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GOLD AND COPPER DEPOSITS OF DUBUISSON AND BOURLAMAQUE TOWNSHIPS, ABITIBI COUNTY, PART C

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BUREAU OF MINES

Honourable J. E. PERRAULT, Minister of Mines

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

ANNUAL REPORT

OF THE

QUEBEC BUREAU OF MINES

FOR THE CALENDAR YEAR

1930

JOHN A. DRESSER, Directing Geologist

PART C

QUEBEC

PRINTED BY R. PARADIS

PRINTER TO HIS MAJESTY THE KING

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by J. E. Hawley

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GOLD AND COPPER DEPOSITS OF DUBUISSON AND BOURLAMAQUE TOWNSHIPS, ABITIBI COUNTY

by J. E. Hawley

INTRODUCTION

General Statement

During the summer of 1930 detailed surveys were made at various points throughout Dubuisson and Bourlamaque townships, and adjoining portions of Varsan, Senneville, Pascalis, and Louvicourt townships, in Abitibi county, northern Quebec. There is one producing gold mine in Dubuisson, that of Siscoe Gold Mines, Limited, and on several other properties in the township shafts have been sunk and gold-bearing veins explored, as at the Sullivan and Greene-Stabell gold mines. In Bourlamaque, there are several gold and copper prospects. An attempt was made to correlate the various deposits and to outline more fully the general geology of the area, which had been previously mapped by officers of the Canadian Geological Survey.

Within the area, gold occurs principally in quartz-tourmaline veins in or adjacent to bodies of granodiorite, or related rock, which intrude Keewatin lavas either as small stocks or as the larger batholithic mass which occupies the north half of Bourlamaque township and extends west to the Sullivan mine at lake De Montigny. Gold is also present in quartz veins associated with various porphyritic dykes cutting the Keewatin, as at the Greene-Stabell mine. Chalcopyrite mineralization has been found in Bourlamaque, both in silicified Keewatin lavas, near the Bourlamaque granodiorite, and farther to the south in a diabasic diorite, in rhyolite, and in tuffs.

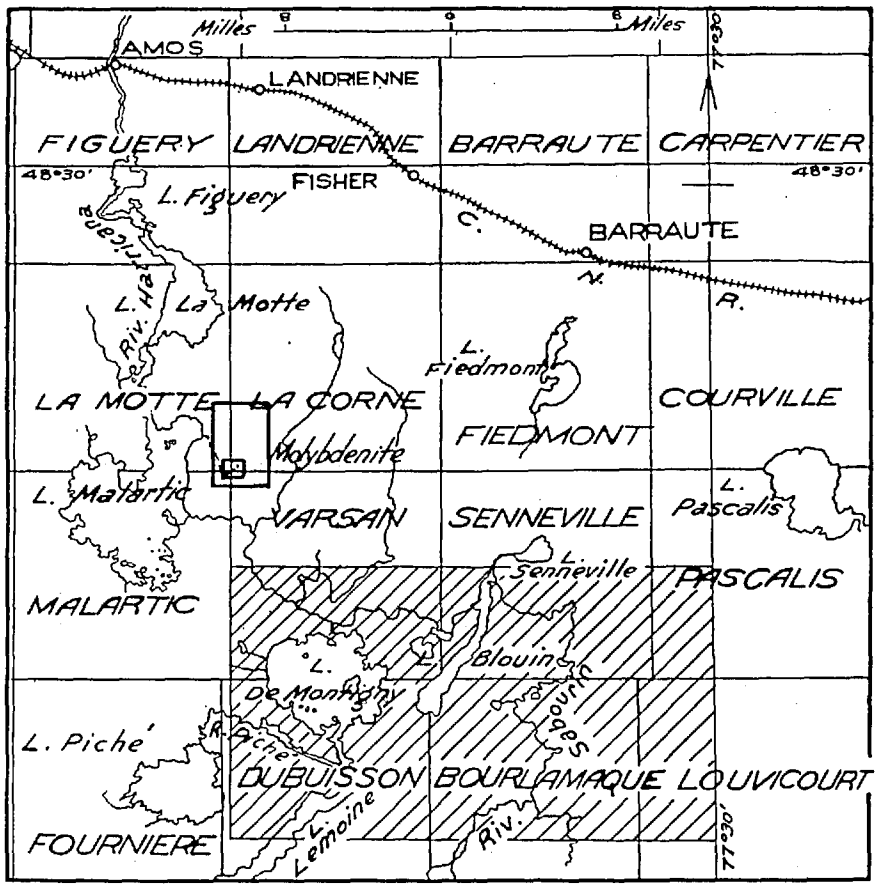
Only at the Siscoe were mining operations in progress during the writer's visit. At this mine, a considerable advance in development work has been made since the report of James and Mawdsley (1) in 1926, and promising deposits are being opened up. Elsewhere in the district, though prospecting has been pursued sporadically for many years, and a considerable amount of exploratory work has been completed, no deposits of large extent have been really proved up. Mining development at the Greene-Stabell mine has shown a considerable, though limited, body of minable gold ore. Some new gold-bearing veins have been discovered by underground work or drilling at the Sullivan mine, but a great deal more exploratory work is required before active mining can be considered. Elsewhere, there are several interesting prospects requiring further development before their worth will be apparent. During the period of field work, very little prospecting was being carried on in the area, though there are many claims held on work accomplished in previous years. In the fall of 1930, some activity was reported in the southwest corner of Pascalis township.

Location of Area and Access

The area is situated in the basin of the Upper Harricana river, 40 miles southeast of Amos on the Transcontinental branch of the Canadian National railway and 52 miles east of the Rouyn copper area.

Transportation into the area is readily effected by boat from Amos to lake De Montigny. During the past several years a small steamboat has plied between the Siscoe gold mine and Amos, three times a week. The Harricana river, lake Blouin, and the Bourlamaque and Colombière rivers afford excellent water routes throughout the area, the Colombière being navigable by canoe to the northeast corner of Bourlamaque township. On the Bourlamaque river, about 6 miles above its confluence with the Colom-

(1) James, W. F. and Mawdsley, J. B., "Fiedmont and Dubuisson Map Areas, Abitibi County, Quebec"; Geol. Surv. Can., Sum. Rept., 1926, Part C, pp. 56-72.



Index sketch showing location of Dubuisson-Bourlamaque map, and of La Corne deposits map.

bière, are four short rapids and one small fall. Away from the rivers and lakes, winter roads lead across country, connecting the Sullivan and Greene-Stabell mines and Blouin lake. A good road runs from the Read-Authier property to Blouin lake, with a branch to the Greene-Stabell mine. From here, winter roads have been cut southeast to the Bourlamaque river and thence east to the Caribou Copper property, which is also connected by trail to the north with the Colombière river.

Previous Work

The general geology and gold deposits of this area have been reported on by many writers. The most recent reports are those of Bancroft (1), Mailhiot (2), Cooke (3), James and Mawdsley (4), and Cooke, James and Mawdsley (5), issued between the years 1912 and 1931. Map No. 224A, the Dubuisson Sheet, issued by the Canadian Geological Survey and compiled from surveys by James and Mawdsley, shows accurately the distribution of the various formations and outcrops.

Acknowledgments

The writer is indebted to the officials of the various mining properties visited for many courtesies extended and for their co-operation in facilitating the work in every way. Thanks are especially due to Mr. C. O. Stee, Manager of the Siscoe mine, Mr. Pierre Beauchemin, of the Sullivan mine, and Mr. R. Roux, Mining Recorder at Amos. In the field, the writer was ably assisted by A. M. Bell, J. L. Tremblay, and Robert Méthot. A considerable portion of the detailed mapping is the work of Mr. Bell.

