain an occasional bomb-like fragment.

All the fragmental rocks in the area that occur in bands of sufficient size to be shown on the accompanying geological map are grouped together. They are very largely pyroclastics, but some volcanic breccias, i.e., flow breccias, are necessarily included because it is often impossible to distinguish between these rocks of different origin.

The intimate association of these pyroclastics with the lavas is of widespread occurrence throughout the Lake of the Woods region. It indicates that at various intervals during Keewatin time, rock fragments and volcanic ash were ejected from the same subterranean source as the molten lavas and produced the intermingling of the flows and pyroclastics. At certain points the fine ashy material was sorted by erosional agencies and deposited in beds to form the tuffaceous sediments. Even the fragments in the agglomerate are sometimes rounded and pebble-like in appearance as if they had undergone some erosion.

Greer[1] has pointed out that the true agglomerate north of Picture Rock point grades laterally into a type with rounded fragments, which could be termed a volcanic conglomerate. This statement could apply to other localities, especially a number of islands east of Infernal point. The finer-grained tuffs were certainly partly water-laid, and it is very likely that some of the intimately associated agglomerate was affected by the same erosional agencies.

The pyroclastics have been metamorphosed in much the same way as the lavas. They are sheared to sericite schist or chlorite schist, depending upon the original composition of the rock.

Bedded greywacké on the shore of the mainland north of Ferris island.

Sediments

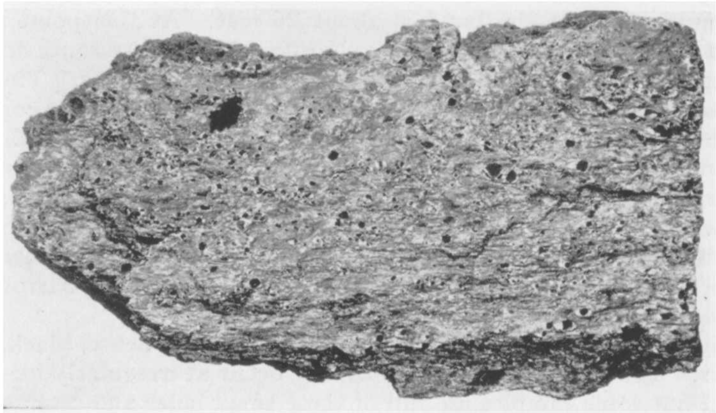
Greywacké and Slate.—It has already been pointed out that some of the well-bedded tuffaceous sediments are indistinguishable from ordinary greywacké. However, besides these sediments associated with the pyroclastics, there are other bands found locally between lava flows. Most of these sediments consist of greywacké, slate, and minor amounts of chert. They are lithologically similar to the sediments of the Timiskaming series, and differ only in their structural relationship. The bands range in width from a few inches to half a mile. Bedding is generally well defined, and the strata may vary from a fraction of an inch to over half a foot in width. They cometimes show distinct gradation in grain size from granular material at the base of a bed to very fine grained slate at the top. In places, thin basaltic flows, sometimes only 2 feet wide, are interbanded with these sediments. An example of this relationship may be seen on the north shore of the southern peninsula of Cliff island (north of Aulneau peninsula).

The largest area of these sediments outcrops on Wiley point, Queen island, Infernal point, and island No. 831. If it is assumed that these areas are part of a continuous band, it would have a length of at least 5 miles and a maximum width of half a mile. The structure of the sediments, as detailed in a later part

[1]Leonard Greer, "Geology of the Shoal Lake (West) Area," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, pp. 45, 46.

of this report, indicates that they are interbanded with the lavas and pyroclastics, i.e. not Timiskaming in age. The sediments are all fine-grained clastics, mostly bedded, but a small amount may be of tuffaceous origin. No lava flows were found within the boundaries of this sedimentary area.

Iron formation.—At two or three places in the area, small bands of lean iron formation are found, but they are so insignificant that they hardly merit description. On the northwest corner of Corkscrew island there is a narrow band of cherty iron formation containing traces of iron oxides. West along the strike this passes into massive chert. The chert is of interest because the black carbonaceous sediments described below are associated with it.



Specimen (one-half natural size) of vesicular graphitic chert from Corkscrew island. Most of the vesicles are empty, but a few are filled with carbon.

Graphitic Chert.—This is a peculiar and unique type of cherty, carbonaceous sediment that is locally characterized by the presence of spherical holes (see photograph above). It is found in a few places around the Lake of the Woods and has been described by Lawson,[1] Parsons,[2] and Greenland,[3] under the name of "carbonaceous schist." Similar rocks have been described in the country east of the Lake of the Woods.[4] The writer prefers the name graphitic chert, owing to the fact that the rock has the composition of a chert and contains a considerable amount of carbon in the form of graphite; it is not always schistose. The rock generally contains a sufficient amount of graphite to soil the fingers on handling. Weathered pieces somewhat resemble gas-blown slag.

Five occurrences of the vesicular rock are known in the area, but by far the best exposures occur on the shore of the northwest corner of Corkscrew island. The vesicular graphitic chert always occurs as part of a band of black slate, massive chert, or lean iron formation. Only relatively few of the black slate bands in the country, however, have the vesicular structure. The maximum observed width of these sedimentary zones was 25 feet. They are always interbedded with altered acid or basic lavas. In the majority of cases the lavas on

[1] A. C. Lawson, Geol. Surv. Can., Vol. I, pt. CC, 1885, pp. 58, 59.
[2] A. L. Parsons, Ont. Bur. Mines, Vol. 22, pt. 1, 1913, pp. 221, 222.
[3] C. W. Greenland, "On the Origin and Structure of the Carbonaceous Schists of the Lake of the Woods," Trans. Can. Min. Inst., Vol. 16, 1913, pp. 584-597.
[4] Jas. E. Thomson, Ont. Dept. Mines, Vol. XLIII, pt. 4, 1934, pp. 9-11; Vol. XLIV, pt. 4, 1935, p. 12.

either side have been greatly sheared and are now sericite or chlorite schists. The cherts, however, by virtue of their composition, have acted as competent rocks and have resisted the shearing movements to such an extent that the vesicles are well preserved. Occasional graphite slip-planes occur throughout the rock. As the chert is composed almost entirely of tiny quartz grains, no platy minerals, such as micas, can develop; and the rock, despite the many holes, is relatively more resistant to shearing stresses than the adjacent lavas. Shearing was evidently localized near the contact of the lavas and this strong competent rock.

The Corkscrew island exposures are worthy of more detailed discussion. Here, a band of sediments has been preserved at various places along the shore and outcrops at intervals for a distance of almost half a mile along the strike. The maximum width of the band is about 25 feet. At this point a detailed section from south to north shows slaty chlorite schist on the south wall, then a series of six interbanded vesicular and non-vesicular chert zones. The vesicular chert ranges in width from 8 feet to less than 1 foot in width. Then comes a zone of black chert 10 feet wide. It is in sharp contact with sericite schist on the north boundary. Samples of typical vesicular chert and the non-vesicular variety were taken from this location for rock analyses, and their composition is recorded below. Contrary to the observations of Lawson,[1] the vesicular chert contains little or no pyrite in the form of round balls filling the spherical holes, although occasionally a few pyrite cubes are found in or near narrow silicified and pyritized zones in the adjoining chert.

Freshly broken samples of the vesicular chert show a dense, black, slate-like groundmass. The spherical cavities generally occur at irregularly located zones in the rock, but some samples are full of these small holes and resemble pumice in texture. The cavities range from half an inch in diameter to microscopic dimensions. The greater number of these are empty, but some are partly filled with rounded masses of graphite; others contain a framework of delicate graphite flakes and fibres. The larger cavities are often enclosed or partly enclosed by a narrow rim of quartz. At a few exposures the vesicles are filled with pyrite or marcasite, but this condition is rare.

Thin sections of the black chert show the rock to be composed of tiny quartz grains with delicate wisps of carbonaceous material interlaminated between bands of quartz. There are also traces of sericite. The vesicular graphitic chert consists of the same mineral assemblage, but the graphite particles are often so numerous that they make parts of the section almost opaque. The primary quartz and graphite of the groundmass appear to have been deposited simultaneously. Secondary quartz occurs as small veinlets, which run in all directions through the groundmass, and also as small columnar crystals arranged in a radial fashion around the rim of a vesicle. Traces of sericite are sometimes found with the secondary quartz.

Chemical tests made on the carbonaceous material show that it is largely in the form of graphite. The soft carbonaceous material that occupies the cavities, when heated over a Bunsen flame, is partially burnt showing that a small amount is amorphous carbon. When the material is boiled in *aqua regia*, however, no noticeable amount goes into solution, showing that by far the greater proportion is crystalline graphite.

Chemical analyses were obtained of both the chert and the vesicular chert from the above-mentioned location on Corkscrew island, and are recorded below.

[1]A. C. Lawson, op. cit., p. 58.

The striking similarity in chemical composition of these rocks shows how closely they are related and suggests a common sedimentary origin. The composition of both rocks checks closely with that of cherts from various parts of the world.[1] Other analyses show considerably more carbon than found in the samples taken by the writer. Lawson[2] states that a sample of the carbonaceous rock was found on analysis to contain 5.77 per cent. carbon, and an analysis by Greenland[3] of similar material from Corkscrew island shows 8.24 per cent. carbon.

ANALYSES OF CHERT FROM CORKSCREW ISLAND

	No. 1	No. 2
	per cent.	per cent.
SiO_2	96.87	94.01
Al_2O_3	1.61	2.27
Fe_2O_3	.03	.59
FeO	.02	nil
CaO	nil	nil
MgO	.22	.32
K_2O	.22	.42
Na_2O	.32	.16
TiO_2	nil	nil
MnO	nil	nil
P_2O_5	.05	.07
CO_2	.09	.11
H_2O	.13	.56
FeS_2	.13	.28
C	.40	1.38
Total	100.09	100.13
Specific gravity	2.655	2.112

Sample No. 1—Black chert, Corkscrew island, Lake of the Woods. Analysis by Provincial Assay Office, 1936.

Sample No. 2—Graphitic chert with vesicles, Corkscrew island, Lake of the Woods. Analysis by Provincial Assay Office, 1936.

The origin of the vesicular rock is rather obscure. Lawson[4] suggests that the confining of gas may have been responsible for the formation of the spherical cavities. Parsons'[5] explanation is as follows:—

> The vesicular structure can probably be best explained by the expansion of gaseous matter in the rock, and is probably due to the coking of carbon compounds, which may have been coal-like deposits or an asphalt vein filling.

Greenland[6] suggests that the vesicles were formed by the removal of pyrite crystals and the subsequent infiltration of silica, and that the carbonaceous material is of inorganic origin and introduced by hot solutions.

The writer would suggest the following origin: Silica, derived by the weathering of adjacent igneous rocks, was transported as colloidal silica and deposited in local shallow ponds or lake basins. This mode of solution and transportion would be similar to that suggested for the Keewatin iron formation by Moore and Maynard.[7] It has already been stated that the graphitic chert passes into lean iron formation along the strike on Corkscrew island. Moore and Maynard[8]

[1]F. F. Clarke, "The Data of Geochemistry," U.S. Geol. Surv., Bull. 770, 1924, p. 551.
[2]A. C. Lawson, op. cit., p. 59.
[3]C. W. Greenland, op. cit., p. 587.
[4]A. C. Lawson, op. cit., p. 59.
[5]A. L. Parsons, op. cit., p. 222.
[6]C. W. Greenland, op. cit., pp. 588-597.
[7]E. S. Moore and J. E. Maynard, "Solution, Transportation and Precipitation of Iron and Silica," Econ. Geol., Vol. 24, 1929, pp. 272-303, 365-402, 506-527.
[8]Ibid, p. 524.

postulate the presence of organic matter in the solutions carrying the iron and silica, this organic matter preventing the iron and silica from mutually precipitating one another until they are finally deposited by the electrolytes of the sea. In the case under discussion, the solutions were almost devoid of iron but rich in silica. The precipitation and consolidation of the silica along with the closely associated organic matter would form the black cherts. These contain a relatively small amount of carbon. At intervals, however, a large amount of organic material may have been collected with the silica to form a thick ooze. It is within the realm of possibility that gases, such as carbon dioxide, methane, and other hydrocarbons formed by the decay of the organic remains under these conditions, would be entrapped, and thus produce the bubble holes or vesicles. The subsequent breaking-down of these confined gases would produce the carbon now found within the vesicles. In support of this idea it may be pointed out that in the analyses shown above the vesicular chert contains between three and four times the amount of carbon found in the ordinary chert. According to this explanation, the vesicular phases of the chert would represent horizons where a proportionately large amount of organic material was entombed. Most of the carbon would be altered to graphite during the subsequent folding of the Keewatin series and the granitic invasion. At that time, also, the secondary quartz and pyrite or marcasite could have been introduced into the cavities.

The above hypothesis postulates the presence of life in Keewatin time, probably in the form of primitive plants or animals. It would be impossible to actually prove the presence of lowly organisms in this case, but several geologists[1] have expressed the opinion that such forms probably existed at that time. It seems more logical to assume the presence of organisms during the Keewatin period than to seek an explanation through the introduction of the carbon from magmatic sources, for which there is no particular evidence. Graton and associates[2] consider that the Keewatin carbonaceous sediments in the Porcupine area are of organic origin.

Acid Volcanics

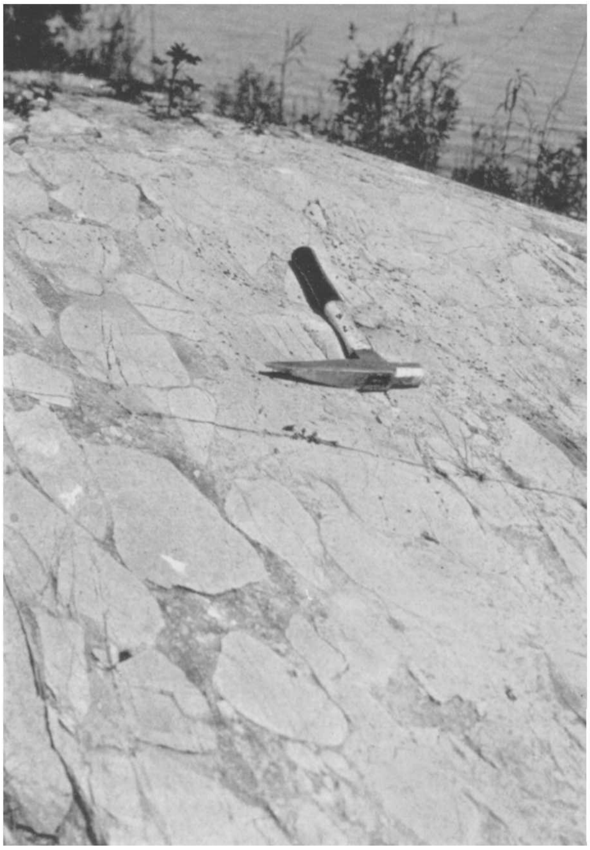
Lavas.—Rhyolite, rhyolite porphyry, and their schistose equivalents are rather widespread throughout the area, but generally occur as small bands interbedded with other members of the Keewatin complex. The largest area of these acid lavas is found on Rat Portage Indian Reserve No. 38A and on Corkscrew island. The rhyolite is characteristically lighter-coloured than the basic flows and varies from pink or grey to creamy-white in colour. It is generally massive and very hard, and has a dense, cherty appearance. The rhyolite porphyry contains quartz phenocrysts in a cherty, rhyolitic matrix. It is virtually impossible to distinguish this extrusive rock from the intrusive quartz porphyry in hand samples, and any differentiation between the two must be made by a study of their field relationships. In several places throughout the area intrusive quartz porphyry intersects the rhyolite, and there is no doubt as to the age relationships of these rocks. Fine exposures of porphyry intruding rhyolite may be seen on the east side of island No. 757, south of Infernal point (Crow Rock island), and on Mather island.

On the northwest side of Poplar bay (east of the Northern peninsula), a schisted, reddish-grey, rhyolitic rock with conspicuous quartz phenocrysts is found. Westward on White Partridge bay this grades into a normal rhyolite,

[1]See E. S. Moore and J. E. Maynard, op. cit., p. 523.

[2]L. C. Graton, H. E. McKinstry, and Others, Trans. Can. Inst. Min. and Met., Vol. 36, 1933, pp. 4, 5.

which may be traced around the nose of a belt of Timiskaming sediments and west along the southern contact for a distance of 6 miles. There is no evidence that the rhyolite or rhyolite porphyry intrudes the sediments, but the conglomerate of the sedimentary series contains pebbles of the rhyolite. At some places the rhyolite shows flow structure, and narrow bands of agglomerate are interbedded with it. The Western peninsula contains many small bands of rhyolite. When interbanded with the basic lavas this rhyolite always has a sharp contact with them.



Rhyolite breccia on a small island west of island G. 772 in Ptarmigan bay.

The rhyolite throughout the area is often brecciated and associated with acidic phases of the agglomerate. Where shearing has masked the original structure it is often very difficult to differentiate between the acid pyroclastics and the brecciated acid extrusives. A fine exposure of rhyolite breccia occurs on a tiny bare island a quarter mile west of island G. 772 in Ptarmigan bay (south of the Northern peninsula). Here masses of rhyolite, sometimes many feet in diameter, are lodged in a slightly darker coloured matrix (see photograph above). This may have been formed by the shattering of the consolidated crust on the surface of a flow and the engulfing of the fragments in the still molten interior.