General Nature of the Area

A description of the general character of the area is contained in the report by Bancroft cited above. The district lies close to the height-of-land and is of exceedingly low relief. It is characterized by great stretches of flat spruce swamp and muskeg, a dearth of rock outcrops, shallow, muddy lakes, and slow meander-

(1) Bancroft, J. A., "Report on the Geology and Natural Resources of an Area embracing the headwaters of the Harricana River, Northwestern Quebec"; Que. Bur. Mines, Ann. Rept., 1912, pp. 199-236.

(2) Mailhiot A., "Gold Deposits of Lake De Montigny, Abitibi"; Que. Bur. Mines, Ann. Rept., 1919, pp. 125-160. Reprinted 1922.

(3) Cooke, H. C., "Some Gold Deposits of Western Quebec"; Geol. Surv. Can., Sum. Rept., 1923, Part C 1, pp. 76-100.

(4) James, W. F., and Mawdsley, J. B., "Fiedmont and Dubuisson Map Areas, Abitibi County, Quebec"; Geol. Surv. Can., Sum. Rept., 1926, Part C, pp. 56-72,

(5) Cooke, James and Mawdsley, Memoir 166, Geol. Surv. of Can., 1931.

ing streams. The northwestern and northern portion is underlain by clays, which are excellently exposed along the shores of lake De Montigny. This portion is the most swampy and is devoid of rock outcrops, except near the waterways. The highest land follows a belt of easterly-trending volcanic and sedimentary rocks south of lake De Montigny and across Bourlamaque township. In this township, surprizingly enough, a large area lying to the north of the volcanic rocks and underlain by intrusive granodiorite is also of low relief and covered by clay and some low gravel and sand ridges. High sand ridges are prominent two to three miles south of lake Blouin, and along the northeastern shore of this lake rather prominent terraces have been cut in thick deposits of sand and boulders.

No agriculture is carried on in any part of the area, and the unfavourable character of the greater portion of it will probably long continue to prohibit its utilization for this purpose. On the west shore of lake De Montigny, extending to the western edge of the township, and between this lake and lake Blouin, are some areas covered by thick vegetation and underlain by clays ; these, if cleared, would be favourable for agriculture of the type best suited to these latitudes.

Some lumbering has been carried on through the western portion of the area, especially along the west shore of lake De Montigny. A considerable amount of pulp wood is still to be found in the higher areas, between this lake and lake Blouin, on the south of the Piché river, and to the east of the Bourlamaque river, between the falls and the Caribou Copper property. Along the higher rocky ridges extending east from lake Lemoine to the Bourlamaque river, fires have removed practically all good growths of trees, and the hollows between the ridges are filled with small spruce and alders.

The Map

Map No. 147 (in pocket), showing the general geology of the area, covers much the same ground as the Dubuisson sheet (No. 224A) issued by the Canadian Geological Survey. A photographic

enlargement of the latter map, on a scale of forty chains to one inch, was used as a base map during the course of the work. New information added consists in the location of various mining properties, a more detailed mapping of the outcrops near mines and prospects, and a more detailed subdivision of geological formations, including particularly porphyritic dykes and an older diabasic diorite.

An attempt was also made to outline the approximate location of the contacts of the large granodiorite intrusive that extends west from Bourlamaque township to the Sullivan mine in a narrow tongue, and to determine therefrom whether this same mass extended on the northwest to Siscoe island. This work was carried out by the use of a dip needle. Compass lines were run north and south from located outcrops and the magnetic inclination measured at frequent intervals. Appreciable changes in dip were noted over known outcrops of Keewatin volcanics and granodiorite, the former giving the higher readings. The results, in many places, were sufficiently consistent to justify the approximate delineation of the contact. It is hoped that this may be of some value in any future exploratory work. As a result of this survey, as will be shown later, the conclusion was reached that the Siscoe intrusive is not simply the extension of the Bourlamaque granodiorite, but rather a separate stock, though both are genetically and chemically related.

GENERAL GEOLOGY

All consolidated rocks within the area are of pre-Cambrian age. The following table of formations shows their approximate relations to one another. Owing to the drift-covered nature of the area, it is exceptional to find actual contacts between the different formations, and some relations are inferred. This applies particularly to the several types of acidic porphyry dykes. In general, the classification of the Canadian Geological Survey for this and adjacent regions has been adopted.

TABLE OF FORMATIONS

RECENT AND PLEISTOCENE		Recent alluvium, clays, sand and boulders
PRE-CAMBRIAN	KEWEENAWAN or PRE-COBALT (?)	Olivine diabase and quartz diabase dykes
	Intrusive Contact	
	PRE-COBALT INTRUSIVES (related intrusives)	Mica lamprophyre Granite, granitic and aplite dykes Amphibolite associated with granite Syenite and syenite porphyry Feldspar porphyry, albitite, andesite Granodiorite and granodiorite porphyry Diorite—border phase of granodiorite Diorite or 'older' diabase
	TÉMISCAMIAN	Greywacke and slate
	KEEWATIN	Peridotite, augitite, serpentine intrusives Clastic sediments and tuffs Acid volcanic flows, rhyolite, trachyte Basic volcanic flows, andesite, pillow lava, basalt

KEEWATIN

KEEWATIN VOLCANICS :

Highly altered volcanic rocks, identical with those classed as Keewatin elsewhere in northern Quebec and Ontario, extend across the area in a belt ten or more miles wide and strike very uniformly a little south of east. They are interrupted in Bourlamaque and south Senneville townships by a large mass of granodiorite, and elsewhere by smaller masses of related intrusives. On the south they are bordered by a syncline of Témiscamian sediments, and to the north, outside the map area, they are cut by granite and syenite.

Rocks of this series consist, in the main, of volcanic flows, which range in composition and character from basalts to rhyolites,

agglomerates, and tuffs. Andesitic pillow lavas predominate. Amygdaloidal basalts, while not so common, are excellently displayed on the Greene-Stabell property.

Porphyritic flows of andesitic composition are of common occurrence, and since they somewhat resemble porphyritic intrusives their distinction is important. Such flows were noted on the property of the Dubuisson Development Company, southwest of lake De Montigny, where they grade into pillow lavas. Others occur in the main belt of Keewatin in the eastern portion of the map sheet.

On the south shore of lake De Montigny and on many of the small islands south and west of Siscoe island, basic flows, in places with fragmental tops, occur. These have a dark greenish-black colour and, where scoured by ice action, they are exceptionally hard and break with a conchoidal fracture. Under the microscope, they are found to be similar in composition to altered basalts and to consist now of secondary hornblende, chlorite, epidote, and sericite, with scattered grains of magnetite. Some similar rocks contain actinolite in fine needles, and secondary quartz. They are to be distinguished from the basic intrusive rocks described below as peridotites or augitites, now altered in part or entirely to serpentine. The latter, when fine grained, resemble them very closely in appearance, yet lack the greenish tone of the true lavas.

More acidic volcanics, including altered trachytes and rhyolites and fragmentals, are most prominent along the southern border of the Keewatin and towards the top of the series. Associated with these in western Louvicourt are well bedded tuffs. A prominent belt of sericite schists extends in an easterly direction from the southeast corner of the Read-Authier property in Bourlamaque township. These rocks are probably derived from acid volcanics, though no remnants of the original rocks were observed.

KEEWATIN SEDIMENTARY ROCKS :

Sedimentary rocks of the greywacke type, in which bedding may be clearly distinguished, occur within the Keewatin volcanics along the northern border of the map area, and along the contact

with the Témiscamian sediments on the south. Those on the north are so altered and poorly exposed that in no case could their relation to the lavas be determined. They appear to be of small distribution and local in character.

Near the Témiscamian rocks, clastic sediments are interbedded with tuffaceous schists and appear definitely a part of the Keewatin. Within the portion mapped as Témiscamian by James and Mawdsley, no volcanic rocks are found, so the line of contact, though drift covered, may be fairly well determined.

ANDESITE, PERIDOTITE, OR AUGITITE INTRUSIVES :

Two distinct types of old intrusives cut the Keewatin rocks. One consists of small dykes or sills ranging from andesite to basalt in composition, many of which are altered to actinolite, chlorite, and secondary quartz. The other type consists of larger dykes or stocks of ultra-basic rocks, peridotite or augitite, which have been changed to serpentine. All probably antedate by some time the intrusions of granodiorite.

Dykes of altered porphyritic andesite were noted on island No. 22, southwest of the Sullivan mine, in lake De Montigny. These cut chloritic lavas and unite in a small sill parallelling the flows.

The ultra-basic intrusives are prominent on some islands in lake De Montigny and along its shores. Some also occur in western Louvicourt. In the former locality, where fresh surfaces have been exposed, the rocks are dark to black in colour and, though consisting largely of secondary minerals, are hard and tough. All are fine grained. Weathered surfaces are soft and greasy. In the field, these rocks were classified as ' soapstone '. Under the microscope they are seen to consist of rounded aggregates of serpentine, black metallic grains of magnetite, and a few remnants of unaltered augite. No olivine was found in the sections examined. The rocks are altered peridotites or augitites, as noted by James and Mawdsley on their map. That they are intrusive dykes or small bosses in the Keewatin volcanics is well shown on a reef immediately southwest of Parker island. This consists of a black, highly serpentinized augitite extending for

about 100 feet north across the strike of an andesite flow that outcrops on an adjacent island to the west. The flow exhibits a chilled top on the south and strikes N.80°E. Larger masses of similar basic intrusive rocks occur on islands Nos. 21 to 25, southwest of the Sullivan mine ; in outcrops on the property of the Dubuisson Development Company, where they again cut lavas ; and on the shore of the lake just north of the Sullivan mine. They also occupy a portion of the bay due east of the north side of Siscoe island, as shown by drill cores of the Stanley Siscoe Extension Gold Mines, Limited.

At the eastern margin of the map area, in Louvicourt, two miles southeast of the northwest corner of the township, are isolated outcrops of green serpentine rock which appear almost enclosed by granodiorite. They consist of a darker green, medium grained serpentine, penetrated by very fine stringers (3 to 5 mm. wide) of lighter green, fibrous serpentine. The darker serpentine contains some remnants of augite, some fine particles suggesting olivine, and serpentine of both fibrous and lamellar character. Magnetite is finely disseminated throughout, but is more abundant in the darker rock, while carbonates are present in the lighter coloured type, which seems clearly secondary after the darker serpentine.

The serpentinization of these ultra-basic rocks may be due either to hot waters following their intrusion, or possibly to later intrusives. The latter is suggested by their localization at both the eastern and western extremities of the granodiorite intrusives.

STRUCTURE OF THE KEEWATIN :

The Keewatin rocks have been folded so that they now dip steeply either north or south. Their strike is very uniform, about S.80°E. Determination of the tops of flows was attempted in many places, both by noting the attitude of pillows and the position of chilled or fragmental tops in the flows, and the gradation in size of grain in the tuffs. In general, the observations made check those of Cooke (1) and others, that the tops of the

(1) H. C. Cooke, *op. cit.*, p. 98.

flows face south and that the southern portion of the series occupies the north limb of a syncline. North of the granodiorite intrusive that extends east from lake De Montigny, no satisfactory structural data were found.

In the southwest portion of lake De Montigny, and on the small islands in this vicinity, the general easterly trend appears interrupted by minor folds which must allow a swinging of the Témiscamian contact to the north, since outcrops of the sediments in Fournière and Malartic townships extend much farther in this direction than they do in Dubuisson. Details of this minor folding are difficult to determine from the sparse outcrops on scattered islands. Variations in the strike of the flows, however, are numerous. In places some of the pillow lavas appear nearly flat. On island No. 22, near the southeast shore, banded schistose lavas are much contorted into minor folds, the axial planes of which strike east-west and dip 75°S. All the folds pitch easterly at 40 degrees. It seems probable that some of this secondary folding is post-granodiorite in age, as veinlets and fractures in the granodiorite at the Sullivan and Siscoe mines were found to have been similarly contorted and to have an almost identical pitch.

TÉMISCAMIAN

Témiscamian sediments outcrop along the shores of Lemoine lake and extend northwest and easterly, well across the area, to the south of the Keewatin. They appear not to have been intruded by later granitic rocks in this area, though to the west, in Fournière township, intrusives of this type are abundant in the Témiscamian. Diabase dykes cutting these rocks have been mapped on the Dubuisson sheet.

Only the northern border of the sediments was examined. They consist there of finely interbedded, schistose greywacke, arkose, and slate, composed largely of quartz, biotite, hornblende, and minor feldspar. The beds seldom exceed one foot in thickness and usually average but a few inches. Slaty cleavage due to shearing is confined to the slaty beds and is essentially parallel to the bedding. The schistose cleavage of the greywackes, as

shown by oriented micas and hornblende, is likewise practically parallel to the bedding. At a point about two miles southeast of the lake, fracture-cleavage was found cutting the bedding at a low angle. These observations indicated the tops of the beds to be facing south. Similar distinctions on a basis of gradation in size of grain, or cross-bedding, could not be found, but the structure thus determined fits that of the Keewatin and indicates that the sediments lie in a syncline above the volcanics.

The relation existing between the two series is not readily determined in this area, because of the highly schistose nature of the contact. The general concordance in strike, and the presence of intercalated sediments with the volcanics near the contact, suggests that little if any unconformity exists between the two series here.

Within the sediments above described, and running parallel to the bedding for distances of many hundreds of feet, are numerous dark-bluish quartz veins. These seldom attain a foot in thickness, and they pinch and swell, but their persistence along the strike of the rocks is remarkable. In no place, however, were they found to contain other minerals than quartz, and, while not differing much in appearance from some gold-bearing quartz veins, they offer little encouragement for prospecting.

PRE-COBALT INTRUSIVES

Intrusive igneous rocks, assigned a pre-Cobalt age by other writers because of their relation to the Cobalt sediments in areas to the west, are abundant throughout this district. They vary greatly in size and shape of occurrence and in composition, and intrude the rocks mapped as Keewatin. In general the oldest are the more basic, the youngest, the more acidic. They are best divided into two main groups which are to be distinguished from a third group of younger gabbro (diabase) intrusives which have many features in common with Keweenawan dykes of other areas in Quebec and Ontario.

The oldest type has now the composition of hornblende diorite, but is characterized by a pronounced ophitic texture and a

gabbroic rather than dioritic aspect. This will be classified as the ' older ' diorite or diabase and appears to be the counterpart of similar rocks in the Rouyn area, described by Cooke (1). It has a relatively small distribution in the southeast portion of the area.