Metamorphosed Acid Lavas.—The rhyolitic rocks are greatly altered at some points. In the initial stages of deformation they have simply tended to brecciate but have yielded to intensive stresses by shearing along local lines of weakness to form sericite schist. This same schist has also been produced by schisting of acidic phases of the agglomerate and tuff or acid sediments. It is thus not always possible to state the origin of the schist.

The rhyolite, especially the schistose phases, is sometimes carbonated in much the same way as the basic lavas.

Basic Intrusives

Certain small dikes or narrow bands of dark-green to greenish-grey basic rocks of medium to coarse texture are intimately associated with the basic lavas. They are generally massive, but are schisted locally, and the mineral constituents are always considerably altered. In the field they may be roughly classified as altered diorite or gabbro.

In a previous section of this report it has been shown that some of these coarse-grained rocks are phases of Keewatin lava flows. In a few places, however, the diorite or gabbro is intruded as dikes that intersect the lavas and agglomerate. In two or three places in the area long narrow bands of coarse-grained dioritic rock strike parallel to the flows. It is probable that this diorite occurs as sills, which were injected parallel to the flows and were derived from the parent magma that produced the lava. Such a sill-like mass of diorite may be traced for about 5 miles in a general direction of N. 60° E. across the central part of Ferris island and the neighbouring islands. The width of the band averages about 300 feet. The strike is parallel to that of adjacent bands of bedded tuff and lava flows.

Sometimes these sills are very narrow and so similar to the lavas that they can be detected only in exceptionally good rock exposures. For example, on the wave-worn shore of a small island north of Copper island in Ptarmigan bay, a diorite sill, 6 feet in width, lies between two flows of pillow lava and shows a sharp intrusive contact. The intrusive nature is accentuated by wave action, but ordinarily this relationship could not be recognized and the rock might easily be taken for an extrusive.

A band of rock, quite basic in composition and distinctly porphyritic in places, extends along the north side of Welcome channel (east of the Northern peninsula) for almost 3 miles. A sample taken from the extreme northeastern tip of the large island northwest of Thompson island was examined microscopically. It proved to be a serpentinized pyroxenite porphyry, and contained large crystals of augite, altered in part to serpentine, in a dark indistinguishable groundmass. Parsons[1] has discussed this band of basic rock and suggested that it may be a basic phase of the Keweenawan diabase dikes. The writer would be inclined to regard it as a phase of the Keewatin basic intrusives.

In the Bigstone Bay area, which adjoins the map-sheet on the east, Suffel[2] has mapped similar bands of diorite, which are regarded as intrusive. At the Wendigo mine they are sill-like in character.[3]

Timiskaming Series

A band of sediments, which lies stratigraphically above the Keewatin complex, runs in an east-west direction across the south side of Clearwater and White Partridge bays. On White Partridge bay this belt is broken into two parts: One branch continues eastward to the end of the bay; the other runs northeast to

[1]A. L. Parsons, op. cit., p. 225.

[2]G. G. Suffel, "Geology of the Bigstone Bay Area, Lake of the Woods," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, p. 65.

[3]Jas. E. Thomson, Ont. Dept. Mines, Vol. XLIV, pt. 4, 1935, p. 36.

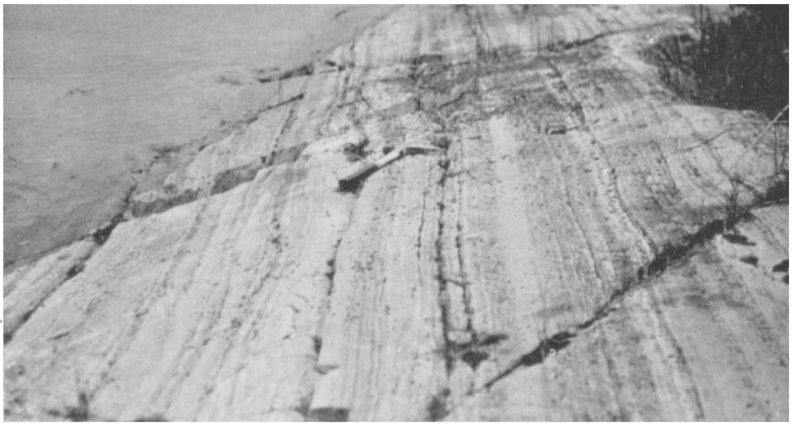
Abernethy lake. These sediments consist of conglomerate, arkose, greywacké, slate, and quartzite. No pyroclastics or lavas occur within the boundaries of the sedimentary series. Bedding is generally well preserved, especially in the finer-grained clastics, but some of the arkose is very massive and shows no evidence of sorting over considerable distances. The beds range in thickness from a fraction of an inch to over 2 feet. In many places they show a gradation from relatively coarse-grained sandy material at the base to very fine grained slate at the top. Fine exposures showing this kind of sedimentation may be seen on island P. 105 and in outcrops near the entrance to White Partridge bay. At one or two places in this vicinity wave ripple marks are rather well preserved in bedded greywacké. On the south side of island P. 105 the fine-grained clastics grade into tiny bands of iron formation.

Timiskaming conglomerate showing rounded granite boulders, north shore of White Partridge bay.

Conglomerate is not widely distributed throughout the sedimentary series. The best exposures are found on the north side of White Partridge bay about a mile east of the entrance, and also about a mile northeast of this point. The conglomerate consists largely of pebbles ranging in size from quite small ones up to 8 inches in diameter. They are well rounded and lodged in an arkose or greywacké matrix. Sometimes thin bands or lenses of conglomerate alternate with thicker arkosic strata. In some instances such arkose shows a rude cross-bedded structure. A composite estimate of different kinds of pebbles in the conglomerate, made from several exposures, shows the proportion to be about as follows: granite and porphyry, 45 per cent.; basalt and dioritic greenstone, 25 per cent.; rhyolite, 20 per cent.; vein quartz (?), 5 per cent.; cherty iron formation, 5 per cent.

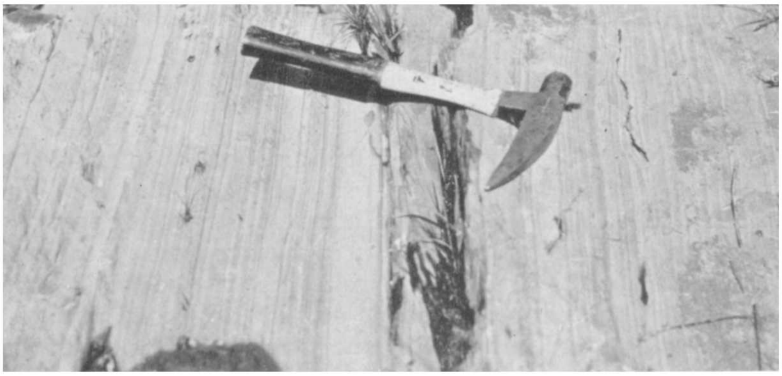
A poorly developed basal conglomerate occurs in contact with basic lava on the northwest corner of the large island north of Corkscrew island. The greater part of the conglomerate, however, either lies stratigraphically some distance above the base of the sedimentary series or else has been thrust up to the present erosion surface by minor folds, thus exposing the basal horizons.

Arkose is a rather common phase of the finer-grained clastics. Where typically developed, it is a massive, cream-coloured rock containing angular quartz and feldspar grains up to a tenth of an inch in diameter. In hand samples it is not unlike the intrusive quartz porphyry in appearance. Under the microscope, however, the sedimentary nature is definitely determined; angular frag-



Bedded greywacké of the Timiskaming series, south shore of White Partridge bay.

ments of quartz and feldspar crystals occur in a fine-grained groundmass. The grains have been water-sorted and are of uniform size. The name greywacké is applied with rather loose significance to those fine-grained, thin-bedded clastics that are partly slate and partly quartzite or arkose and may often be seen to grade from one into the other. In some parts of the sedimentary series bands of dark-grey or black, thin-bedded slates occur. These are metamorphosed clays.



Bedded slates of the Timiskaming series, south shore of Clearwater bay.

Algoman(?)

Granites and Gneisses

The granitic rocks in the area occur (1) as the border phases of large granite batholiths lying north and south of the greenstone belt on the Lake of the Woods, and (2) as small intrusive stocks within the boundaries of the older lava-sedimentary complex. So far as could be determined, these rocks were intruded during one period of plutonic invasion, although there is a considerable variation in texture, composition, and colour, and gradations from one type to another.

The granite may be generally described as a medium- to coarse-grained rock, pink to grey in colour. It is mostly massive, but gneissic phases occur, especially near the main granite-greenstone contacts. The ratio of hornblende to biotite varies with the locality, the hornblende variety being more abundant near the greenstone contacts.

Contact conditions between the granite and greenstone vary somewhat in different localities. North of the Trans-Canada highway the granite-greenstone contact is quite sharply defined. In contrast to this the contact in places along the north side of Aulneau peninsula is of the gradational type. The greenstones near the contact are highly sheared to chlorite and mica schists and injected by granite dikes in a *lit par lit* fashion. In the transition zone the number of these granite dikes gradually increases until the rock is predominantly granite with occasional xenoliths of mica schist. This is not always the case, for on the east side of Beaver inlet the contact is quite sharply defined.

The numerous small stocks all contain very massive, fresh-looking granite, sometimes quite quartzose. Often small quartz veins and lenticular quartz masses occur in this granite. The contacts between these stocks and the greenstones is always very sharply defined. The granite stock south of Quandary bay contains a more basic marginal phase, which has the composition of granodiorite.

The age of the granite and associated porphyries cannot be very definitely stated. No granite or porphyry dikes were found to intersect the Timiskaming sediments, but a lamprophyre dike cuts them on a small island immediately west of the large western peninsula of Rat Portage Indian Reserve No. 38A. As shown below, the lamprophyre and porphyries are intimately related and of the same general age as the granite. This would indicate a post-Timiskaming age for the granitic intrusives. Lawson differentiated the large granitic areas bordering the greenstone belt, which he thought were granitoid gneisses of Laurentian age, from the small stocks of massive granite. He states that the granite is later in age than the granitoid gneiss, which he correlated with the Laurentian period.[1] However, as stated above, the writer can find no reason for any such distinction and considers that any differences in the nature of the granitic rocks may be due to either differentiation within the granitic magma or the assimilation of basic lavas near the contact with these older rocks. At present there does not seem to be a great deal of evidence that the Laurentian granite is exposed to any extent in the western part of Ontario, and for this reason the writer would be inclined to regard the granitic rocks as very largely, possibly entirely, of Algoman age. There is no doubt that a pre-Timiskaming granite did exist somewhere in the Lake of the Woods region, but where it is now or how it disappeared is still somewhat of a mystery.

Porphyries and Related Intrusives

This group consists of the porphyries, aplite, and lamprophyre. The association, composition, and geological relationships of these rocks shows that they are very closely related to the granites and probably derived from the same parent magma. Porphyritic or aplitic phases may occasionally be found in the granite or vice versa.

A large percentage of the porphyry occurs as dikes or sills. These range from dikes a few inches in diameter to sill-like masses, the largest of which is a

[1] A. C. Lawson, op. cit., p. 100.

quarter of a mile in width and over 2 miles in length. They have been largely injected parallel to or nearly parallel to the strike of the schistosity of the adjacent rocks. The porphyries are typically dark-grey to cream coloured rocks, generally massive but sometimes schistose, and distinguished by the presence of distinct "eyes" of quartz, feldspar, or both minerals. Syenite (feldspar) porphyry differs from the quartzose variety only in the occurrence of feldspar phenocrysts instead of quartz. The majority of the porphyry bodies contain both quartz and feldspar phenocrysts and are thus quartz-feldspar porphyries. The aplite is a dense, fine-grained intrusive and is a finely crystalline equivalent of the granite. Aplite dikes frequently intersect the granite. On the west side of Ash bay there is a band of fine-grained aplitic intrusive rock. This is similar to the rock which Lawson[1] and Greer[2] have named felsite in the adjacent Shoal Lake area.

At a few places the porphyry grades laterally into a non-porphyritic rock of rhyolitic appearance. This condition is well shown in island D. 167, located a half mile northwest of Aylmer point on Thompson island. On the west side of this small island there is a massive syenite porphyry with distinct porphyritic texture. This grades into massive rhyolitic rock on the east side. On the mainland a short distance southwest along the strike the same porphyritic phase distinctly intrudes the greenstones. On island No. 1,144, north of D. 167, the same gradation of porphyry into a rhyolitic phase may be seen.

Some of the porphyry dikes contain a large amount of quartz. This occurs as a stockwork of small veins and stringers, which run in all directions throughout the dike. The pattern formed by the quartz suggests that it occupies tension cracks which were developed by shrinkage of the dike on cooling from a molten condition. Such dikes are generally mineralized with small amounts of disseminated sulphides and are known to contain gold values in a few places.

Lamprophyre dikes are occasionally found. They intrude the Keewatin and Timiskaming rocks and appear to be about the same age as the porphyry. A splendid exposure on the southwest side of island D. 208 (southeast of Crow Rock island) shows the typical relationship of these rocks. Here five successive dikes have been injected into rhyolite tuff. These are alternately syenite porphyry and basic lamprophyre. Although all these dikes run in a parallel direction and are continuously in contact with one another there is no sign of one type cutting the other. The two kinds of rock are distinctly different in appearance, and the contact between them is sharply defined. This same intimate association may be seen in other places and shows the contemporaneity of age between the porphyry and lamprophyre.

The lamprophyre dikes are generally less than ten feet in width. The rock is dark-coloured and medium- to fine-grained, and often contains much mica, usually biotite.

Keweenawan

A few large diabase dikes run in a general northwest-southeast direction across the area, and are presumably part of the Keweenawan basic intrusives so commonly found in the Lake Superior region. Some of the dikes are very persistent and have been traced great distances along the strike. They intersect all other formations in the country. The rock is a quartz diabase, and quartz, orthoclase, labradorite, augite, hornblende, and titanite are the constituent minerals revealed by the microscope. Some of the dikes attain a width of 300 feet.

[1]A. C. Lawson, op. cit., pp. 90-101.
[2]Leonard Greer, op. cit., p. 49.

The diabase in the interior of these large dikes is very coarse grained and roughly banded parallel to the contact. The diabase has been discussed in detail by Parsons.[1]

Pleistocene and Recent

The most extensive drift-covered section of the area is on the Northern peninsula and part of Corkscrew island. Throughout the remainder of the area rock outcrops are abundant, although overburden lies everywhere in the depressions. Morainal deposits of boulders and clay are occasionally seen. A mile and a half west of Beaver inlet there is an east-west trending gravel and sand ridge that is either a kame or an outwash deposit.

A small amount of conglomerate occurs on the south shore of the long peninsula directly north of Victoria island in Ptarmigan bay. The conglomerate lies unconformably on pre-Cambrian rocks and consists of an assortment of water-worn pebbles, including granite, porphyry, and slate. The pebbles are cemented in a limonitic sandy matrix. On the property of Brae-Breest Gold Mines, trenching through overburden about a claim length to the west of the camp has exposed an interesting geological section. A 4-foot deposit of reddish-brown conglomerate lies unconformably on the pre-Cambrian rocks. This contains pebbles of granite, greenstone, and chert, and is well cemented by ferruginous material. A 6-foot section of bedded glacial sand and silt lies on this conglomerate with apparent conformity. The contact between the two sedimentary types is sharply defined.

There are two possible explanations for the occurrence of this conglomerate. It may be glacial gravel cemented by circulating iron-bearing solutions. On the other hand it may be a preserved remnant of some earlier geological period. Isolated patches of Cretaceous conglomerate in the Mesabi district of Minnesota[2] have a similar appearance. It is not known that the Cretaceous seas advanced over the Lake of the Woods district, but it seems possible that they did so. The eastern boundary of the Cretaceous sediments now lies about 150 miles to the west in Manitoba.

The glacial phenomena on the Lake of the Woods have been discussed in great detail by Lawson.[3] Everywhere throughout the country there is evidence of the polishing and grooving effects of the ice passage. The direction of ice movement, as indicated by glacial striae, ranges between S. 27° W. to S. 65° W.

STRUCTURAL GEOLOGY

A certain amount of information regarding the structural features in the map area has been obtained in those parts where the primary structures, such as bedding, pillow structures, etc., are well preserved. Any attempt, however, to trace the continuity of these structures over wide areas is hindered by the large expanses of water and, to a lesser extent, of overburden. A further impediment lies in the fact that the rocks over considerable areas are schistose, and the primary structures by which the attitude of the formations might be determined have been destroyed. Accordingly, while there are areas where the structure may be interpreted with a fair degree of accuracy, the determination of the relationship of these to the intervening areas where no reliable information can be obtained is accompanied by a certain amount of conjecture.

In general, the rocks of the Keewatin and Timiskaming series have been so closely folded into anticlines and synclines that individual lava flows or beds now

[1]A. L. Parsons, op. cit., pp. 222-225.
[2]C. R. Van Hise and C. K. Leith, U.S. Geol. Surv., Mon. 52, 1911, pp. 178, 179.
[3]A. C. Lawson, op. cit., pp. 130-140.

have a vertical or nearly vertical dip and in some cases have been overturned. Thus, a measure of the dip of an individual flow or bed has no significance as to its location on a fold. The general strike of the axes of the folds over a large part of the area would average about N. 80° E; this swings more towards the northeast in the southwestern corner of the map-sheet. Flow contacts, sedimentary strata, and the schistosity consequently have the same general strike, except where distorted by some local influence. The tops of the strata may be determined by (1) gradation in grain size across individual beds, (2) the relation of secondary cleavage to the bedding, (3) cross-bedding, and (4) on rare occasions, wave ripple marks. In the lavas the top of an individual flow may be recognized by the shape and position of the pillow structures, as previously described. A certain amount of discretion must be exercised in the use of these data, for, unless they are fairly well preserved and well exposed, erroneous deductions may easily be made. The most satisfactory results are obtained in those areas where these criteria may be compared with one another. For example, in areas of interbanded lavas and sediments the pillow structures in the lava may be checked against gradation in grain size or cross-bedding in the sediments.

Folding of the Keewatin Series

The most convenient method of discussing the folding of the Keewatin rocks and their relation to the Timiskaming series is by reference to a section across the map area along a line where the rocks are typically developed. All the reliable determinations of flow tops and tops of beds that were made are shown on the accompanying geological map (No. 45b). The interpretation of the structure along the section A-B is based on this information.

North of Clearwater bay no determinations of the attitude of the flows or pyroclastics were obtained, owing to the alteration of the lavas near the granite contact and the absence of stratified horizons in the agglomerate band. However, the structure across the Timiskaming sediments, discussed below, is synclinal, the axis of the folds striking about N. 85° E. near the section line. Between these sediments and the north side of Corkscrew island the lava flows west of the line of section face north. No further information about the attitude of the flows is obtained until the south side of Ptarmigan bay is reached, although on Victoria island to the west the flows face north. At three points on the south shore of Ptarmigan bay the flows and tuffs face north. North of Luella island one point shows the tops facing south. Three miles south of Ptarmigan bay, an anticlinal axis, trending about N. 80° E., which extends across the middle of Mather, Shammis, and Crow Rock islands, and the Western peninsula, would intersect the line of section. Along the north side of these islands the members of the Keewatin formation face north, whereas south of the anticlinal axis the tops are south wherever determined.

Thus at various intervals from the Crow Rock anticlinal axis north to the synclinal axis of the Timiskaming sediments on Clearwater bay the members of the series are found generally facing in the same direction. It is possible that this is a continuous succession of lavas and pyroclastics on the north limb of the Crow Rock island anticline with minor folds superimposed on it, accounting for the occasional top facing south. At two points north of island G. 772 (south of the Northern peninsula) poorly developed pillows suggested south-facing tops, but the evidence was discarded as unreliable. Since the flows and sediments stand almost vertically, the Keewatin series would have an apparent thickness of 7 miles along this line of section if the effects of possible faulting, minor folds, and pre-Timiskaming erosion were disregarded. There is the possibility, however, that faulting parallel to the strike of the folds may have effected the apparent thickness of the series. Intense east-west shearing along the south side of Fox island and points to the west show the probability of faulting along Ptarmigan bay. Similar shearing at other places across the section, e.g. the north shore of Nancy lake, may also be due to faulting.

South of the Crow Rock anticlinal axis a number of determinations on both sides of the line of section show the tops to face south until Quandary bay is reached. Somewhere between Quandary bay and the southern part of Kennedy island there is another synclinal axis. From Kennedy island to the southern granite contact the few observations obtained show that the lavas and sediments face north. Similar determinations in the southeastern part of the map-sheet indicate that the east-west trending Quandary bay synclinal axis passes somewhere in the vicinity of island D. 27 or Crescent island. West of Quandary bay this same synclinal axis exists but is not very closely defined; it must be somewhere between Bishop point and Lily island. The meagre evidence available from a few locations near the line of section suggests that the axial plane of this syncline dips about 70° to 80° S. and that the flows and sediments on the south limb are overturned to this extent.

The thickness of the Keewatin series between the Crow Rock island anticline and the Quandary bay syncline would be between 5 and 6 miles, if it is assumed no complications exist other than simple folding. The estimate on the southern limb is probably more accurate than on the northern one because there is no concrete evidence of fault movements or minor folds along the line of section. The above estimate would include the Queen island sediments, which have a maximum width of half a mile. The tops of the beds face south across this whole band of sediments and it is only a horizon in the Keewatin complex.

It is interesting to compare the above structural evidence with that obtained by Greer[1] in the adjoining Shoal Lake area. A synclinal axis was found to pass through the northern part of Shoal lake in Indian bay. To the south of this an anticlinal axis lies about a mile north of Galt island. If the Crow Rock anticlinal axis on the Lake of the Woods were projected westward at an angle of W. 10° S., which is its general strike, it would coincide almost exactly with the Shoal lake anticlinal axis. Greer considers that the Keewatin series on the northern limb of this anticlinal axis is about 5½ miles in thickness, if faulting and drag-folding are disregarded. Insufficient data were secured on the south side of Shoal lake to work out the structure, but near Picture Rock point Greer found the lava flows faced south. This agrees with the evidence near Bishop point on the Lake of the Woods.

The above information suggests that two major synclines with an intervening anticline trend in a general east-west direction across the central part of the Lake of the Woods and Shoal lake. It must be remembered, however, that no structural information has been obtained over considerable areas in certain parts of the country, and further detailed examination may modify this conception. There is every reason to believe that this simple picture has been complicated by faulting and superimposed minor structures. The branching of the Timiskaming series on White Partridge bay implies a split in the synclinal axis in that vicinity and the presence of an intervening anticline in the Keewatin series. However, no structural details about the Keewatin rocks were obtained other than the line of contact with the adjacent sedimentary belt.

The three above-mentioned estimates of the apparent thickness of the Keewatin series in different parts of the Lake of the Woods region by Greer and

[1]Leonard Greer, op. cit., p. 52.

the writer range from 5 to 7 miles. These make no allowance for the effect of probable thickening of the section by faulting and minor folds or thinning by erosion before the deposition of the Timiskaming rocks. Greer[1] supposes that the true thickness of the Keewatin rocks in the northern part of Shoal lake may be at least 4 or 5 miles. A similar estimate might be made for the true thickness of the adjacent sections in the north central part of the Lake of the Woods, but it can have only a very general significance for the reason that there must have been considerable variation in the original thickness of the lavas, sediments, and pyroclastics that make up the series. Lawson has elaborated on this point regarding the stratigraphy of the Keewatin series as follows:[2]—

> The conception of the series as a mixture of altered volcanic *ejectamenta* and aqueous sediments, laid down sometimes synchronously, and sometimes in alternations, implies the accumulation of overlapping and interchanging strata, differing in lithological character, some of which might be largely developed in one portion of the basin, and be very meagrely represented or altogether wanting in another at no great distance away.

Although the value of the above estimate of the thickness of the Keewatin series is weakened because of the lack of detailed data, it nevertheless gives some conception of the enormous thickness of lavas and pyroclastics that piled up during Keewatin time.

Folding of the Timiskaming Series

The sedimentary rocks on Clearwater and White Partridge bays are folded into two synclines with an intervening anticline. Excellent exposures in the vicinity of the line of section A-B offer structural criteria that prove the above statement. Along the north side of island P. 105 in Clearwater bay, gradation in grain size shows that the beds face south, while on the southern side of the island the beds face north. This narrow, closely folded syncline is overturned so that its axial plane dips to the north at an angle of 70 to 80 degrees. A narrow band of sediments is found at a few places west of island P. 105 for about 2 miles along the strike and is probably an extension of this syncline. East of island P. 105 this synclinal axis probably extends along the northern branch of the sedimentary belt that runs northeast to Rock lake.

On the shore of the large island south of P. 105 the beds face south, but near the southern contact with the lavas several determinations on the north shore of the long bay west of the narrow isthmus showed that the beds face north. Here again is a syncline. The synclinal axis in all probability extends eastward along the belt of sediments on the south side of White Partridge bay.

Evidence of Unconformity

The structural features show that the Timiskaming series lies stratigraphically above the Keewatin complex. On the south side of the main synclinal axis both lava flows and strata face north. Near the western nose of this syncline one point in the lavas near the contact on the north limb showed the top to face south in harmony with the attitude of the sediments in that vicinity. The nature of the sediments is strongly suggestive of an unconformity between the Timiskaming and Keewatin series. As previously stated, the conglomerate contains rounded boulders of greenstone, rhyolite, and iron formation that undoubtedly have been derived from the erosion of the Keewatin series. The type of sedimentation in the Timiskaming rocks suggests that the strata are of terrestial

[1]Leonard Greer, op. cit., p. 52.
[2]A. C. Lawson, op. cit., p. 101.

origin and were laid down in shallow lakes or seas. The conglomerate was probably derived from a country of pronounced relief and the boulders transported by streams, thus producing rapid erosion and deposition.

No evidence of a structural unconformity was obtained from any point at the immediate contact between these formations. An unconformity, however, is suggested from structural data not far from the contact. The best evidence is found near the east end of the lake immediately south of Abernethy lake. Six hundred to seven hundred feet from the contact the bedding in a narrow cherty horizon in the tuff and agglomerate strikes N. 75° E. Five hundred feet north of this point a slaty horizon in the pyroclastics strikes N. 65° E. The sediments on the lake near the contact strike N. 35° E. Here is an angular discordance in strike of 30 to 40 degrees between the Keewatin and Timiskaming series. Due to lack of good exposures this was not checked at any other place along the contact.

It might be noted that on island D. 183 (northwest of Corkscrew island) and points eastward, the strike of the lava flows is N. 72°-75° E. About a mile east across the lake along the strike of the flows the sediments have a general east-west strike. There is thus some suggestion of an angular discordance, but considering the distance by which these structural features are separated, it cannot be regarded as very reliable evidence.

Faulting

Reference has already been made to the strong sheared zones that strike parallel to the axes of folding. These are probably lines of faulting movements along which the stresses that caused the folding were relieved to some extent. The sediments on Queen island have been offset a small amount by cross-faults. The bedding is distorted and locally drag-folded in the vicinity of the faults, especially near the western one. There is some suggestion that the diabase dikes have been offset by faulting movements at certain points.

Fracturing and Shearing

In a general way, the rocks in the area have yielded to deforming stresses in two different ways depending upon the original nature of the rock. The hard competent rocks, such as cherty rhyolites, intrusive porphyry and granite in the form of dikes or small stocks, and arkosic or quartzitic sediments, have yielded by brecciation or fracturing. On the other hand, the basic lavas, slates, agglomerates, and basic tuffs have sheared to form micaceous schists. Thus, a system of fractures is sometimes found in porphyry dikes, and the fractures are filled with quartz veins or veinlets. Similarly, veins, lenses, or stockworks of quartz are found along fractured zones in small stocks of granite. Fracturing was also observed in arkose and rhyolite. The shearing movements in the softer rocks have not been distributed uniformly but rather concentrated along or near local lines of weakness, while intervening rocks are more massive.

It is interesting to note the amount of granite and porphyry intrusion along the anticlinal axis that runs in an east-west direction across Crow Rock, Shammis, and Mather islands. This anticlinal axis must have constituted a particular line of weakness.

HISTORICAL GEOLOGY

The geological history of the area, covering untold millions of years, may be briefly summarized. The earliest known period (Keewatin) was a time of great volcanic activity. Lava flows were poured out through vents or fissures. At various intervals the vulcanism was featured by violent explosions that hurled forth rock fragments and great quantities of volcanic ash along with the molten lava. During certain quiescent periods erosional agencies carried some of the material into local bodies of water. The sand, mud, iron oxide, and possibly even primitive forms of life in these shallow basins were eventually consolidated into strata and covered by more volcanic material. Towards the close of the period granitic intrusion must have taken place somewhere, probably coincident with a limited amount of rock-folding and mountain-building. A period of erosion followed during which the rugged mountains were worn down, granites were exposed and eroded, and this rock material was deposited locally in lakes or seas as gravel, sand, and mud. These eventually consolidated to form the Timiskaming sediments.

Great mountain-building movements again affected the region. The Keewatin and Timiskaming rocks were thrown into close folds, and in some places the pressures that produced the folding were relieved in part by faulting. Contemporaneous with or following the folding came the intrusion of an enormous amount of granite (Algoman). Some of this worked up through the older rocks and is found to-day in bodies of various shapes known as stocks, batholiths, and dikes. Offshoots from the granite mass formed the porphyry bodies. It is thought that the gold-bearing veins were formed at a very late stage in this period of granitic intrusion. During a later period of disturbance (Keweenawan), which affected the whole Lake Superior country, the diabase dikes were intruded into all the older rocks.

A great erosion interval followed the Timiskaming-Algoman period of mountain-building. This exposed a large part of the granitic core of the ancient mountains and removed much of the Keewatin greenstones and Timiskaming sediments throughout northwestern Ontario. The net result is that these greenstones and sediments are now preserved only in the deepest parts of the ancient folds, and widespread areas of granite occupy the intervening country. This means that quartz veins and intrusive rocks now exposed were originally formed at great depths below the surface.

Within comparatively recent geological time (Pleistocene), the continental ice-sheet advanced over the country, scouring and polishing the weathered rock surfaces. The thin mantle of sand, gravel, and clay that overlies the bed rock, and the imperfect drainage system of the country, are all the result of this glaciation.

ECONOMIC GEOLOGY

Nature of the Gold Deposits

The only mineral resources within the map area that are of economic interest are the gold deposits. Gold is found at a number of locations in different parts of the area, but at only a very few places is it known at present that there is sufficient continuity in size and grade to constitute some promise of an ore body. Gold generally occurs in quartz veins. These veins have been found in greenstone, rhyolite, agglomerate and tuff, granite and porphyry. The veins in the lavas and pyroclastics occupy sheared zones or fractures; they are sometimes lenticular in outline, sometimes branch in the form of a lode or composite vein, or may occupy a single fissure and have well-defined walls. The veins within small stocks of granite or porphyry may form a stockwork of quartz in irregularly located fractures (e.g. the Gold Mountain mine and possibly the Norah mine) or may be "true fissure" veins. Quartz veins in porphyry dikes are inclined to be irregular in shape, size, and distribution. Sometimes a porphyry dike containing a network of quartz veinlets and having disseminated sulphide mineralization may be traced for a considerable distance.

The auriferous veins may contain tourmaline and carbonate and varying amounts of such sulphides as pyrite, chalcopyrite, galena, and arsenopyrite, and also native gold. Different generations of quartz occur at the Kenricia mine.

Most of the known gold occurrences in the area are found either in or near dikes or small stocks of porphyry or granite, and there is reason to believe that the gold deposits are genetically related to these intrusives. The quartz veins are later in age than the granite and porphyry; the gold mineralization, in some cases at least, is later than part of the quartz. It is, therefore, evident that the gold-bearing solutions must have been one of the last differentiates from the granitic parent magma.

Prospecting Conditions

In estimating the mineral possibilities of an older mining district such as the Lake of the Woods, there is always a tendency to consider that it was pretty thoroughly prospected during previous periods of mining activity. While it is undoubtedly true that there has been sporadic prospecting in this country over a long period of years, yet the very fact that a property is as readily accessible as the Kenricia mine was dormant from 1890 until 1935 shows that the country still deserves detailed examination by prospectors and field engineers.

Throughout the Lake of the Woods region the majority of the gold deposits are found in the greenstone complex at or near its contact with bodies of granite and porphyry intrusives, especially where the rocks are fractured, sheared, or otherwise ruptured to serve as a source of access for the mineralizing solutions. Dikes and small stocks of these intrusives occur in several parts of the north central part of the Lake of the Woods; in many places the rocks have undergone considerable deformation, as described in a previous section of this report. With these geological conditions, the area may be regarded as containing favourable prospecting territory.

Quartz veins occur in many parts of the area, but a greater number than usual were noted in the following localities: (1) the southern part of the Western peninsula, (2) the burnt-over country northeast of Portage de Bois (near porphyry intrusives), (3) near bodies of porphyry in the vicinity of Bath and Gull islands (north of Cliff island), (4) along a zone of porphyry and granite intrusives on Crow Rock, Shammis, and Mather islands.

Mineralized porphyry dikes that contain quartz veinlets are known to carry gold values in at least three places within the area. A number of mineralized dikes were seen in different parts of the area. The dikes generally carry disseminated sulphides including pyrite, chalcopyrite, and arsenopyrite. Although no particular encouragement has been obtained to date from this type of deposit in the Lake of the Woods region, it deserves some attention due to the possibility of finding large tonnages of low-grade ore.

Replacement bodies of massive sulphides occur in a number of places, especially in the northern part of the area. These bodies are generally small and contain such sulphides as pyrite, pyrrhotite, chalcopyrite, and arsenopyrite. A grab sample of massive sulphides from the shore of a bay a mile southwest of island D. 183 gave a trace of gold when assayed. On claim 5 K. at the west end of Rat Portage bay there is an old test pit on a massive sulphide body containing pyrite, pyrrhotite, and arsenopyrite. A grab sample contained neither gold nor nickel. Rusty zones and mineralized quartz stringers occur in the vicinity of the contact between Keewatin fragmentals and Timiskaming sediments southwest of Abernethy lake. On claim T. T. 9 an old shaft was found. The rocks are covered with overburden at the shaft but the material on the dump contains some fine-grained pyrrhotite and arsenopyrite in green schist, also a little sugary quartz with sulphides. A grab sample was assayed but contained no gold.

Mineralized carbonated zones rarely occur within the map area. On two tiny islands within the limits of claim W. A. 16, over a mile west of Corkscrew island, a carbonated zone runs for about 300 feet along the shore. It contains an irregular series of small quartz veins, which are mineralized with arsenopyrite. The schist in the zone contains some apple-green mariposite. A grab sample of mineralized quartz assayed 0.01 ounces gold per ton.