The second, younger, group consists dominantly of a sodic granodiorite which attains batholithic dimensions in Bourlamaque and south Louvicourt townships. Associated with the granodiorite, and closely following its intrusion, are a great variety of porphyritic rocks which occur as dykes either in the Keewatin or in the granodiorite itself. They range from granodiorite to syenite and aplite in composition. Some might be classed as quartz porphyries. Like the granodiorite, they are rich in soda. In a few places, as at the Siscoe mine, small dykes of andesite cut the granodiorite, but their relation to the porphyries is not certain. In outcrops at lake de Montigny, mica lamprophyres cut across sericitized porphyry dykes and appear as an end phase of this period of intrusive activity. Associated with this group of intrusives are the quartz-tourmaline veins carrying gold. They appear in general to be later than the porphyries and both earlier and later than some of the andesites. It is possible that the copper mineralization in Bourlamaque and Louvicourt townships is also related to the granodiorite group of intrusives.

Older Diorite

In Bourlamaque township, to the south and east of the confluence of the Sabourin and Bourlamaque rivers, and on the Hughes mining claims a few miles to the west of this point, small elongated masses of dark hornblendic rocks protrude above the glacial drift and clays. Similar rocks were noted on the Obaska property, in western Louvicourt. They occur locally in contact with greenish rhyolites which they intrude, and in one place, south of the Sabourin river, are cut sharply by a dyke of coarse granodiorite (acid plagioclase) porphyry.

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(1) Cooke, H. C., Geol. Surv. Can., Sum. Rept., 1926, Part C, p. 52.

Thin sections of these rocks were examined, and in all cases they were found to be diorites in composition, with andesine feldspar, green to nearly colourless (bleached) hornblende, minor quartz in graphic intergrowth with acid plagioclase, titaniferous magnetite or ilmenite, and titanite as the chief constituents. Secondary minerals are abundant, consisting of epidote, zoisite, sericite, and chlorite. The texture is medium grained, and always markedly ophitic. This description agrees closely with that of Cooke's (1) ' older gabbro ', later called quartz-diorite, but since primary quartz is here such a minor constituent and always in graphic intergrowth with feldspar, the writer prefers to call the rock diorite.

Intrusive relations show these rocks of an age between the Keewatin (and probably Témiscamian) and the granodiorite porphyries. Cooke (2) has suggested that similar rocks of the Rouyn area are very closely related in age to the granodiorite, since they differ so little from basic phases of the latter. This may well be, though no proof of such a relationship is available in this area. As noted below, however, there are in this district other quartz diorites which border the granodiorite intrusives and appear to grade into them. These differ from the ' older ' diorite in lacking the distinctive ophitic texture, and for this reason the two have been mapped and described separately. They may be slightly different phases of the same intrusive.

Granodiorite Series of Intrusives

In this group of intrusive rocks may be included a relatively basic chloritic contact-phase of the granodiorite, quartz-diorite, the granodiorite proper, and a number of porphyritic rocks slightly later in age but very similar chemically. Associated with them are porphyries of a more alkaline or siliceous type and even small masses of granite and dykes of aplite which may similarly be grouped together, though in the field and even microscopically they are distinguished from the granodiorite group with dfficulty.

(1) Cooke, H. C., op. cit., 1926, pp. 51-53.
(2) Ibid., p. 53.

Cutting the porphyries are minor lamprophyre dykes, genetically related to the more acid intrusives. Diabases, and both quartz- and olivine-gabbros, cut the granodiorite and seem to belong to a distinctly later period of intrusive activity, probably Keweenawan.

QUARTZ-DIORITE, DIORITE—CONTACT PHASE OF GRANODIORITE :

All the rocks mapped as quartz-diorite are dark, chloritic, and medium grained. In most cases they are highly altered. Locally they have been sheared and given a schistose texture. Some adjoin the granodiorite, as in Bourlamaque and Louvicourt townships. Other masses occur separately, as at a point half a mile southeast of the Unison mine. It is probable that the Siscoe intrusive, described separately below, belongs here, though it is now so altered it is difficult to distinguish even as a granodiorite.

The quartz-diorite in Louvicourt, on the southeast edge of the granodiorite, is highly feldspathic and somewhat porphyritic. It contains andesine feldspar, some quartz, and abundant chlorite and epidote.

A small mass of similar rock intrudes sericite schists 1¼ miles east of the Read-Authier property. It contains highly altered feldspar, near andesine, graphic intergrowths of quartz and acid plagioclase, and secondary chlorite, sericite, epidote, and carbonate. The presence of graphic intergrowths of quartz and feldspar suggests a resemblance to the Siscoe intrusive.

Just to the southeast of the Unison mine, south of lake De Montigny, a rounded stock of a medium grained intrusive is completely isolated by drift from all other rocks. From south to north, it ranges in composition from diorite to quartz-diorite, with a decrease in hornblende and an increase in quartz content. The feldspar is andesine ; secondary epidote, chlorite, and calcite are present, and a little black tourmaline replacing hornblende. The rock resembles both the above described quartz-diorites and the so-called amphibolites which are associated with granitic intrusives to the west. In containing abundant fresh hornblende, it is especially like the latter.

Other rocks of this type occur on the Read-Authier property

where shearing, alteration, and their admixture with Keewatin lavas is such that their mapping is more or less diagrammatic. These are described below under the heading of Read-Authier Intrusives.

THE SISCOE INTRUSIVE :

The intrusive rock in which the gold-bearing veins of the Siscoe mine occur occupies the northern portion of Siscoe island and extends an unknown distance into the adjacent portions of lake De Montigny. This small stock, nearly a mile long, east and west, was mapped by early workers as a part of the Keewatin, but James and Mawdsley (1) distinguished it as an intrusive and correlated it with the granodiorite of the Sullivan mine and Bourlamaque township. Particularly where carbonated near the *D* shaft, it greatly resembles massive volcanic flows, but where less altered to carbonate it has a dark green colour and is locally schistose. Near the *C* shaft and office buildings there are two distinct phases, one green and chloritic, the other light-weathering and quartzose. The latter intrudes the former as small dykelets, tongues, and irregular stringers. The chloritic portion is in most places characterized by bluish opalescent eyes of quartz. On a weathered surface, both quartz and feldspars stand out in sharp relief. To the west and underground, this type predominates. Thin sections show the quartz as rounded phenocrysts or intergrown with feldspar, which is close to albite in composition. These phenocrysts and intergrowths occur in a groundmass consisting entirely of secondary minerals. Quartz, chlorite, and epidote, and locally magnetite, pyrite, chalcopyrite, and tourmaline, are present.

The light-weathering dykelets are micropegmatites consisting almost entirely of quartz graphically intergrown with plagioclase (Ab90An10). They are thus identical in composition with the ' phenocrysts ' of the chloritic phase, which strongly suggests that the latter are secondary.

That the two phases are intimately related is evident from their field occurrence. That the chloritic phase is an intrusive into the Keewatin is shown by its uniformity underground and to

(1) Op. cit., 1926, pp. 67-68.

the west, and by its difference from volcanic rocks to the south. That it is related to the granodiorite is strikingly shown by chemical analyses of material collected from the Central shaft. This was homogeneous, showed blue eyes of quartz, and no stringers of micropegmatite. The analyses (see page 24) show the Siscoe rock to have a slightly higher soda and iron content, a typical low potash content, lower lime, and very similar silica, alumina, and magnesia content, compared with less altered granodiorites from the Sullivan and Herbin Lake properties. The higher content of secondary minerals in the Siscoe rock, compared with the other rocks analyzed, makes the chemical correspondence rather surprising. It is probable that the dominant constituent added during the alteration was soda ; allowing for such an addition, the original rock would correspond more with a quartz-diorite than a granodiorite, though there is no question that both these rock types are here intimately related in time. The intrusive is cut by dykes of albitophyre or albitite and dykes of andesite, as well as by numerous gold-bearing quartz-tourmaline veins.