A considerable part of the map area, especially in the northern part, is taken up in patented claims and islands and the Indian reservation. Certain parts of the area, including all the islands in the Lake of the Woods, have been set apart by the Department of Lands and Forests of Ontario for summer resort purposes and are not open for staking except when a valuable mineral discovery is made.[1]

Description of Properties

The mining properties in the area fall into two groups: (1) the old workings on which nothing has been done since they were abandoned many years ago, and (2) older properties that have been examined and developed to some extent within recent years, and recent discoveries. Little information was obtained about some of the members of the first group for the reason that the old shafts are filled with water and timbers; in some cases it is even difficult to locate them. Little attempt was made to open up veins by trenches or test pits in the early days. Early prospecting and development methods on the Lake of the Woods have been discussed elsewhere.[2]

OLDER PROPERTIES

Norah Mine

The main workings of the Norah mine are located on claim J.E.S. 38 between Fox and Nola lakes. In 1900, the property consisted of claims J.E.S. 38, 41, 42, the west half of 39, and J.C. 79 and 80. An old road leads to the workings from a small bay on the south side of the central part of Fox lake.

The timbers obscure any sign of a vein at the old shaft, but 10 feet to the east a white quartz vein about 18 inches wide is revealed. It appears to strike about N. 65° E. The vein lies at or near the contact of intrusive porphyry and basic lava. Porphyry may be seen northwest of the vein and greenstone southeast of it. The rock on the old mine dump has been sorted into two heaps. The rock dump is green basaltic lava, and the ore dump (?) contains quartz and porphyry. The porphyry is fractured and intersected by quartz stringers. It is slightly mineralized with pyrite The quartz is rather white and sugary and contains no sulphides. A little green fuchsite is developed in the porphyry and along fractures in the quartz. The primary quartz has been fractured and recemented by later quartz. There are several tons of quartz and porphyry on this dump. A representative grab sample of this material assayed 0.30 ounces

[1]See The Mining Act, 1935, p. 12, sec. 39c.
[2]W. E. H. Carter, "The Mines of Ontario," Jour. Can. Min. Inst., Vol. 7, 1904, pp. 124-139.
E. L. Bruce, Ont. Dept. Mines, Vol. XXXIV, pt. 6, 1925, pp. 3-21.
Jas. E. Thomson, Trans. Can. Inst. Min. and Met., Oct. 1936, pp. 686-701.

gold per ton. Subsequent sampling by prospectors did not reveal such encouraging gold values.

In 1900, Bow[1] described the underground development as follows:—

On location J.E.S. 38 a shaft with a dip of 79 degrees north has been sunk on the vein to a depth of 120 feet and is being continued. The cross-section at the surface is 4 by 7 feet, and lower down 6 by 10 feet. At a depth of 72 feet the vein appears to split; one branch bending to the north, with a dip of 45 degrees, and the other continuing straight. The north branch was followed for 25 feet by an incline, showing a good hanging wall with selvage. The vein in this incline is well defined. The shaft had subsequently been continued on the other branch, maintaining the same dip as above. The width of the vein underground ranges from 1 to 4 feet. The first level is at a depth of 72 feet; a 4- by 7-foot drift has been driven east 49 feet.

Gold Mountain Mine

Gold Mountain mine on claim K. 4,386 (old location P. 48) is near the south side of the Western peninsula. It was developed by a shaft and some surface trenches. The old workings are on a ridge northeast of Umbel lake. The showing consists of a stockwork of quartz located in a small stock of intrusive syenite porphyry. An irregularly shaped area, striking about N. 70° E., contains a large percentage of quartz. This body is poorly exposed for a length of at least 350 feet and is 30 feet wide in one of the old trenches. The dump at the shaft consists of red porphyry containing variable amounts of quartz in the form of veinlets and stringers, which run in every direction. The quartz is white and of a rather unpromising appearance, but an occasional sample contains pyrite, pyrrhotite, and traces of galena. A representative grab sample of the quartz and porphyry from the dump assayed 0.04 ounces gold per ton. A few feet south of the shaft the rock consists of rhyolite and a narrow band of well-bedded greywacké.

The property was worked in 1895. Blue[2] reported at that time that the quartz had been traced about 1,500 feet across the property and was from 25 to 65 feet in width.

Sentinel Mine

The Sentinel mine was worked in 1898.[3] It consisted of claims W.A. 7, 8, and 9, located on the shore of Labyrinth bay. Two shafts were sunk on claim W.A. 7, one to a depth of 40 feet, the other over 100 feet. A mill test of 60 tons of vein material was made at the Rat Portage Reduction Works in 1898.

Both shafts were located on small amounts of quartz in a stock of massive pink granite. At the deeper shaft a quartz vein, 6 inches wide, may be traced about 20 feet. The quartz is white and sugary in appearance. A grab sample of this material assayed 0.11 ounces gold per ton. Traces of quartz and mineralized granite may be seen on the dump at the other shaft.

Dead Broke Mine

Dead Broke mine was the name applied to some old workings on location 64 P., on an island northwest of Cliff island. A quartz vein, 18 inches wide, may be seen in an old test pit, but is not otherwise exposed. Some of the quartz on the dump is mineralized with pyrite and traces of chalcopyrite and galena. A grab sample of this material contained a trace of gold when assayed. About 100 feet to the south there is a small tunnel on a porphyry dike that intersects the basaltic country rock. The dike is about 6 feet wide and contains quartz masses up to a foot in width. One hundred and thirty feet south of the tunnel there is another parallel porphyry dike.

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[1]Jas. A. Bow, Ont. Dept. Mines, Vol. IX, 1900, p. 60.
[2]A. Blue, Ont. Bur. Mines, Vol. V, 1895, p. 187.
[3]Jas. A. Bow, Ont. Bur. Mines, Vol. VIII, pt. 1, 1899, p. 64.

In 1892, Slaght,[1] the mining inspector, made the following comments on this property:—

The vein has been stripped 50 feet in length and nearly the same in width. An open cut has been made 20 feet in length and 12 feet in width and a few feet in depth, from which about 75 tons of ore have been removed, and showing by frequent assays from $7 to $133 per ton; 25 tons of the ore have been taken to the Reduction Works to obtain a mill run.

The writer did not see the above-mentioned open cut.

Claim S. 70

On the south side of Shammis island on claim S. 70 three old test pits are located on a quartz vein, which has been traced 120 feet. It is about 2 feet wide. The quartz is rather white, but a few samples on the dump at one pit are well mineralized with sulphides. A grab sample of this material did not contain gold when assayed. The vein lies in massive greenstone near porphyry intrusives.

MORE RECENT DEVELOPMENTS

Clearwater Bay Syndicate

Clearwater Bay Syndicate owns 15 claims (K. 4,246 to K. 4,260, inclusive) located on the south side of Clearwater bay. These include some old workings, which were known as the Three Friends mine when originally worked in 1890.

The northern part of this group of claims is underlain by agglomerate and tuff; greenstone lies to the south. These formations are cut by an occasional quartz porphyry dike.

On claims K. 4,248 and K. 4,250, three old shafts and three test-pits are located at intervals for a distance of 550 feet along a zone that strikes N. 65°-70° E. Small lenticular veins of quartz may be seen at each of the old workings; the maximum width of quartz is 2 feet, but none of the lenses can be traced any appreciable distance. The quartz is generally white but occasionally has a bluish shade and may contain a little tourmaline and carbonate with the slightest trace of pyrite and arsenopyrite.

Near the boundary between K. 4,260 and K. 4,259 (A.L. 38) there are some old workings at the lake shore. Some quartz with pyrite, arsenopyrite, and traces of chalcopyrite lie on the dump beside an old test pit in which very little vein material may be seen. A grab sample of the mineralized quartz contained 0.01 ounces gold per ton. A short tunnel was driven from the lake shore towards the pit to intersect this material at a lower level, but very little mineralization can be seen in the tunnel.

About 300 feet west of the above point, old trenches reveal a similar type of quartz in what appears to be a number of small discontinuous veins, scarcely ever more than a foot wide. A grab sample of the mineralized quartz contained a trace of gold.

On a small island at the entrance to a marshy bay near the south boundary of K. 4,246, quartz float and a small vein are exposed at the water's edge. The quartz is well mineralized with arsenopyrite, galena, and a little sphalerite. A grab sample of this assayed 0.02 ounces gold per ton. Samples taken from here by prospectors have shown about the same value.

Lake Hill Gold Mines, Limited

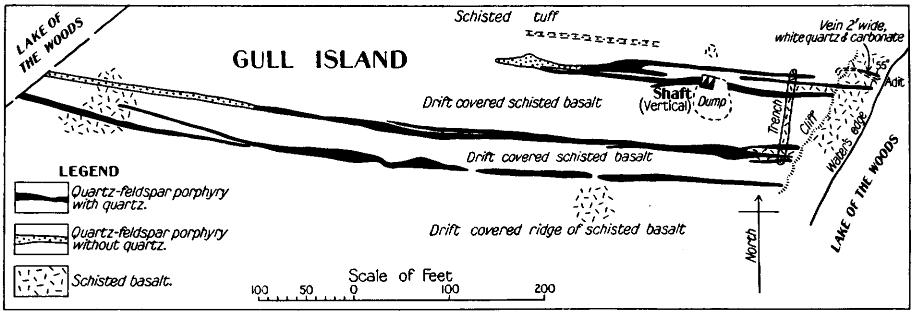
Lake Hill Gold Mines, Limited, was organized in 1934 to develop a group of 7 claims on Gull island. These include the old Ambrose mine, which was worked

[1] A Slaght, Ont. Bur. Mines, Vol. II, 1892, p. 232.

in 1898.[1] Old workings consist of a small shaft and an adit at the lake shore. Recent development work has been devoted to surface trenching and examination of old workings. The property has been sampled by engineers representing several different mining organizations.

The country rock in the vicinity of the showings is schisted basalt and tuff. This is intruded by a number of parallel quartz-feldspar porphyry dikes that usually contain a network of veinlets and irregularly shaped masses of quartz. In some places the quartz would constitute about 30 per cent. of the dike. The quartz is massive and almost devoid of sulphides, but some ankerite occurs with it. Gold values are obtained from this material.

A reddish tuff lies north of the workings and somewhat resembles the porphyry in appearance. Occasionally, however, it shows fragments of cherty and rhyolitic material.



Geological sketch map of the showings on the property of Lake Hill Gold Mines, Limited, Gull island.

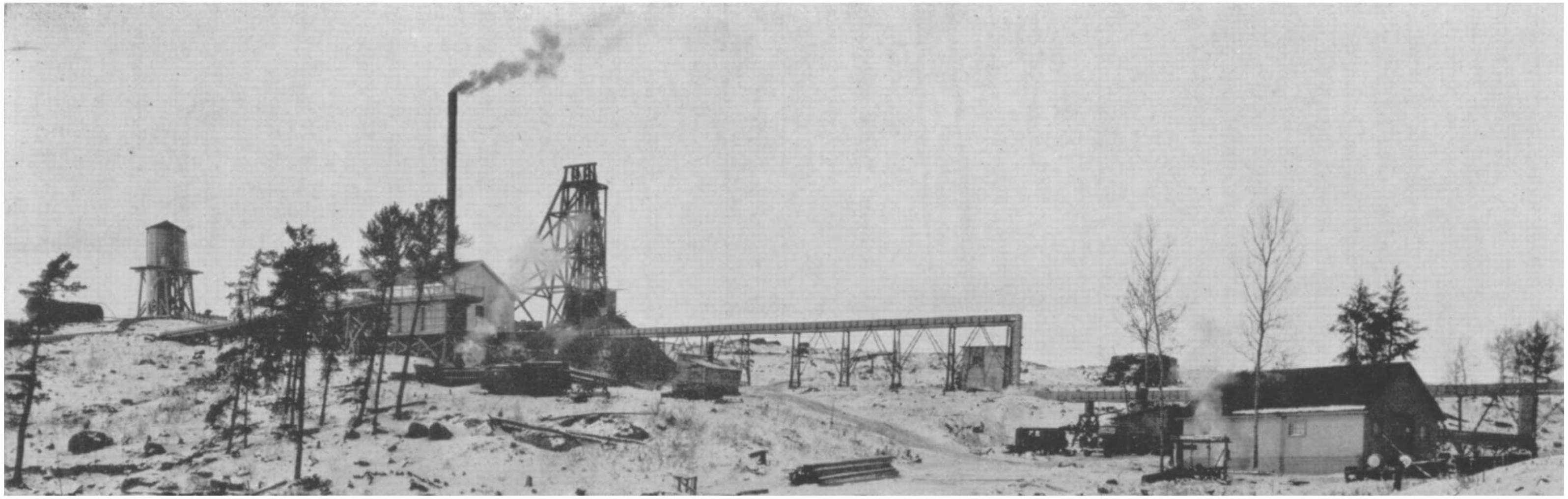
Kenricia Gold Mines, Limited

The main workings of Kenricia Gold Mines, Limited, are on claim P. 211, which is a peninsula located at the northeastern corner of Clearwater bay, about a mile south of the Trans-Canada highway. The company owns a group of 12 unsurveyed claims adjoining P. 211. The property was worked in 1889 and 1890 under the name of the Three Ladies mine,[2] and three small shafts were sunk. During the summer of 1935 it was optioned by Jos. Errington and C. W. Greenland. The showings were developed by surface-trenching and diamond-drilling. This work provided sufficient encouragement for a company, called Kenricia Gold Mines, Limited, to be formed to finance underground development, which commenced in September, 1936.

The country rock on the property is very largely agglomerate. An occasional basaltic lava flow is interbanded with it. The agglomerate has undergone a moderate amount of schisting and is intruded by massive quartz porphyry dikes. In places the porphyry contains quartz veinlets and some pyrite mineralization. This material was found to contain low values in gold.

Veins.—Development work has revealed a number of gold-bearing quartz veins. Veins Nos. 1, 2, 3, and 4 strike in a general east-west direction, which is approximately parallel to the regional schistosity; the dip is almost vertical. By October, 1935, No. 1 vein had been uncovered for a length of 700 feet and traced

[1] Jas. A. Bow, Ont. Dept. Mines, Vol. VII, pt. 1, 1898, p. 39.
[2] A. Blue, Ont. Dept. Mines, Vol. VI, 1896, p. 48.



View of the Kenricia mine, Lake of the Woods.

considerably farther along the strike. It has a maximum width of 6 feet. No. 3 vein has been traced 1,450 feet and opened up for over 950 feet. C. W. Greenland, consulting engineer, reported that sampling had indicated that a section of this vein, 700 feet in length, averaged $20 in gold (at $35 per ounce) across an average width of 30 inches.

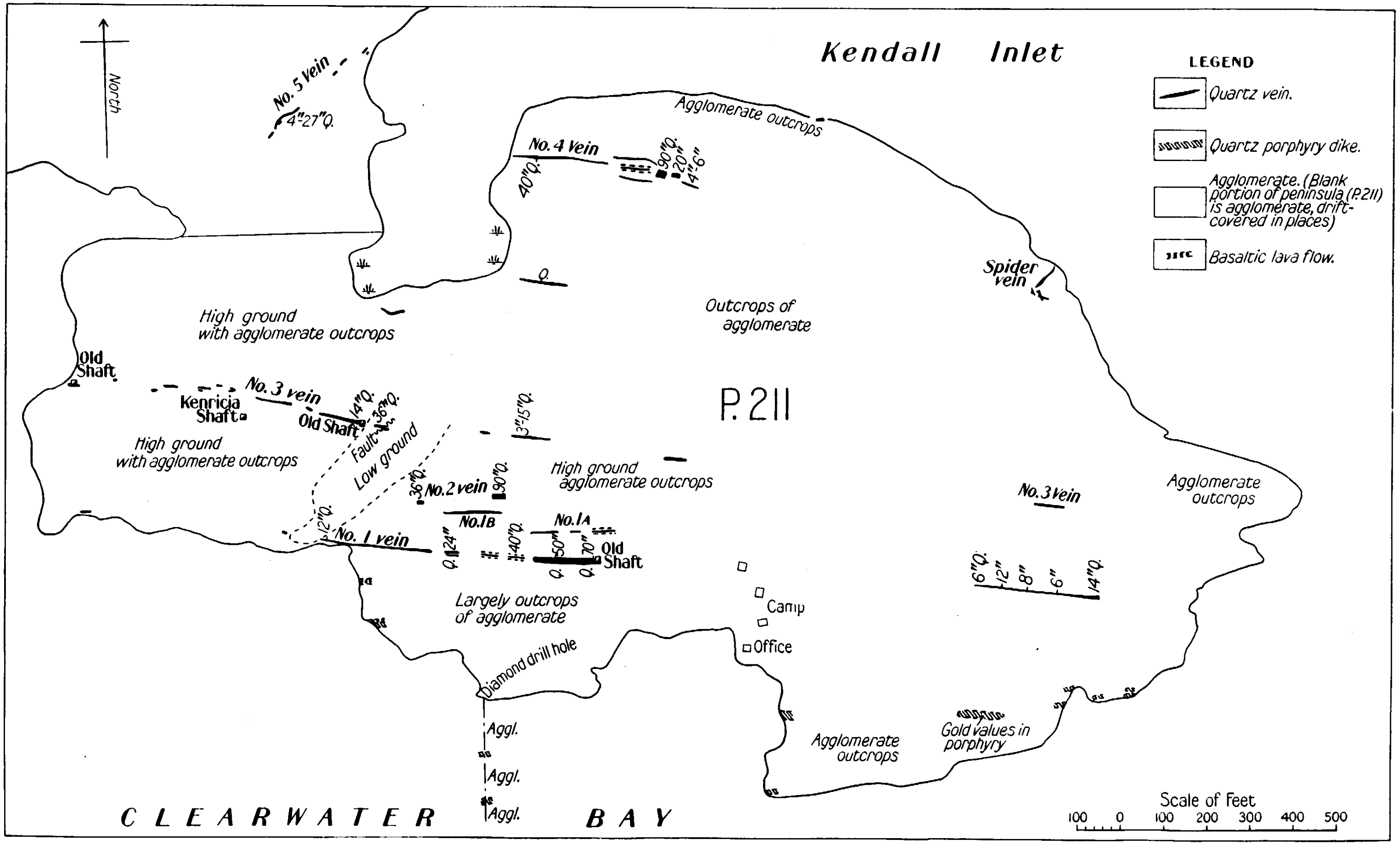
Fifteen diamond-drill holes were put down at intervals over this length, most of them intersecting the vein zone at points 100 feet to 125 feet below the surface, but two of them were below 200 feet. All these gave gold values, with

No. 3 vein, Kenricia Gold Mines.

the average bearing out the surface results. The vein zone was shown by drilling to have a width of from 1.8 to 9.2 feet. Three short veins lie between No. 1 and No. 3, and are roughly parallel to them. Vein No. 1B indicated an ore section 35 feet in length on the surface.

No. 4 vein was opened up over a length of 440 feet and shows a maximum width of 90 inches. At this place, the vein has the form of a stockwork of quartz in brecciated agglomerate and schist and is mineralized with pyrite and chalcopyrite. Some coarse gold was panned from the weathered surface of this vein.

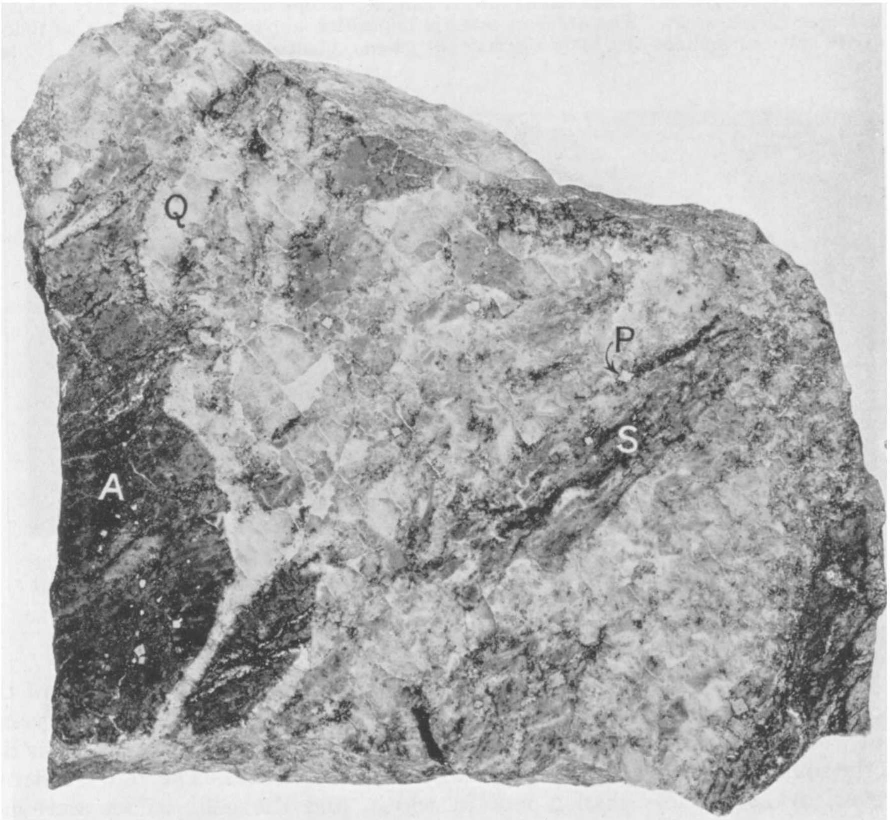
No. 5 vein has been traced 300 feet but is distorted and lenticular, and rolls considerably. It consists of white quartz and tourmaline with spotty sulphide mineralization and carries some gold values.



Geological sketch map of claim P. 211, Kenricia Gold Mines, Limited, Clearwater bay.

The "Spider" vein follows a series of fractures, which run in several directions. It contains reddish vein quartz and tourmaline with varying amounts of chalcopyrite and pyrite; the maximum width of the quartz is 30 inches.

Mineralization.—All the veins on the property consist of quartz, which generally contains some black tourmaline. They are mineralized with pyrite, chalcopyrite, galena, and native gold, which occurs sparingly. Traces of lead telluride (altaite) are found by microscopic examination of the ore. A feature of the veins is the presence of different generations of quartz. In a test pit on



Polished sample (natural size) from No. 4 vein, Kenricia Gold Mines. The vein material is a breccia containing agglomerate (A), schist (S), quartz (Q), and pyrite (P).

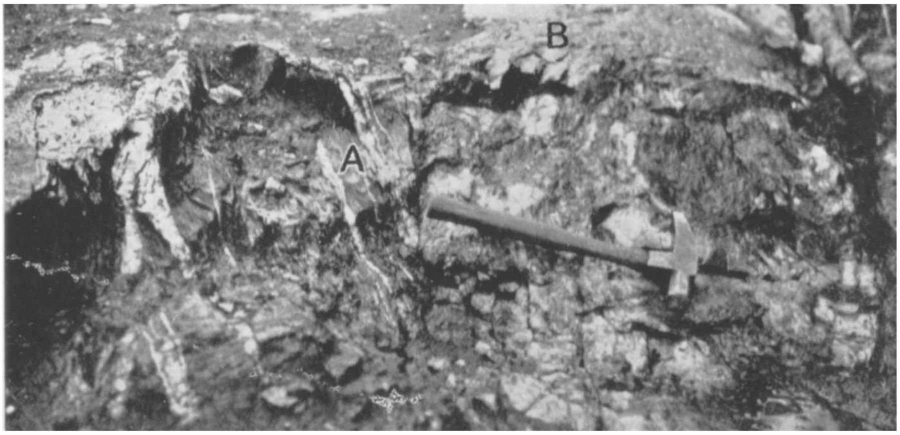
No. 3 vein a series of quartz carbonate veinlets in the wall rock are cut off sharply by the main vein (see photograph on page 36). This later vein consists of sugary quartz of a delicate bluish cast with tourmaline occupying lines of fracture, which run more or less parallel to the wall of the vein, and sulphides, which appear to be concentrated along or near the tourmaline zone. Sampling has indicated that this generation of quartz with associated tourmaline and sulphides carries the best ore values, whereas the older quartz contains only low values.

A later (third) generation of white glassy quartz cuts the sugary quartz-tourmaline-sulphide variety (see photograph on page 37). These two types of quartz were carefully separated in a selected sample and assayed. The sugary quartz-tourmaline vein with sulphides gave 1.46 ounces gold per ton, but the later white quartz gave no values.

There are thus three generations of quartz in the veins. Preliminary development on the property would indicate that the chief gold values are in the intermediate generation of quartz with tourmaline and associated sulphides.

A polished section of the ore from No. 3 vein was examined by Professor J. Ellis Thomson, of the University of Toronto, who reported as follows:—

The chief metallic mineral in this section is pyrite, but it contains also considerable galena as well as minor quantities of gold, chalcopyrite, and altaite. These metallic minerals are associated with a mixed quartz-tourmaline gangue and occur in the following forms: pyrite as isolated crystals or small crystal aggregates scattered through the gangue; galena, chalcopyrite, native gold as short veinlets or tiny blebs in the quartz gangue; altaite as two or three tiny inclusions in the larger galena areas. The order of mineral deposition appears to have been as follows: (1) pyrite and tourmaline; (2) early quartz; (3) galena, chalcopyrite, gold, altaite; (4) later quartz.



Test pit on No. 3 vein, Kenricia Gold Mines, showing two ages of quartz. The older quartz veinlets (A) are cut off sharply by the main quartz vein (B) at the left end of the hammer handle.

Waite Option

J. H. C. Waite optioned a group of claims located immediately west of the Kenricia mine in the spring of 1936. Surface prospecting revealed a few veins, one of which was found to carry gold values over a length of 400 feet. This lies near the southeastern corner of Inglis lake on claim K. 5,849. The vein is narrow, however, averaging less than a foot in width, and the gold values were not encouraging; the option was accordingly dropped.

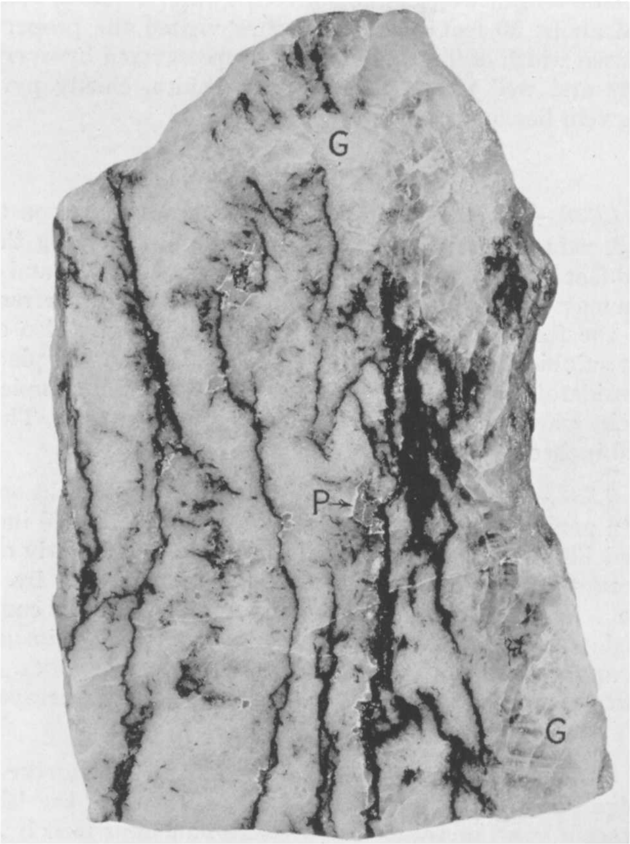
Westricia Gold Mines, Limited

Westricia Gold Mines, Limited, took over a group of claims lying immediately west of the Kenricia mine in the early months of 1937. These include the claims previously dropped by J. H. C. Waite. Surface-trenching and test-pitting was carried on.

Oliver-Severn Gold Mines, Limited

In the autumn of 1935 a group of six claims were staked and three optioned by Oliver-Severn Gold Mines, Limited, on the south side of Kendall inlet, immediately east of the Kenricia mine. This broad peninsula is underlain largely by agglomerate and tuff with some Timiskaming sediments near the corner of the Indian reserve. In April, 1936, W. E. Segsworth, president of the company, stated that surface exploration of the claims, under the direction of C. W. Taylor, had revealed 7 gold-bearing veins, which were stripped and sampled, but preliminary work failed to show that any of these were of sufficient size and grade to make ore; these claims were eventually dropped.

A gold-bearing vein on claim K. 3,963 was traced 50 feet and averages 8 inches in width. It is mineralized with pyrite, traces of chalcopyrite and galena, and probably a little magnetite.



Polished sample (natural size) of gold ore from No. 3 vein, Kenricia Gold Mines. Sugary quartz with black tourmaline and pyrite (P) is cut by a slightly later generation of glassy white quartz (G).

Brae-Breest Gold Mines, Limited

Brae-Breest Gold Mines, Limited, owns a group of claims located north of the east end of White Partridge bay. These were staked by Jack Nutt in 1936. The camp may be reached by a motor road and lies about 6 miles southwest of the town of Kenora.

The main showing was developed by surface-trenching and diamond-drilling during the summer of 1936 under the direction of H. M. Whimpster. It consists of mineralized porphyry, probably flow rhyolite porphyry, which is said to carry gold values at certain places. At the showing the porphyry is interbanded with greenstone, but the disseminated sulphides with which the gold values seem to be associated are largely confined to the porphyry. Mr. Whimpster informed the writer that a channel sample from No. 1 trench assayed $24.60[1] in gold across 17 inches. A long trench, 60 feet southeast of the above, is reported to contain gold values ranging from $1.75 to $3.50[1] per ton over an 80-foot length. These values are from contiguous samples cut in 5-foot sections along the trench. A number of diamond-drill holes were put down in the vicinity of these trenches. The showing is not located on any definite structure; the gold values reported by the company seem to be associated with disseminated sulphides in country rock.

About a claim length west of the above showing, a quartz vein was exposed for a length of about 50 feet when the writer visited the property. It had a maximum exposed width of 9 feet; both ends were covered by overburden. It is a bluish quartz and well mineralized with sulphides, chiefly pyrite and chalcopyrite. The vein lies in a cherty rhyolite.

Other Showings

Claim K. 4,073.—Claim K. 4,073 is located on an island on the north side of Ash bay. A vein has been uncovered in three places along the strike for a distance of 320 feet from the lake shore. It strikes N. 70° W. and dips 60° N.E. The vein lies in massive andesite and consists of quartz, which is fractured parallel to the walls; the fractures are filled with tourmaline. It also contains some carbonate, but sulphides are erratically distributed. In a few places the quartz contains a considerable amount of chalcopyrite. A grab sample of this well-mineralized vein material assayed 0.19 ounces gold per ton. The vein quartz is from 8 to 20 inches in width.

Claim K. 3,888.—Claim K. 3,888 is located between Smiths and Parth lakes on the Western peninsula. A gold-bearing quartz vein, 2 to 8 inches in width, has been traced 130 feet in two sections, one of which is slightly offset from the other. The country rock is agglomerate and is intersected by an occasional porphyry dike. A test pit on the west end of the showing contains massive pyrite and chalcopyrite across a width of one foot. The vein quartz is white and sugary in appearance and contains only a trace of sulphides. A composite sample of quartz chipped from various places along the vein assayed 0.13 ounces gold per ton.

Claim K. 3,645.—Claim K. 3,645 is an island in the northeastern part of White Partridge bay. An old shaft on the north side of the island has been dewatered in recent years and some surface stripping done near by. There is no sign of a vein at the shaft; 20 feet east a quartz vein 4 inches wide is exposed but cannot be traced any distance. A grab sample of the quartz assayed 0.06 ounces gold per ton. West of the shaft a series of white quartz stringers, 18 inches wide, have been traced for a length of 50 feet. The quartz veins lie in massive rhyolite and rhyolitic tuff.

Island No. 616.—Island No. 616, which is sometimes called Little Crow Rock island, lies west of Crow Rock island. A sheared zone, striking about N. 60° E. has been opened up for a distance of 250 feet along the strike. The sheared zone roughly follows the contact between greenstone and tuff and has a maximum width of 8 feet. Rusty carbonated zones and small amounts of massive sulphides occur in the schist. Near the shore small lenses and stringers of quartz are well mineralized with sulphides. A grab sample of this quartz showed no gold content when assayed. Parts of a 2-stamp mill are stored in one of the buildings. It is reported that some gold values can be obtained from the vein.

[1]At $35 an ounce.

PROPERTIES OUTSIDE OF THE MAP AREA

Rush Bay Holding Company, Limited

In 1934 the Rush Bay Holding Company, Limited, acquired a group of 10 claims between Rush bay and Echo bay on the Lake of the Woods. These include the old Golden Horn mine, the main workings of which are located on claim K. 390. This property was first worked in 1901 and operations continued until about 1903. A small amount of ore was milled. It was optioned by the Consolidated Mining and Smelting Company in 1935. The old workings at the Golden Horn mine were dewatered and the vein was sampled, but the option was later dropped.

In the early days a shaft was sunk 255 feet and drifting was done on the 100-, 166-, and 244-foot levels. Some crosscuts were also made. A small amount of stoping was done on the 100- and 166-foot levels. The shaft is located on the hanging wall of the vein and dips about 85° N.

The rocks on claim K. 390 consist of a band of rhyolite flanked on either side by basaltic lava, which has a dioritic texture in places. The rhyolite body is 100 to 175 feet in width and runs in an east-west direction across the claim. The main workings of the Golden Horn mine lie in the rhyolite near the northern contact. A small aplite dike was found on the southern boundary of the claim.

There is no surface exposure of the vein, but it is well defined underground The vein strikes about east-west. It ranges in width from a couple of inches to 3.2 feet, and there are often a number of small quartz stringers running parallel to the main leader. The main vein would average less than a foot in width over the whole of the underground workings. On the 100-foot level the vein is about 190 feet in length. The wall rock is silicified rhyolite with disseminated pyrite.

There are two distinct types of quartz, a blue and a white variety, the latter being by far the commoner. The blue quartz generally occurs near the outer margin of the vein. The vein has a banded appearance in places due to the presence of narrow seams of schist. Sulphide mineralization is scanty and consists largely of pyrite. Some of the blue quartz on the dump contains traces of galena and sphalerite. Sampling of underground workings indicated that the gold values were closely associated with the sulphides in the main vein. It is reported that the wall rock and parallel quartz stringers do not carry gold values.

A few other small, irregular, white quartz veins occur in the vicinity of the main workings. It is reported that sampling of these indicated low gold values at some places.