Sodic Granodiorite :

The granodiorite intrusive extending east from the Sullivan mine, lake de Montigny, for 15 miles across Bourlamaque into Louvicourt township, with a maximum width of five miles, is a coarse grained rock of pink to grey colour and is characterized chemically by a high-soda low-potash content. Thin sections of specimens collected at various places show a fairly constant mineral composition. The rock is marked almost everywhere, as noted by James, by bluish opalescent eyes of quartz. The feldspar is plagioclase, ranging in composition from oligoclase to almost pure albite. No orthoclase was observed in the thin sections examined, nor was quartz seen in graphic intergrowth with the feldspar. Other minerals present are quartz, green hornblende (in part altered to chlorite), magnetite, ilmenite, titanite, and apatite, together with secondary chlorite, epidote, sericite, and carbonate. In specimens from the Sullivan and Herbin Lake properties, the plagioclase is between Ab90An10 and Ab80An20, while that in a sample from Louvicourt township was found to be almost pure albite.

The accompanying Table gives the results of analyses, made at the Provincial Government Assay Laboratory, Ecole Polytechnique, Montreal, of samples of granodiorite collected from the dumps at the Siscoe and Sullivan mines, and from drill core at the Herbin Lake property. With these are given analyses of an average granodiorite and diorite. Allowing for the water and carbon dioxide content (loss on ignition), the analyses correspond to a rock between the average granodiorite and diorite. With free quartz present, these rocks cannot well be classed as diorite, and the term granodiorite is therefore retained. The exceptionally high soda and low potash content justifies the use of the prefix ' sodic '.

ANALYSES OF GRANODIORITE AND DIORITE

	Siscoe	Sullivan	Herbin Lake	Average Granodiorite*	Average Diorite*
Sp. Gr.	2.7682	2.7847	2.7868	.....	....
SiO_2	57.37	57.06	58.98	65.82	57.56
TiO_2	tr.	tr.	tr.	0 52	0.85
Al_2O_3	14.48	16.44	15 80	15 99	16.90
Fe_2O_3	1.58	0.86	1.60	1.66	3.20
FeO	8.98	6.33	4.73	2.69	4.46
MnO				0.05	0.13
CaO	3.49	5.36	6.75	4.71	6.83
MgO	1.96	1.73	1.25	2.19	4.23
Na_2O	7.13	6.40	6.28	3.86	3.44
K_2O	0.32	0.90	0.71	2.32	2 15
P_2O_5	0.03	0.08	0 35	0.16	0.25
FeS_2	0.26	0.43	0:35	.....	.....
Ignition	4.52	4.76	3 92	.....	.....
	100.12	100.29	100.22	100.00	100.00

* Analyses from Daly's "Igneous Rocks and their Origin", 1914, p. 386.

The granodiorite is cut by porphyries of somewhat similar composition and by small aplite dykes. One dyke of later diabase or gabbro was found cutting the intrusive near the falls on the Bourlamaque river.

The main intrusive has dimensions of a small batholith. From the borders to the centre, very little difference in size of grain was noted. The exceptionally low relief across the mass, and the presence of fairly abundant inclusions of chlorite schist at least a mile from the nearest contact with Keewatin rocks, suggest that the exposed surface of the intrusive is everywhere fairly close to its original top, which in this case must have been rather a rounded than an inclined, serrated surface. No evidence was found, however, that would suggest it might be a sill or laccolith.

THE READ-AUTHIER INTRUSIVE :

Throughout the Keewatin rocks south of the main granodiorite tongue which extends west to lake De Montigny are several small masses of rocks possibly related to the granodiorite. The majority of these are small and unimportant. On the Read-Authier property, Bourlamaque, is a complex assemblage of rocks the mapping of which is perhaps open to question. In the central portion, outcropping on a ridge to the east of the camps is a porphyry with phenocrysts of both quartz and feldspar. The latter consist of orthoclase and oligoclase in a fine groundmass of secondary minerals such as zoisite, chlorite, carbonates and sericite. The rock has suffered considerable shearing and is altered in places to sericite schist. In composition it corresponds to a granite porphyry. Small dykes of syenite porphyry, with fine phenocrysts of feldspar cut it in several places. The grain of the porphyry is such that it might belong either to an acidic lava flow or to a fine grained intrusive. On earlier maps it appears as a part of the Keewatin. Lack of definite volcanic textures, and the presence of similar rocks occurring as definite intrusives in various drill cores, support the present interpretation that it is intrusive, though well defined intrusive contacts were not found on the surface.

Surrounding this acidic rock is a zone of more basic chloritic rocks of a highly altered character. On the main map sheet these have erroneously been labelled granodiorite instead of diorite or quartz diorite. This zone is by no means homogeneous, but includes chloritic and carbonate schists following shear zones and of questionable origin, breccias, in part of a volcanic nature, made up of acidic to basis rock fragments in a chloritic groundmass, and of medium to fine grained chloritic diorite or quartz diorite. Drill cores show these rocks are cut by numerous less chloritic dykes of quartz diorite porphyry, containing in places, either biotite or hornblende. The whole is interpreted as a contact zone near the roof of an intrusive of dioritic composition, and probably related to the main granodiorite which comes to the surface in this latitude, east of the Bourlamaque river. In support of this may be noted the presence of fairly high-temperature, auriferous quartz-tourmaline veins, similar to those found elsewhere in the granodiorite itself.

Just to the north of Shaft No. 1, a 15 foot vertical section is visible in a sharp depression. At the top, the rock is highly schisted, and consists of acidic and basic rock fragments in a chloritic matrix identical with many volcanic breccias. Traced downward these pass rapidly into larger and less schisted fragments of coarser grain and dioritic composition, and at the base of the exposure the rock is homogeneous and resembles a quartz diorite, not dissimilar from the chloritic phase of the Siscoe intrusive. It is interpreted as an intrusive capped in places by remnants of Keewatin flows or breccias.

All of this zone has been mapped earlier as Keewatin and volcanic in origin. The occurrence just described is plainly open to this interpretation, that the top is merely a schistose breccia of a coarse flow. It might be noted that the altered Siscoe intrusive was at one time also interpreted as a flow, the alteration making the identification extremely difficult. No final conclusion is here given, but the two possibilities should be further examined. Should this zone, excluding the several intrusive dykes found in drill cores, be largely volcanic, however, a significant structural interpretation may be made, namely that to the north of Shaft

No. 1, the flows lie in a horizontal position, with possibly a pitch to the west, and that an easterly trending anticlinal axis passes through this point. This, in conjunction with the known intrusive dykes, and the presence of some auriferous quartz veins, is a feature worthy of further study from an economic point of view. Incidentally, this structure is one into which intrusives related to the granodiorite might well be expected to make their way.

Other small intrusives occur as rounded stocks in the Keewatin to the west of the Read-Authier property and south of the Greene-Stabell mine. These are more acidic than granodiorite and may be classified as monzonites or granites. Since they cut granodiorite, they are described below.

Porphyritic Intrusives :

Other porphyritic intrusives, consisting chiefly of narrow dykes, are abundant in the southern belt of Keewatin rocks and cut the granodiorite. Except at the Read-Authier property, as mentioned above, none of the several types of porphyry were found in contact with one another, so definite age relations are not known. In composition, they range from granodiorite to granite. Some are highly alkaline, and, though containing quartz, they are rich in albite and are properly classed as albitophyre or albitite.