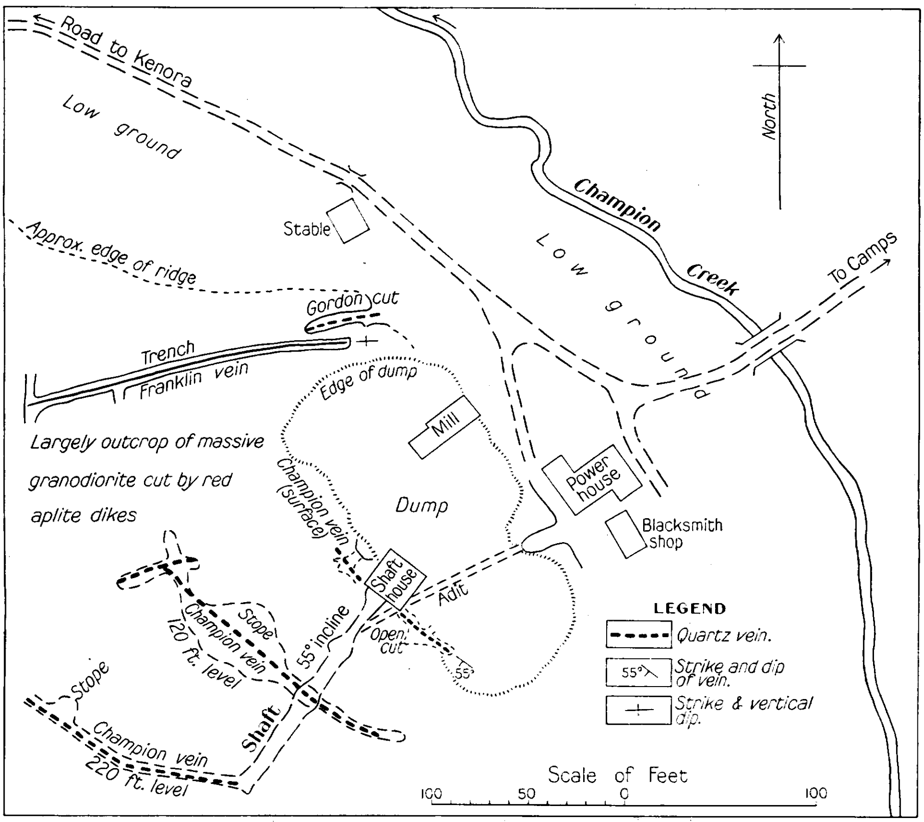
Franklin Gold Mining Company, Limited

The Franklin Gold Mining Company, Limited, was organized in 1934 and took over the property of Ontario Champion Gold Mines, Limited. The property is situated in Haycock township and is 9 miles east of Kenora, and a short distance south of Margach station on the Canadian Pacific railway. The main workings are located on claim P. 349.

The property was first worked about 40 years ago. Some ore was shipped to the Keewatin Reduction Works at that time. The property was reopened in 1925 and operated for about two years. The mine workings were dewatered and re-examined in 1931. During 1935 the company's group of claims was prospected. A diamond-drilling programme was carried out in the vicinity of the main workings during the early months of 1936, and later in the year some underground development was done at the old workings. Toward the end of the year the property was taken over by Franklin Gold Mines (1936), Limited.

In previous development an inclined shaft was sunk on the vein at an angle of 55 degrees to a slope depth of 235 feet. Levels were established at 120 and 220 feet. At a depth of 70 feet an adit was cut to the edge of the hill. Three small stopes were made.

General Geology.—Near the shaft the country rock consists of massive, coarse-grained granodiorite with occasional inclusions of altered basic lava. Some hybrid varieties of a plutonic rock, slightly different in composition from the granodiorite, have been formed by assimilation of the greenstone. Micro-



Sketch map of the main showings on the surface and underground workings, Franklin mine.

scopic examination of the rock 600 feet south of the shaft proved it to be a granodiorite, although the rock somewhat resembles a diorite in hand samples. The granodiorite and related rocks are cut by numerous dikes and small irregularly shaped bodies of red aplite and fine-grained red granite. These granitic bodies are probably a later and more acid differentiate from the same parent magma that produced the granodiorite.

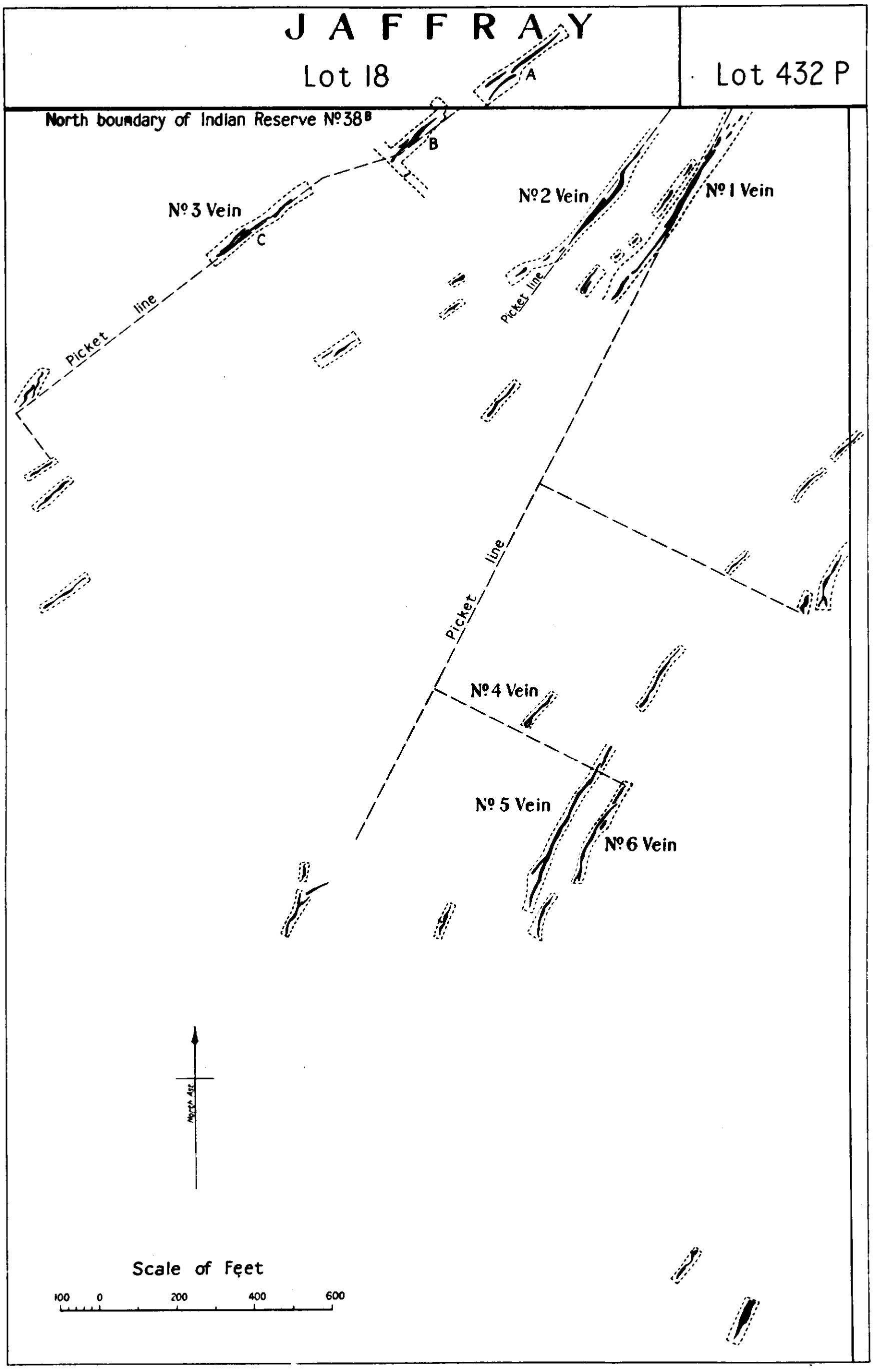
The gold-bearing veins are very closely associated with the aplite dikes. Quartz veins generally occur at or near the contact of aplite and granodiorite, but at some places the quartz is bounded on either wall by aplite. Immediately adjacent to the veins the granodiorite is often sheared to chlorite schist, whereas sericite sometimes borders the veins in aplite. In several places it appears that the aplite and associated quartz have been injected along previously established fractures in the granodiorite. A few fractures cut across aplite dikes showing that some of this movement is later than the period of gold deposition.

Veins.—The vein on which the shaft is sunk (Champion vein) roughly follows an aplite dike along a fracture zone in massive granodiorite. The vein strikes northwest-southeast and dips 55° S.W. The aplite dike may be traced from the surface to the 220-foot level, but it pinches and swells considerably.

No. 1 vein at the O'Sullivan property (Split Lake Gold Mines, Limited).

On the surface the quartz has been traced about 100 feet and ranges from 8 to 24 inches in width. On the 120-foot level quartz occurs almost continuously along the 180 feet of drifting. It has a somewhat irregular distribution, the veins being controlled by the irregularities of the aplite. The veins on this level are generally from 1 to 24 inches in width, but at one place in the stope the quartz and included schist bands widen out to about 6 feet. On the 220-foot level quartz occurs under the same conditions as on the 120-foot level over a length of 100 feet.

The vein quartz is white and somewhat banded in places due to chloritic seams. Sulphides are sparsely distributed and consist chiefly of pyrite, with



Sketch map showing the location of the veins on the O'Sullivan property (Split Lake Gold Mines, Limited). (After C. W. Taylor.)

traces of galena, sphalerite, and chalcopyrite. The gold is mostly native and occurs in the quartz.

A report on the property in 1931 by P. E. Hopkins, consulting geologist, indicated the possibility of a small ore shoot at the old workings.

In the summer of 1935 a gold discovery was made on claim K. 4,261. A slightly sheared zone in the granodiorite contains some sulphides and gold values over widths up to 4 feet. The zone was traced for 60 feet and then disappeared under heavy overburden.

O'Sullivan Property (Split Lake Gold Mines)

During the summer of 1936, Oliver-Severn Gold Mines, Limited, did a considerable amount of surface-trenching on a group of claims owned by J. J. O'Sullivan. These adjoin the Trans-Canada highway about 5 miles east of the town of Kenora. The group surrounded Hilly lake and included part of the western portion of Indian Reserve No. 38B. The work revealed a number of quartz veins in a body of granite and granodiorite. The greenstone contact is not a great distance away, and inclusions of greenstone are found in the granitic rock. Near these inclusions the intrusive is more basic in composition and might be classified as a diorite.

The vein quartz has a fine-grained, cherty appearance, and is generally banded with tourmaline. It carries sulphides in places, mostly pyrite and chalcopyrite. Native gold occurs in several of the veins and is usually found along fracture planes in the quartz. The walls of the veins are sharply defined, and the wall rock does not carry gold values. Gold values in the quartz are erratic in distribution.

The quartz veins appear to occupy a fracture pattern in the granodiorite and diorite. They strike N. 25° E. to N. 50° E. The more promising veins were opened up and channel-sampled at 5-foot intervals by C. W. Taylor (who prepared the sketch map on page 42). The best values were obtained on No. 2 vein, which was reported[1] by W. E. Segsworth, president of the company, to average 0.53 ounces gold across an average width of 24 inches, over a length of 83 feet. On No. 1 vein, located 100 feet east of the above, a section 38 feet in length was reported by Mr. Taylor to average 1.40 ounces gold across an average width of 7 inches. None of the other quartz veins yielded commercial results.

A small amount of diamond-drilling was done on the main showing (No. 2 vein). The option on the property was dropped in December, 1936.

In the early months of 1937 the property was taken over by Split Lake Gold Mines, Limited, and examined by J. F. Wright, consulting geologist. He reported that No. 2 vein averaged approximately $24 in gold[2] across 3 feet, for a length of 80 feet. Further development work was planned.

[1]Annual report, 1936.
[2]At $35 an ounce.

GOLD DEPOSITS ON SHOAL LAKE (WEST)

By Jas. E. Thomson

Introduction

During September, 1935, a detailed geological examination was made of a group of islands in Shoal lake adjoining Cameron island, on which is situated the Duport mine. Recent developments at the Cedar Island property of Kenora Prospectors and Miners, Limited, were also examined. The writer is indebted to the management of both companies for the information provided and facilities afforded in the course of the field work. The greater part of the geological mapping was done by Bruce Russell, field assistant.

Earlier developments at these properties were discussed in a previous report.[1] The geology of Shoal lake has been described by Greer.[2]

Duport Mine and Vicinity

The success attained by the Duport Mining Company, Limited, at Cameron island has led to surface prospecting and some diamond-drilling of the adjoining islands. Bodies of mineralized felsite, narrow quartz veins, and sheared zones have been found, some of which carry gold values.

GENERAL GEOLOGY

The geological features of Cameron, Stevens, Dominique, and adjoining islands are shown on the accompanying geological map. The geological succession is as follows:—

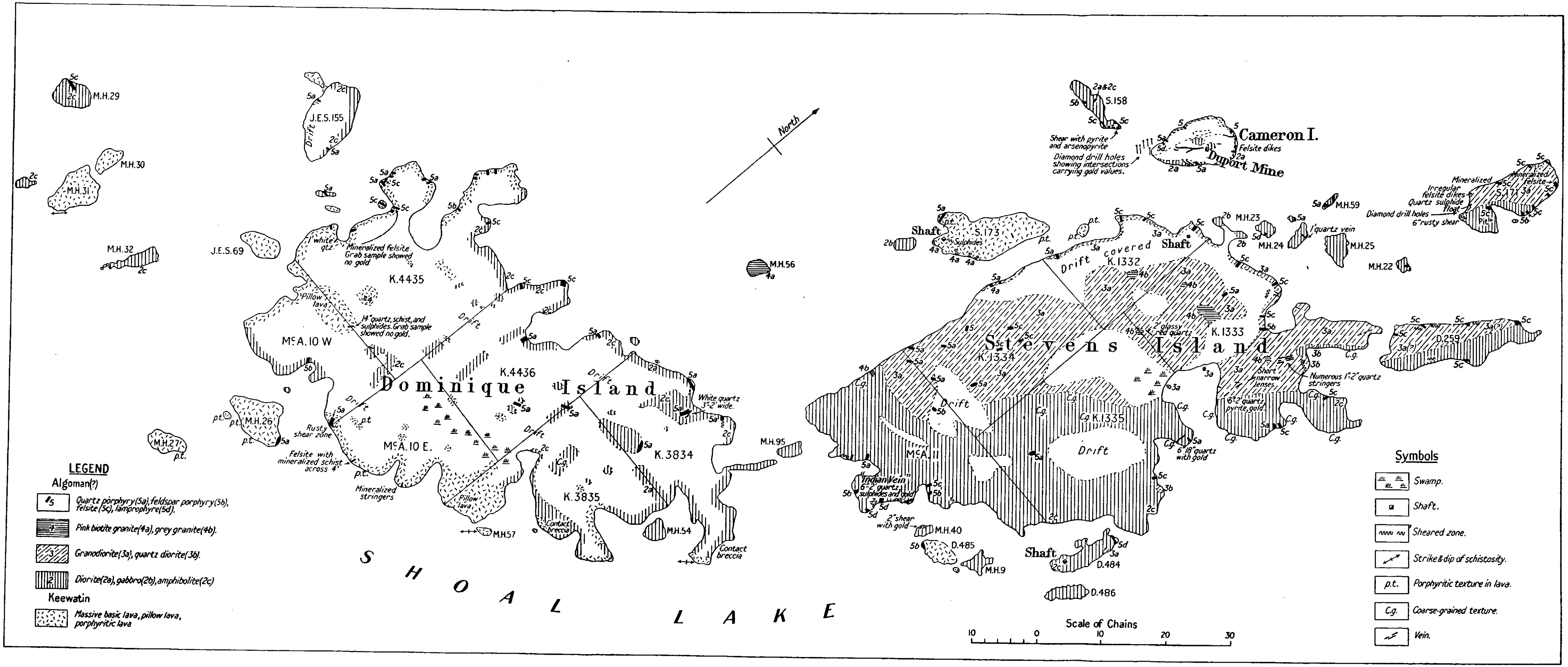
ALGOMAN(?):	Quartz porphyry, feldspar porphyry, felsite, lamprophyre. Pink biotite granite, grey granite. Granodiorite, quartz diorite. Diorite, gabbro, amphibolite.
KEEWATIN:	Massive basic lava, pillow lava, porphyritic lava.

The Keewatin rocks consist of massive basic lavas ranging from andesite to basalt in composition. They are found on the southern part of Dominique island, Pine island (S. 173), and part of Cameron island. Pillows are found in the lavas on Dominique island, and narrow bands of porphyritic lava occur at a few places. The latter consist of feldspar crystals, up to an inch in diameter, embedded in a fine-grained lava matrix. The porphyritic lavas appear to constitute certain horizons in the volcanics.

The larger part of the area mapped is underlain by a series of plutonic rocks ranging from biotite granite through granodiorite, diorite, gabbro, and possibly amphibolite. There are also intermediate variants of these, a rather common one being quartz diorite. All these plutonic rocks are fairly massive and medium- to fine-grained in texture. There appears to be a gradual transition from the granite through the series to the most basic members. It probably represents some sort of differentiation series influenced to a certain extent by assimilation of the older greenstones near the contact. Despite the fact that transition from one rock type to another is the most characteristic feature of the series, there is some suggestion that the granites are slightly later in age

[1] Jas. E. Thomson, "Gold Deposits on the Lake of the Woods," Ont. Dept. Mines, Vol. XLIV, pt. 4, 1935, pp. 43-47.

[2] Leonard Greer, "Geology of the Shoal Lake (West) Area," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, pp. 42-56.



GEOLOGICAL MAP OF CAMERON, STEVENS, DOMINIQUE, AND ADJACENT ISLANDS, SHOAL LAKE.

than the more basic members. Dikes of pink granite cut the granodiorite; porphyry dikes, which are believed to be closely related to the pink granite, cut all the more basic members of the plutonic series.

On the small islands east of Stevens island, the diorite and gabbro contain unassimilated inclusions of fine-grained basalt, and are thus undoubtedly intrusive into the Keewatin lava. Near by are irregular areas of amphibolite, which is interpreted as a hybrid rock produced by contact action of the intrusives on the greenstone. This amphibolite also occurs on Dominique island and the eastern side of Cameron island. It is a dark-coloured, medium- to coarse-grained rock and grades into gabbro and diorite. On Cameron island this amphibolite is composed almost entirely of long black crystals of hornblende. This rock may be either a recrystallized basalt, a basic marginal phase of the plutonic series, or a hybrid rock produced by the intermixture of the intrusives and the older lavas. The irregular distribution of the amphibolite near the contact with lavas or near xenoliths and its peculiar chemical composition, given below, suggest the hybrid origin. In a previous report[1] the rock on the eastern side of Cameron island was interpreted as a diorite, but the chemical analysis shows that amphibolite would be a more appropriate name.

Most of the non-quartzose part of the plutonic series might be appropriately classified in the field as a gabbro or diorite. The presence of bluish opalescent eyes of quartz in the quartz diorite and granodiorite serve to distinguish them from the diorite and gabbro. All these rocks are very intimately associated and grade from one type to another. At a few places on Stevens island the transition zone between granodiorite and diorite could be confined to a distance of about 50 feet. On island M.H. 56, between Stevens and Dominique islands, a massive, pink, biotite granite is found. Along the south side of island S. 173, dikes of the same pink granite cut the greenstone. This granite is similar to that found on the islands near the west side of the lake and is probably part of the large granite batholith that extends across the Interprovincial boundary into Manitoba. At a few places in the northern part of Stevens island segregations of quartzose grey granite occur in the granodiorite.

A large number of thin sections of the plutonic rocks on Stevens and adjoining islands were examined to supplement field determinations. These showed that some of the basic differentiates, such as diorite, gabbro, and amphibolite, have undergone intense hydrothermal alteration, and a great deal of secondary epidote, zoisite, sericite, carbonates, and chlorite is sometimes formed.

All the above-mentioned rocks, with the exception of the granites, are intruded by dikes of porphyry, lamprophyre, and related rocks. These dikes generally exhibit a sharp intrusive contact and are massive in appearance. The acid dikes are of two distinct varieties: (1) the quartz or feldspar porphyries; (2) very fine-grained dikes of cherty or rhyolitic appearance, which are locally called felsite. At one place at the west end of Dominique island a felsite dike branches off at right angles from a quartz porphyry dike. The porphyry grades into the felsite, showing that they are different phases of the same intrusive. The lamprophyre dikes contain much biotite with lesser amounts of albite, traces of quartz, and secondary minerals such as clinozoisite, epidote, and carbonate. They are massive, dark-coloured dikes with a maximum width of 30 feet.

Analyses were obtained of some of the unaltered rock types in the area, and their composition is recorded below. The analyses show that the granite, granodiorite, gabbro, and basalt have a composition quite close to the average

[1]Jas. E. Thomson, op. cit., p. 45

for such rocks, but all are high in alumina; the basalt is deficient in magnesia. The analysis of the amphibolite is rather similar to that of the mineral hornblende except for a deficiency of magnesia and a slightly higher lime content.

	No. 1	No. 2	No. 3	No. 4	No. 5
	per cent.	per cent.	per cent.	per cent.	per cent.
SiO_2	69.30	62.74	47.62	39.20	52.89
Al_2O_3	16.92	19.34	24.02	14.93	17.23
FeO	1.34	2.70	2.22	13.35	7.22
Fe_2O_3	.98	.83	2.05	6.43	1.39
CaO	1.80	4.92	12.29	14.15	8.51
MgO	.60	2.50	5.64	2.30	2.71
K_2O	2.45	1.41	.33	.26	.34
Na_2O	5.97	3.32	1.64	.72	4.13
TiO_2	.23	.46	.24	2.89	2.91
P_2O_5	....	.14	.05	.16	.33
CO_2	.28	.35	1.04	3.84	1.41
H_2O	.19	1.40	3.00	1.41	.87
MnO	....	.05	.07	.19	.20
FeS_2	trace	trace	trace	.04	.23
Total	100.06	100.16	100.21	99.87	100.37
Specific gravity	....	2.788	2.933	3.138	3.022

Sample No. 1—Pink biotite granite, island M.H. 56. Analysis by Bruce Russell, Department of Geology, University of Toronto, 1936.
Sample No. 2—Granodiorite, west shore of Stevens island. Analysis by Provincial Assay Office, 1936.
Sample No. 3—Gabbro; first island southwest of S. 173. Analysis by Provincial Assay Office, 1936.
Sample No. 4—Amphibolite, southeast side of Cameron island. Analysis by Provincial Assay Office, 1936.
Sample No. 5—Basalt, west side of Cameron island. Analysis by Provincial Assay Office, 1936.

Since the greater part of the rocks in the area under discussion are covered by water, a certain amount of conjecture necessarily enters into any interpretation of the inter-relationship of the series of intrusives. The available information suggests that they all belong to one period of batholithic intrusion, but there is some range in the age of the various members. The general geological map of Shoal lake (No. 39e) shows that the nose of the main granite batholith on the west side of Shoal lake projects towards the smaller Canoe lake batholith, the western exposures of which outcrop near the Mikado and Cedar Island mines. There is undoubtedly a connecting subterranean ridge between these two exposed areas. In fact the Stevens island granodiorite band extends towards the Canoe lake granite and has been traced to within at least three miles of it. The Stevens island plutonic series, ranging between granodiorite and gabbro in composition, probably represents the upper and first solidified portion of the parent magma. As cooling and crystallization proceeded to greater depths, differentiation of the magma produced more acid phases, which crystallized to form the granite. The offshoots from this residual acidic portion of the magma into the already solidified granodiorite-gabbro series would thus produce the dikes of porphyries, felsite, and lamprophyre.

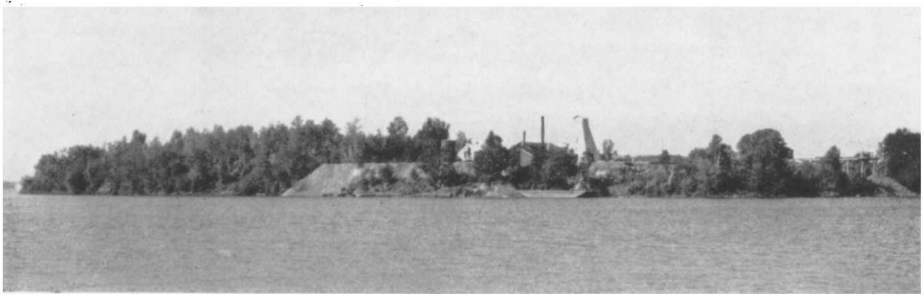
ECONOMIC GEOLOGY

Results of development work to date in the area have brought out two important facts about the gold deposition: (1) Gold values are generally connected with sulphide mineralization and tend to be roughly proportional to the amount of arsenopyrite in the ore. This relationship is well shown at the Duport mine where the high-grade ore contains heavy arsenopyrite mineralization and the lower grade has much less arsenopyrite and a larger proportion of other sulphides. (2) The more important ore occurrences are almost invariably concentrated in the vicinity of felsite dikes. In a number of cases the felsite dikes are mineralized and are occasionally known to carry gold values. At Cameron island, the most favourable host rock for sulphide deposition appears to have been a soft talc schist.

Small quartz veins and narrow sheared zones on Stevens island are known to carry a little gold in some cases. Diamond-drilling off the southwest end of island S. 171 during the winter of 1936 is reported to have traced a gold-bearing vein for a length of about 200 feet under the lake.

Duport Mining Company, Limited

Developments at the property prior to 1935 have been discussed in a previous report.[1] Since that time underground work has been carried on and high-grade gold ore has been shipped to a smelter at Tacoma, Wash. During 1935 and 1936, 1,190 tons of ore were shipped, which yielded 4,571.8 ounces of gold and



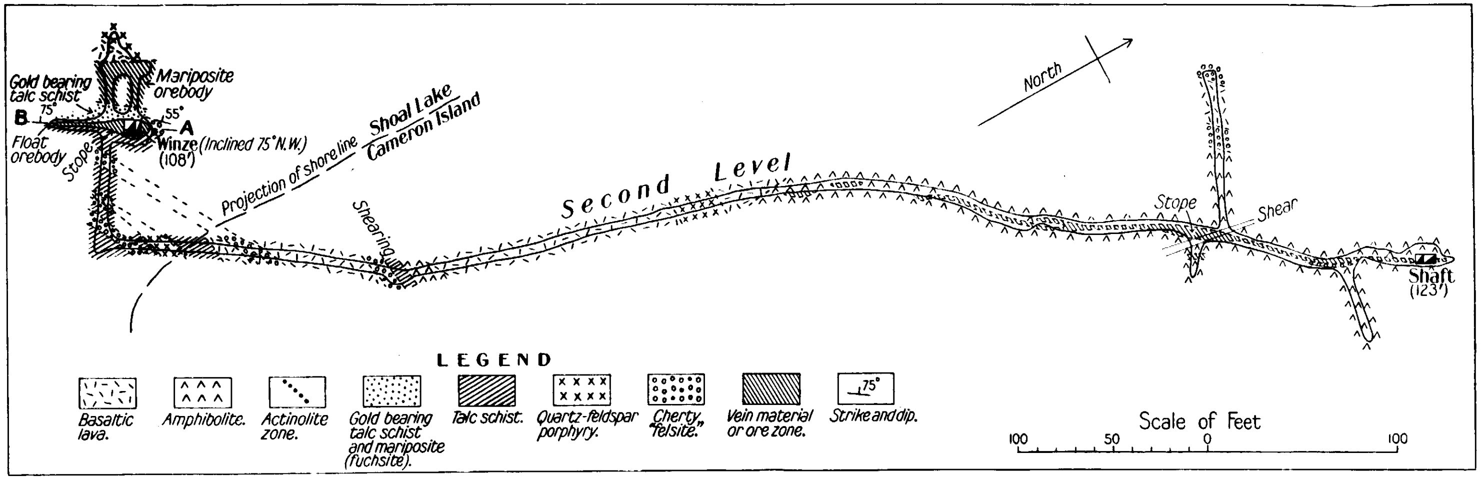
View of Duport mine, Cameron island.

1,143 ounces of silver, or an average of 3.84 ounces gold and 0.96 ounces silver per ton.

A drift on the 2nd (123-foot) level of the old workings was extended southwest towards the ore body encountered by drilling under the lake in 1934. A crosscut from this level intersected the high-grade "float" ore body and the parallel "mariposite" ore body. A winze was sunk in the float ore body and a 3rd level opened at a depth of 120 feet. A sublevel was established at a depth of 60 feet. Drifting and crosscutting had commenced on the 3rd level when the writer visited the property. The 4th level was opened up in 1936, and some underground drilling was done. The mine was closed temporarily in the autumn of 1936. J. G. Cross reported that a new 3-compartment shaft would be sunk in the summer of 1937.

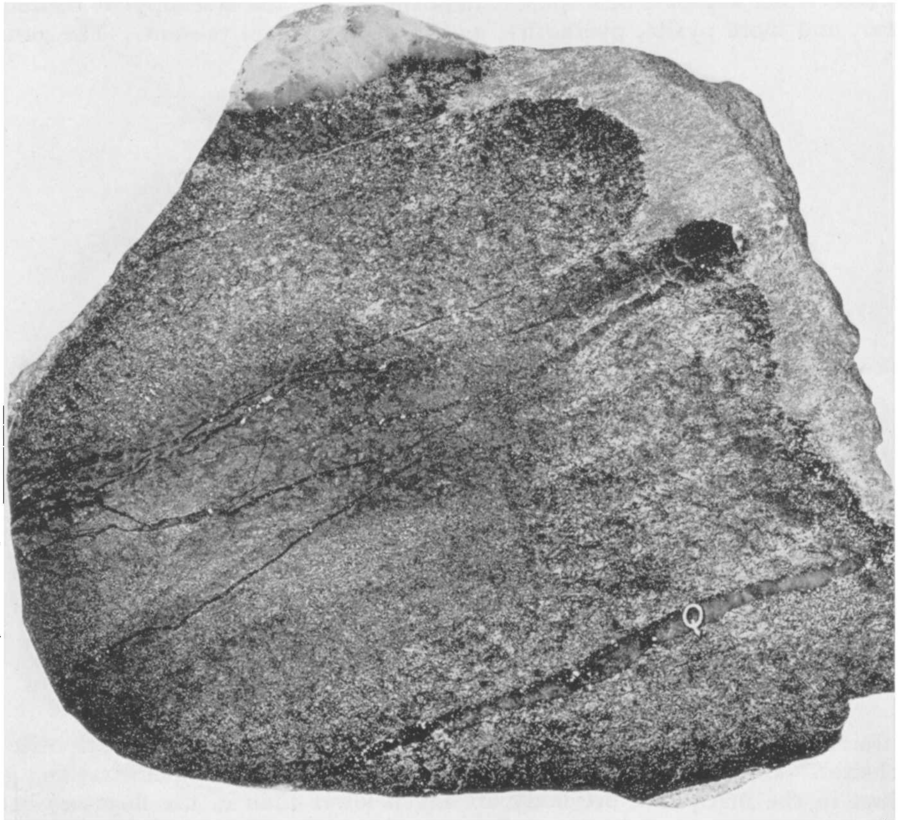
Ore Bodies.—The ore bodies under the lake are sulphide replacements and are largely located in a host rock of talc schist, which is a highly altered phase of the basaltic greenstone. A number of quartz-feldspar porphyry and cherty felsite dikes intrude the greenstone and talc schist in the vicinity of the ore zone. Diamond-drilling and sampling in the crosscut have delimited two more or less parallel ore shoots (the float ore body and the mariposite ore body) separated by a narrow zone that carries low gold values.

[1]Jas. E. Thomson, op. cit., pp. 44-47.



Geological sketch map of the 2nd level and winze, Duport mine.

The high-grade float ore body is regarded as a downward extension of the ore that was found as float boulders on the surface at the edge of the island. It appears to be lenticular in outline and consists of fine-grained arsenopyrite with small amounts of other sulphides. On the 2nd level it is about 50 feet in length and has a maximum width of 15 feet. The ore sometimes has a banded appearance and is cut by tiny quartz veinlets (see photograph above). It contains a high percentage of arsenopyrite, the gangue being largely talc, sericite, chlorite, and secondary quartz. The arsenopyrite occurs as bands of tiny crystals, which



Polished sample (natural size) of high-grade gold ore from the "float" ore body, Duport mine. Very fine-grained arsenopyrite is intersected by quartz veinlets (Q).

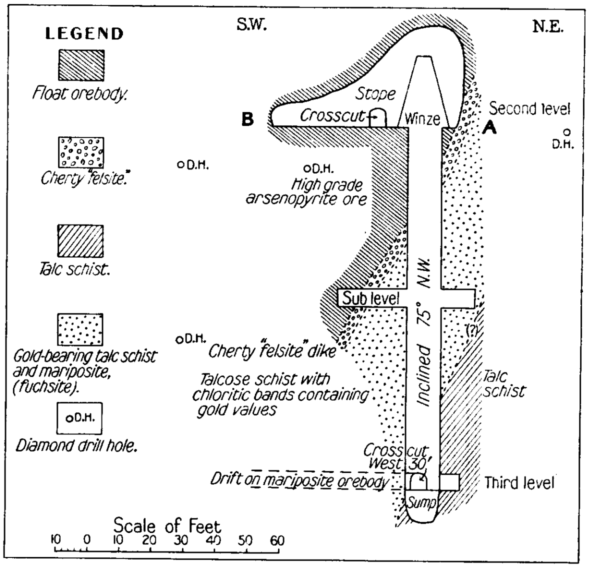
tend to run parallel to the schistosity. At the collar of the winze on the 2nd level the float ore body pitches downward to the southwest at an angle of about 60 degrees. It is picked up in a sublevel at a depth of 60 feet in the winze. Here the ore body appears to lie above and in the trough of a crescentic-shaped cherty felsite dike that controls the dip of the footwall of the high-grade ore and may have some influence on the rake of the ore shoot.

The cherty felsite dike is also mineralized and carries gold values. A thin section of the felsite near the collar of the winze shows that it has been considerably altered. A fair amount of sericite has been formed, and secondary quartz veinlets and arsenopyrite crystals are arranged parallel to the schistosity.

The felsite sample from which the section was made assayed 0.80 ounces gold and contained 5.33 per cent. arsenic, which is equivalent to 11.7 per cent. arsenopyrite in the rock.

Below the felsite dike in the winze the rock is largely talcose schist but includes small irregular areas of dark-coloured chloritic schist. J. G. Cross, the manager, reports that these chloritic schist bands are sometimes rich in gold. Under the microscope the talc schist from this vicinity consists of talc, sericite, a few rutile crystals, and a little arsenopyrite. When arsenopyrite is present, this material contains some gold.

The mariposite ore body lies on the west side of the float ore body. It contains lesser amounts of sulphides than the latter; the arsenopyrite content is lower, and more pyrite, pyrrhotite, and chalcopyrite are present. The gangue



Section in plane of float ore body and winze, Duport mine.