Cooke (1) has described granodiorite porphyry dykes at the Greene-Stabell and Sullivan mines, and on the Legault property, Dubuisson township. They are of common occurrence elsewhere. As regards their age, they may be seen cutting the granodiorite at the Sullivan mine, and on the Legault claims they cut across a breccia consisting of fine granodiorite with angular fragments of chlorite schist (Plate II-A). To the south of the Greene-Stabell mine, a small dyke, more siliceous than a granodiorite, either a quartz-monzonite or granite, was found cutting a dyke of the granodiorite porphyry. Cooke placed these granodiorite dykes as younger than the syenite porphyry dykes, since faults striking N.75°E. in lots 38-43, range VII, Dubuisson, cut through syenite

(1) Cooke, H. C., Op. cit., 1923, pp. 80-100.

porphyries, and at the Legault claims faults with a similar strike are cut by the granodiorite porphyry. However, detailed mapping has since shown that the latter also is displaced by faults with this strike, so that both types of dyke are apparently earlier than this faulting.

That there is some relation between dykes of this type and the gold-bearing veins is suggested by occurrences at the Greene-Stabell mine, where, though the dykes cut a fault-zone mineralized chiefly with pyrrhotite and pyrite, quartz stringers, and some chalcopyrite carrying gold, cut or lie alongside them. That they are younger than at least some quartz-tourmaline veins is suggested by an occurrence at the Sullivan mine (see Figure 4), though their relation to the larger veins there is not known.

Examination of the various porphyries shows them to be clearly related, the major difference in mineral content being the presence of a larger amount of hornblende, and slightly more basic feldspars, in those of granodiorite composition. Granodiorite porphyry from the Greene-Stabell mine is a striking rock, containing white feldspar (near andesine) phenocrysts set in a dark, fine matrix. It is highly altered and contains also chlorite (probably after hornblende), secondary quartz, epidote, carbonate, and ilmenite with a zonal border of titanite. In the Legault porphyry, unaltered hornblende is present and the feldspar is oligoclase. Rarely, biotite is found in these rocks.

Coarse Granodiorite, or Acid Plagioclase Porphyry :

In the southern portion of Bourlamaque township, near the Sabourin river, is a striking porphyry with blocky feldspar phenocrysts, nearly one centimeter long, set in a darker matrix of similar feldspar, quartz, and chlorite. Titanite is also present in rounded zones about ilmenite. The feldspar is acidic andesine ($Ab_{65}An_{35}$) and is all highly sericitized. A few phenocrysts of hornblende are present in some specimens. In composition, the rock is very similar to the Stabell type of porphyry. South of the Sabourin river it cuts the ' older ' diorite as a dyke. About a mile to the north it occurs, perhaps as a small stock, in completely isolated outcrops.

SYENITE AND FELDSPAR PORPHYRY :

Porphyries classed as syenite occur at the Martin mine and at the old St. Germain claims on lots 38-43, range VII, Dubuisson township. These have been described by Cooke (1). They are medium grained rocks with phenocrysts of albite or oligoclase-albite, and some of orthoclase, in a groundmass of the same minerals with some hornblende and biotite.

Feldspar porphyries distinguished, as are the above, by their high content of sodic feldspar and low content of potash feldspar, occur on Siscoe island, both in the Keewatin and granodiorite. Near *E* vein, on the northwest shore of the island, a medium grained porphyry of this type contains phenocrysts of albite-oligoclase in a much altered matrix of chlorite, calcite, sericite, and quartz. In the granodiorite at Siscoe, a waxy-looking porphyry of very fine grain is characterized by a few phenocrysts of albite in a matrix of finer laths of the same mineral, some quartz (in part primary), and chlorite with sericite. This rock has been called an ' albitite ' or ' albitophyre '. Following is the result of an analysis of the rock, made in the Provincial Government Assay Laboratory, Ecole Polytechnique :

SiO_2	72.96
TiO_2	None
Al_2O_3	13.73
Fe_2O_3	0.53
FeO	1.29
CaO	1.57
MgO	1.92
K_2O	1.42
Na_2O	4.78
P_2O_5	0.07
FeS_2	0.30
Ignition	1.54
	100.11
Sp. Gr.	2.6690

(1) Op. cit., 1923, p. 88 and p. 97.

Feldspar porphyries were encountered in several diamond-drill holes put down by the Stanley Siscoe Extension Company in the bay east of Siscoe island. The phenocrysts are albite-oligoclase. Some primary quartz, biotite, and the common secondary minerals are also present. Other finer grained porphyries occur in the same cores as small dykes and consist almost entirely of feathery laths of albite intergrown with minor quartz. Porphyries of this type also occur to the southwest of the Caribou Copper property, in Bourlamaque township, and consist of fine albite in a groundmass of secondary quartz, chlorite, and kaolinite.

A fine grained dyke of feldspar porphyry occurs on the northeast corner of Parker island, in lake De Montigny. This, too, contains phenocrysts of albite in a groundmass fairly rich in finely crystalline quartz, with chlorite and epidote.

QUARTZ-FELDSPAR PORPHYRY, GRANITE, AND APLITE :

Porphyries with phenocrysts of both quartz and feldspar are present in the granodiorite or quartz-diorite at Siscoe island (*D* shaft), in the Keewatin half a mile south of the Greene-Stabell mine, and at the Read-Authier property. The feldspars, except in the last named, which contains some orthoclase, are sodic plagioclase, near albite. The Siscoe Island rock is much altered and contains chlorite, carbonate, quartz, and sericite in the groundmass. That from the Read-Authier contains biotite as well. It is cut by a 2½-foot dyke of green diorite or andesite consisting chiefly of andesine feldspar, hornblende, biotite, and epidote. This may correspond to certain fine grained andesite dykes encountered in the Siscoe mine. The Read-Authier porphyry has been described above.

Corresponding closely in composition with these porphyries but, in places, lacking a porphyritic texture, are dyke-like masses on the northeast shore of lake De Montigny, just east of Siscoe island, described as granite by James and Mawdsley. They are medium grained, and grey to brown in colour. They contain, besides albite-oligoclase, a little orthoclase or microcline, graphically intergrown quartz and feldspar, biotite, and alteration pro-

ducts. Ferromagnesian minerals are lacking. Locally, as shown by drill cores, these rocks have porphyritic phases. From their mineral content, they are best classified with the granite family of rocks.

Intrusives of true granite are exceedingly rare in this area, though they do occur in large masses both to the north and to the southwest. Some of the small stocks intruding the Keewatin south and east of Lake De Montigny have a composition between granite and granodiorite. They contain more quartz and more orthoclase feldspar than the latter, with albite or oligoclase, hornblende, biotite, and apatite. Some are quartz-monzonites in composition. One of these, half a mile south from the Greene-Stabell mine, was found cutting the granodiorite porphyry.

On the northeast shore of lake Blouin, just south of the mouth of the Colombière river, a small mass of granite or quartz-monzonite is exposed. It contains quartz somewhat irregularly distributed, orthoclase and microcline in moderate amount, plagioclase and hornblende. The plagioclase is of two generations, the earlier crystals, near andesine in composition, being small, with marked resorption borders, and are included in much larger crystals of oligoclase and microcline.

Aplite dykes are of common occurrence throughout the granodiorite intrusives. They are fine grained, pinkish in colour, and contain quartz, microperthite, and albite or oligoclase-albite. At Herbin lake they appear earlier than quartz-tourmaline veins.

AMPHIBOLITE :

In the western portion of the area, in Dubuisson township, are several small outcrops of granitic rocks with an exceptionally high content of dark hornblende. In the adjacent township of Fournière, James and Mawdsley (1) have mapped several intrusive bodies of granite, one near the northeast corner of the township. The eastern portion of this and the scattered outcrops to the southeast of it contain 50 per cent or more hornblende, with

(1) Can. Geol. Surv., Sum. Rept., 1925, Part C, pp. 64-67.