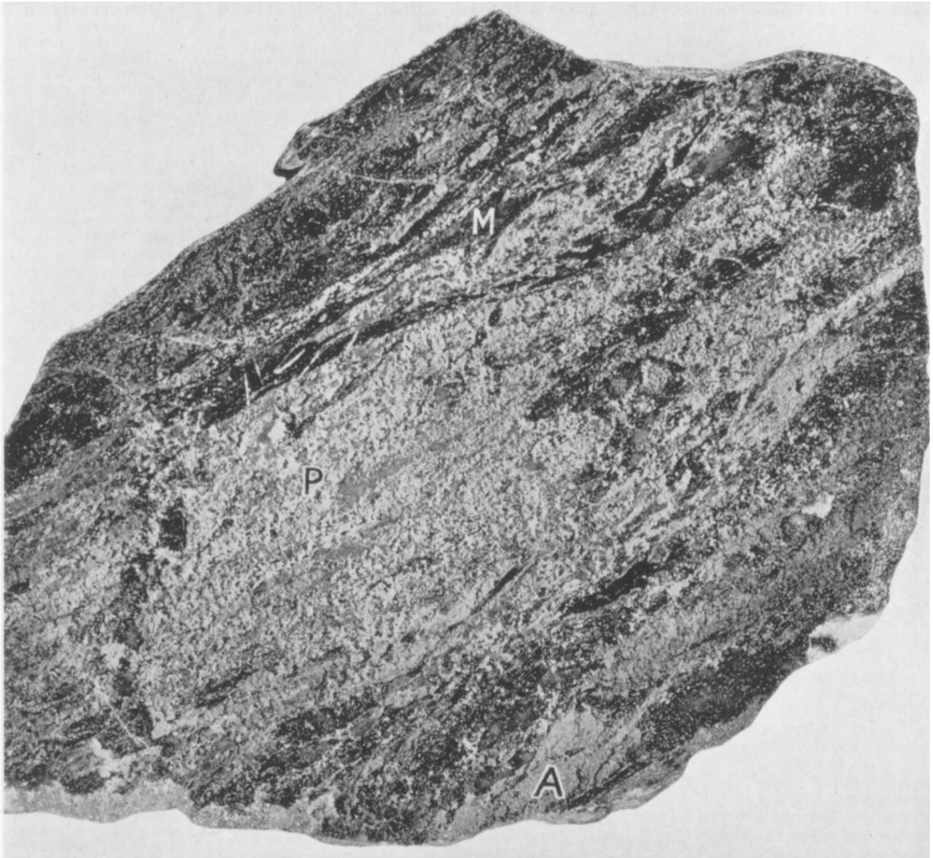
contains a considerable amount of apple-green chrome mica (mariposite or fuchsite). Due to the more disseminated arsenopyrite mineralization, gold values in the mariposite ore body are much lower than in the float ore body. Where it is intersected on the 2nd level, however, a fine grade of ore occurs over widths of 23 and 26 feet on either side of the crosscut. Mineralization similar to that of the mariposite ore body had been encountered in the drift on the 3rd level in October, 1935.

Sampling of the vein material on the 2nd level southwest of the shaft and of surface veins near the shaft indicates an ore body in that vicinity. It is reported that this shoot is 232 feet in length on the 2nd level.

Ore Relationships.—Microscopic examination of the ore at the Mines Branch,[1] Department of Mines, Ottawa, has shown the presence of arsenopyrite, pyrite, pyrrhotite, ilmenite, and native gold. The larger part of the gold occurs with the arsenopyrite. Spectral analyses showed that submicroscopic gold is

[1]Mines Branch, Can. Dept. Mines, Bull. No. 736, 1932, p. 60; and unpublished report of July 30, 1936.

present in arsenopyrite in quantities probably exceeding two or three ounces per ton (of arsenopyrite). Native gold occurs (1) as free grains in the gangue, (2) as small grains within and attached to pyrite and arsenopyrite, and (3) associated with pyrrhotite in the gangue. Most of the visible gold was seen in the gangue.



Polished sample (natural size) of gold ore from the "mariposite" ore body, Duport mine. The lighter-coloured pyrite and pyrrhotite (P) and darker arsenopyrite (A) replace schist which contains green mariposite (M).

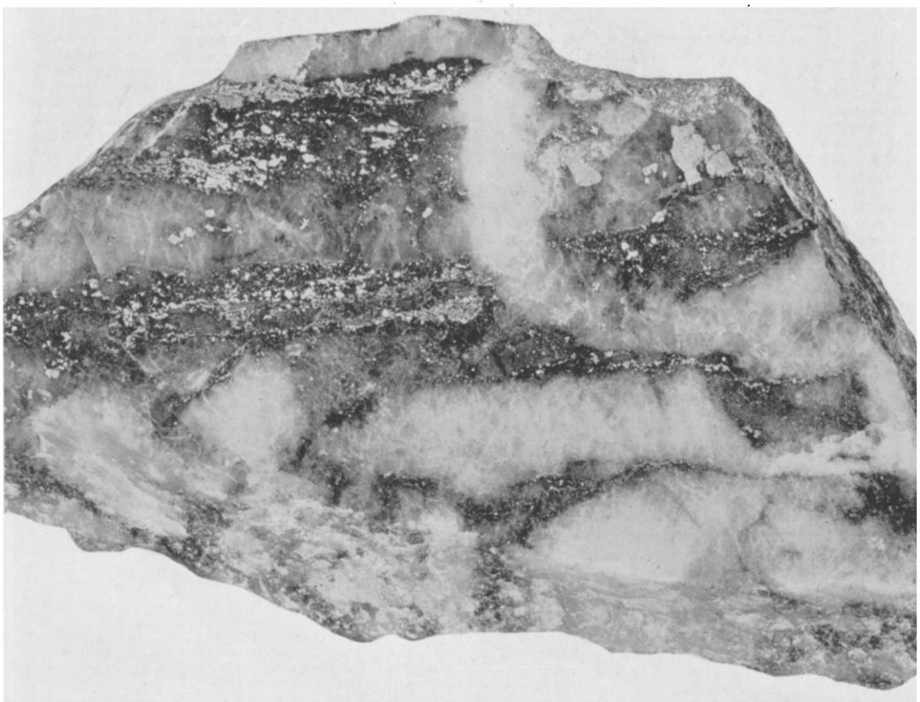
Kenora Prospectors and Miners, Limited

Underground development of the Cedar Island property has continued since the last report was written.[1] No. 2 shaft has been deepened, and levels are established at 283, 383, 500, and 625 feet. A 40-ton mill was installed in the fall of 1935. Production to the end of the first quarter of 1936 amounted to 2,202.63 ounces gold and 1,084.23 ounces silver from 7,377 tons of ore milled, or an average of 0.30 ounces gold and 0.15 ounces silver per ton.

The mine is located in basaltic greenstone a short distance from the contact with a granite batholith. Dikes of granite, pegmatite, feldspar porphyry, aplite, and lamprophyre cut the lava in the mine workings. A mass of granite

[1]Jas. E. Thomson, op. cit., pp. 43, 44.

was encountered in the east drifts on the 283-foot level. The vein material is closely associated with a series of aplite dikes, which appear to be the latest phase of the series of intrusives. The vein often follows along the contact of the aplite and greenstone but in places will angle away from it and broaden out in the form of a stockwork of quartz stringers in the lava. Values seem to fall off in this structure. At certain locations the aplite simply grades into vein quartz. This association has produced irregular bodies of quartz, which are sometimes lenticular, sometimes contorted and folded. Such a condition makes it difficult



Polished sample (natural size) of gold ore from the Cedar Island mine, Kenora Prospectors and Miners, Limited. The darker-coloured quartz containing sulphides is cut by slightly later white quartz. Pyrite is present in the form of crystals and also in a finely granular state along fractures.

to correlate the showings on the various levels and more or less limits ore reserves to rock actually broken.

On the 144-foot level, which was developed from No. 1 shaft, a section of the veins 180 feet in length is reported to average 1.476 ounces gold per ton across 46 inches. The other levels were opened from No. 2 shaft. Little ore was found on the second (283-foot) level. On the 383- and 500-foot levels three more or less parallel veins were found. A section of ore was delimited on the 383-foot level on both the No. 1 and No. 2 veins. On the 500-foot level sections of ore are reported on both the No. 2 and No. 3 veins. In the spring of 1936 drifting was being done on vein material on the 625-foot level, but it was not definitely known how this lined up with any of the veins on the upper levels.

There are two generations of vein quartz. The earlier quartz is fine-grained and sugary in appearance, and generally contains narrow bands or wisps of chlorite. It is fractured, and fine-grained sulphides, chiefly pyrite, occur along the fractured zones. Two generations of pyrite occur, the first as distinct crystals, the second as fine-grained material. In some cases the fine-grained

View of Cedar Island mine, Kenora Prospectors and Miners, Limited, Shoal lake.

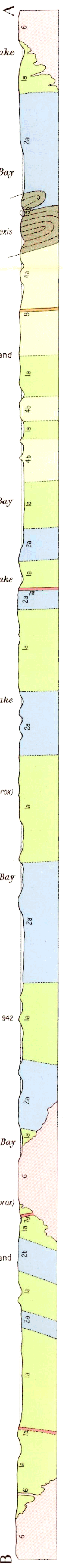
pyrite surrounds the earlier-formed crystals. Small amounts of pyrrhotite, arsenopyrite, sphalerite, galena, and chalcopyrite also occur in the quartz. Gold occurs as small grains and veinlets in the quartz and is usually associated with the later pyrite. A slightly later generation of white quartz cuts across the earlier quartz and sulphides.

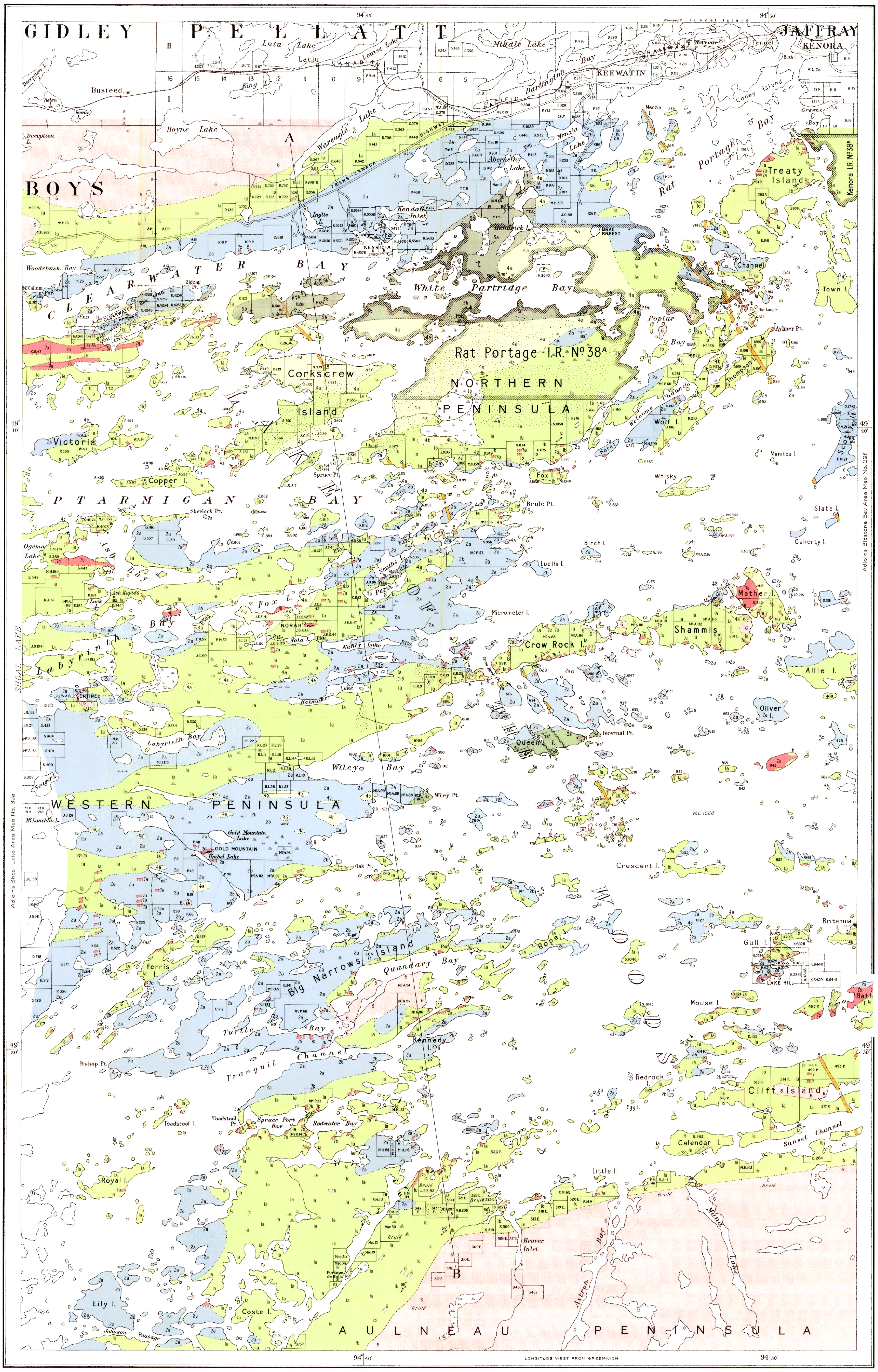
INDEX, PART III

Map No. 45b
NORTH CENTRAL PART,
LAKE OF THE WOODS

PROVINCE OF ONTARIO
DEPARTMENT OF MINES
HON. PAUL LEDUC, MINISTER OF MINES
T. F. Sutherland, Deputy Minister H. C. Rickaby, Provincial Geologist

SECTION ON LINE A—B





LEGEND

QUATERNARY

Pleistocene

Drift-covered. Only larger areas approximately outlined.

PRE-CAMBRIAN

Keweenawan

8 — Diabase.

Algoman?

7 — Quartz porphyry (7a), quartz-feldspar porphyry (7b), syenite porphyry (7c), aplite (7d), lamprophyre (7e).

6 — Granite. This sometimes grades into gneiss or granodiorite near the contact with older rocks.

Timiskaming

5 — Conglomerate (5a); arkose, quartzite, greywacké and slate (5b).

Keewatin

4 — *Acid volcanic rocks: rhyolite and rhyolite porphyry (4a); sericite schist (4b); carbonated acid lavas (4c).

3 — †Sediments interbanded with lavas, agglomerates etc. Greywacké and slate (3a); iron formation (3b); graphitic chert (3c).

2 — *†Agglomerate and tuff (2a); bedded tuff (2b).

1 — *Basic volcanic rocks: andesite, basalt and pillow lava (1a); hornblende and chlorite schist (1b); amphibolite (1c); carbonated basic lavas and schists (1d); altered gabbro and diorite (1e).**

*In some parts of the area the boundaries between these three divisions are quite sharply defined: in other parts the rocks are considerably intermingled and the boundaries are arbitrarily defined on the map.

†In some parts of the area these groups grade into one another.

**Some of these rocks are intrusive into the lavas.

Symbols

Swamp or marsh.
Portage.
Trans-Canada Highway.
Road.
Shaft.
Test pits or surface trenches.
Elevation in feet above sea level.
Strike and dip of bedding.
Strike of vertical bedding.
Strike and dip of schistosity.
Strike of vertical schistosity.
Geological boundary, defined.
Geological boundary, assumed.
Glacial striae.
Quartz vein.
Fault.
Sulphide body.
Direction in which tops of lava flows face.
Direction in which tops of beds face indicated by gradation in grain size.
Direction in which tops of beds face indicated by relationship of cleavage and bedding.
Direction in which tops of beds face indicated by cross-bedding.

SOURCES OF INFORMATION

Base map from Kenora sheet, National Topographic Series, of the Topographical and Air Survey Bureau of Canada.

Township lines etc. from plans of the Surveys Branch, Ontario Department of Lands and Forests.

Geology of the Islands of Town, Scotty, Gaherty and Allie from Bigstone Bay Area Map No. 39f, Ontario Department of Mines, 1930, by G. G Suffel.

Geology by Jas. E. Thomson, 1935.

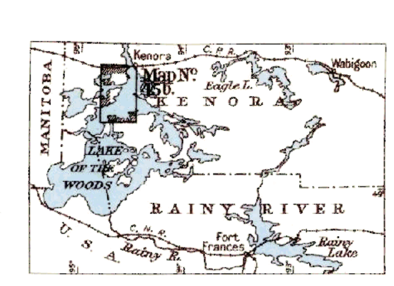
Drawn for photo-lithography by J. Ledingham.

NOTES

Magnetic declination is approximately seven degrees east of north.

The geology for the most part is mapped in relation to salient points in the shore line, rather than to mining claim boundaries. These boundaries belong chiefly to old claims, and few of them can now be readily found.

The names of lakes and streams on this map are in conformity with the rulings of the Surveys Branch, Ontario Department of Lands and Forests.



Scale: 70 miles = 1 inch

Map No. 45b

NORTH CENTRAL PART OF THE LAKE OF THE WOODS

DISTRICT OF KENORA, ONTARIO

To accompany report by JAMES E. THOMSON in Vol. XLV, Part 3, Ontario Department of Mines Annual Report, 1936.

Scale, $\frac{1}{63,360}$ or 1 Mile = 1 Inch

Chains 80 40 0 1 2 3 4 Miles
Metres 1000 0 1 2 3 4 5 Kilometres