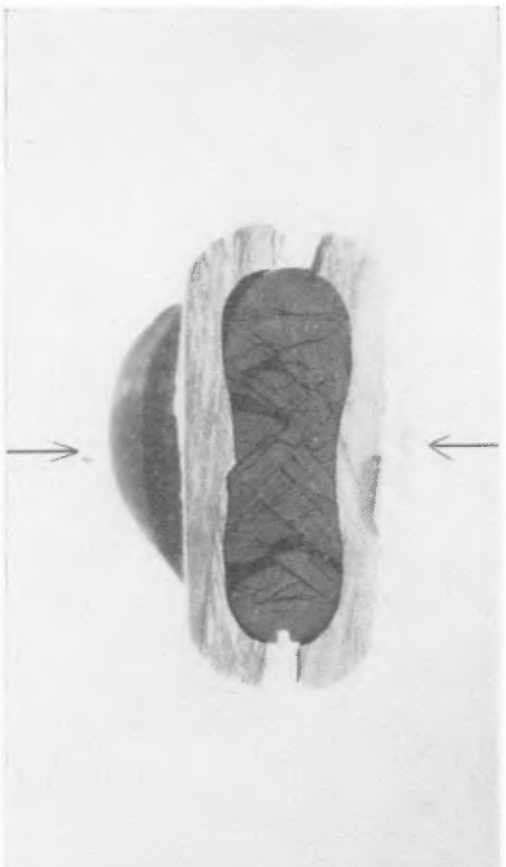
quartz, frequently in graphic intergrowth with feldspar, orthoclase and albite, and magnetite. They are probably to be interpreted as contact phases of the granite. It is interesting to note that quartz-tourmaline veins of the type associated with the granodiorite to the east are also to be found in these rocks.

MICA LAMPROPHYRE :

On the northwest shore of lake De Montigny, and on several small islands in this lake to the west of Siscoe island, small lamprophyric dykes cut through highly sericitized feldspar porphyries. They contain a high percentage of brown biotite, fine needles of a nearly colourless amphibole, and a minor amount of finely crystalline quartz. So far as observed, they invariably have a schistose texture, with the micas oriented parallel to the dyke walls. They may be complementary to some of the acidic porphyries in the region. Other basic dykes, later in age than the granodiorite, are the andesites described in the section dealing with the Siscoe intrusive. They are quite unlike the mica lamprophyres.

SUMMARY : THE GRANODIORITE SERIES OF INTRUSIVES :

The groups of related intrusives described above, while consisting dominantly of granodiorite, range in composition by scarcely perceptible changes from diorite to granite. This variation is best accounted for by differentiation, and to some extent by assimilation of invaded rocks. Contact phases of the granodiorite include rocks rich in hornblende and dark in colour, resembling coarse volcanic rocks. The porphyritic rocks, as might be expected, vary considerably, but all the main intrusives are characterized by a relatively high content of soda. In or close to the larger intrusives, quartz-tourmaline veins of fairly high temperature origin carry gold. These are found in the contact phases as well as in the main intrusives. Associated with the several porphyries are quartz veins carrying chalcopyrite and, in a few places, galena and sphalerite, with also values in gold. These are of somewhat lower temperature origin, and are both smaller and of lower value than the veins of the first type.



A.—Photograph showing Siscoe type of fractures developed by compression of a cylinder of shale in a steel tube. The fractures opened up after the steel was cut.

B.—Vein No. 1 on Legault property.

KEWEENAWAN, OR PRE-COBALT (?), GABBRO

The youngest intrusive rocks in the area consist of olivine-diabase and quartz-diabase dykes, which cut the Keewatin, the Témiscamian, and the granodiorite. Similar intrusives in the area to the west have been described by James and Mawdsley (1) and are shown on their Dubuisson map-sheet as occurring in several places. In no place in the area here dealt with were the two types of dyke found in contact.

A quartz-diabase dyke occurs on the northeast end of the second island northwest of Siscoe island. So much of it is drift covered that its strike is not known. It is medium grained, and consists of labradorite enclosed by augite, together with ilmenite and leucoxene, and a minor amount of quartz in graphic intergrowth with feldspar. This dyke, near its western border, contains two six-foot bands of a dense, black rock which has been polished by ice action and resembles tourmaline at first glance. It grades into a dense porphyry which, under the microscope, is seen to be simply a fine-grained phase of the diabase.

Other dykes of similar composition occur on the northwest shore of lake Blouin. A small dyke of diabase, free from primary quartz, cuts the granodiorite on the claim just east of the falls on the Bourlamaque river.

The olivine-diabase differs from the other type chiefly in weathering dark brown. Besides containing labradorite, augite, and titaniferous magnetite, some apatite, a little biotite, and olivine are present. Such a dyke occurs in lot 44, range VIII, Dubuisson township.

These gabbroic intrusives require distinction from the older diabasic rocks containing hornblende, described on an earlier page. The latter strike more nearly parallel with the volcanic flows in which they occur and are easily distinguished by being hornblendic, whereas the younger diabase dykes strike across the formations.

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(1) Op. Cit., 1925, p. 68.

These younger gabbros or diabases have been assigned by Wilson and also by Bancroft (1) to the Keweenawan. In the Opasatika map-area, however, Cooke (2) found similar gabbros underlying the Cobalt sediments, and as a consequence he referred them to the pre-Cobalt intrusives. Since, in the area under discussion, they differ so materially from the other pre-Cobalt intrusives—though it is true that the latter include some diabasic rocks—and since they do not fit in the sequence worked out for these earlier rocks, the writer favours a Keweenawan age for them. Their similarity to Keweenawan rocks of other areas has been noted and commented on by other observers.

FAULTING IN PRE-CAMBRIAN ROCKS

Faults of considerable magnitude have been found in and about the mines and prospects in Dubuisson township. On Siscoe island, James and Mawdsley (3) have noted the faulted southern contact of the intrusive and Keewatin rocks. It trends slightly south of east and is marked by a highly schistose zone of rocks which were eroded to some depth by a former stream, the valley of which has since been silted up with sand and gravel. Fracture-cleavage in the adjacent rocks suggests that the south side moved east. Other faults at the Martin mine, at the old St. Germain-Gale claims and at the Legault and Greene-Stabell properties, have been noted by Cooke (4). The oldest of these trend south of east. The one at the Greene-Stabell mine has a horizontal displacement of 400 feet with movement of the north side to the south-east. The later faults strike north of east and cut the earlier ones. On the Legault property, a quartz vein lies in such a fault. At the Martin mine, easterly-trending faults have displaced the veins to the east on the south side.

A prominent fault of unknown displacement was encountered in the easterly workings of the Greene-Stabell mine. This strikes N.40°E., dips at 72°-75° N.W. and heads directly into Blouin lake,

(1) Op. cit., pp. 214, 222.
(2) Can. Geol. Surv., Sum. Rept., 1925, Part C, p. 69.
(3) Op. cti., 1926, p. 70.
(4) Op. cit., 1923, pp. 80, 88.

which lies on the same strike as Lemoine lake to the southwest. At Blouin lake, a sharp jog south in the northern contact of the granodiorite suggests a relation to the fault, that it is post-granodiorite, and that the northwest side moved north. This same relation is observed in vein deposits in the mine, but was not found in the south contact of the granodiorite, which is drift covered. Conditions similar to those on Siscoe island were found in the upper portion of this fault, which was deeply eroded and later filled with quicksand.

PLEISTOCENE AND RECENT

The Pleistocene and Recent deposits are of little economic importance at present. High sand ridges have been noted as occurring to the southwest of the south end of Blouin lake. Gravel and boulder ridges are prominent on the east side of this lake throughout its length. Elsewhere, the surface of the area is largely covered by deposits of excellently varved clays, which have a thickness of at least 20 feet and are well exposed along the shores of lake De Montigny. In these, irregular flat calcareous concretions occur in the thinner, apparently more porous, layers, which seldom exceed a quarter of an inch in thickness. The thicker layers are of dense bluish clay and attain a thickness of one inch.

ECONOMIC GEOLOGY

Gold deposits in veins of different types are the only ones which have so far been proved of economic importance in this area. The most important of these occur in or close to small stocks or tongues of granodiorite or related rocks. Mineralization in fractures in Keewatin rocks near the intrusives is in some places very similar, and it is possible that more deposits of economic value will be found, though the heavily drift-covered nature of the area conceals much favourable ground and, undoubtedly, some large veins, the finding of which will, of necessity, be the result only of expensive diamond drilling.

Chalcopyrite mineralization occurs in a few places, in Bourlamaque and Louvicourt townships, in Keewatin or other rocks where they are cut by more acidic porphyries. The exploratory work on such properties has not been successful in proving-up deposits of any commercial size or value, and in only a few places is further work to be recommended. Sufficient data are not at hand to justify the assignment of this type of mineralization to any particular intrusive. In a general way it seems mainly related to the intrusives of the granodiorite group.

The gold-bearing veins occur as four different types. The most important and widespread consist largely of quartz and tourmaline, the latter in places constituting over 50 per cent of the vein. Gold is present in these chiefly in the native state and rarely as a telluride. Other minerals include pyrite and minor amounts of chalcopyrite. Carbonates, of thermal origin, but perhaps slightly later in age, are also present. Veins of this type are found at the Siscoe, Sullivan and Unison mines ; at the Read-Authier, Herbin Lake, and Beauchemin properties in Bourlamaque ; in Louvicourt ; and near the northwest corner of Dubuisson. Veins of the three other types are of lesser importance, though in places they carry good values in gold. Examples are as follows : a quartz-pyrite-carbonate type at the Martin mine ; a quartz-chalcopyrite type cutting an earlier pyrrhotite mineralization at the Greene-Stabell and Legault properties ; and a quartz-pyrite-galena-carbonate type exposed at Parker island and on nearby shores of lake De Montigny. Details regarding the veins of different types are included with the descriptions of properties below.

That all the auriferous veins are associated with, and closely related in time to, the granodiorite or related porphyritic rocks is shown by their field occurrence. Differences in composition of the veins may be as well explained by differences in temperature and pressure conditions as by slight variations in the composition of the intrusives, the higher temperature type (quartz-tourmaline) which seem the richer in gold, prevailing near or within the larger intrusives, and the lower temperature ones in the adjacent

Keewatin schists where they are penetrated by smaller porphyry bodies.

All the veins are not necessarily of exactly the same age, nor, indeed, can they be actually traced to a common source. There is evidence in some localities that at least two stages of mineralization occurred, though these are not necessarily very far apart in time, and the minerals introduced are not always of distinctly different types. At the Siscoe mine, gold seems to occur with both stages of mineralization, but it is not yet known which is responsible for the main gold deposition. From the occurrence of the gold in fractures in both quartz and tourmaline it may be inferred that the later period was the more important.

In most cases, veins were introduced well towards the end of the granodiorite (pre-Cobalt) period of intrusive activity. There is reason to believe that some earlier veins were introduced after the main intrusions but before some of the porphyries and andesite dykes, and that the second period of mineralization followed these. This serves to emphasize the almost igneous character of some of the quartz-tourmaline veins, which are pneumatolytic and intermediate between pegmatites and deposits classed by Niggli (1) as hydrothermal. A relation between the veins and the alkaline porphyries (rich in albite) may be suggested, both being concentrations by differentiation from the original granodioritic magmas. Elsewhere, gold deposits are associated with alkaline quartz porphyries, as in the Porcupine district, Ontario. The exact rôle of the andesites can only be inferred. That they are intimately related to the veins in time is shown by their occurrence in the same fractures as the veins, which in part precede and in part succeed them. The significance, to the prospector, of there being at least two periods of mineralization, is that quartz veins of even fair size may be found carrying only low values in gold, unless they have been re-opened by fracturing and subjected to a later enrichment by other gold-bearing solutions.

In many of the deposits, alteration of the rocks enclosing the quartz-tourmaline veins is very pronounced. At the Siscoe mine,

(1) Niggli, Paul, "Ore Deposits of Magmatic Origin"; T. Murby & Co., London, 1929.

as noted previously by Cooke, and in other places, the walls of quartz-diorite or granodiorite have been altered for distances up to five or more feet away from the veins. This alteration consists in the development of tourmaline and pyrite, locally of apatite, and in many places of albite. The Siscoe mass as a whole is intensely chloritized, and locally carbonatization has been a dominant change. In still other cases, as at the Sullivan, epidotization is marked. Cooke (1) has called attention to the enrichment of the wall-rocks in soda by the development of albite. This is little to be wondered at in view of the highly sodic character of practically all of the granodiorite group of intrusives.

The formation of the vein deposits has depended not solely on the intrusion of the alkalic family of granodiorite rocks, but also on the occurrence of fractures suitable as sites of deposition. The occurrence of many of the deposits in faults, sometimes of considerable displacement, shows that the intrusives and adjacent rocks were subjected to external regional stresses during, as well as following, the periods of mineralization. The best deposits thus occur in fractures not related simply to shrinkage on cooling of the intrusive masses themselves. In general, however, the intrusives, probably being the more brittle, were fractured more closely in places, while the more altered and schistose Keewatin yielded by both flowage and faulting. The number and closeness of the faults in which veins formed in the latter rocks does not appear as great as in or near the borders of the intrusives.

It is considered, then, that the best areas for future prospecting are the small stocks of intrusive granodiorite or related rocks and the contact zones of the main granodiorite mass. That veins of appreciable size occur near the latter is strongly suggested by the fact that large pieces of vein-quartz float are found to the south of the southern granodiorite contact ; but, unfortunately, only diamond drilling will discover such veins, as the contact is in most places heavily drift-covered.

(1) Op. cit., 1923, p. 99.

DESCRIPTION OF MINING PROPERTIES AND PROSPECTS

I.—GOLD MINING PROPERTIES

Siscoe Gold Mines, Limited

General Description :

The property of Siscoe Gold Mines, Limited, the only producing Company in the area, centres about Siscoe island in lake De Montigny. The holdings include also the adjacent waters, four small islands to the northwest, and a section along the mainland to the northeast, embracing lot 39, range I, Varsan township. The main island lies partly in Varsan and partly in Dubuisson township. Mr. J. M. Forbes is managing director, and Mr. C. O. Stee is manager at the mine. In March, 1930, the capital stock of the Company was increased from four million to five million shares of one dollar par value.

For an account of the early discoveries and development up to 1926 the reader is referred to the report by James and Mawdsley (1). Up to that time, five main veins had been discovered and explored to some extent. These were designated the *A, B, C, K,* and *Siscoe* veins. Four shafts—*A, B, C,* and *D*—were sunk to shallow depths. From the bottom of *D* shaft, which is inclined to the east at 57 degrees and reaches a vertical depth of 75 feet, workings were driven north and south to intersect the *Siscoe* and *K* veins, respectively. *C* shaft, inclined to the west at about 40°, had at that time been sunk to a depth of 100 feet.

During and since 1928 attention has been confined largely to vein *C*. The shaft was deepened to the 5th, or 500-foot, level and lateral workings opened up on the 170-, 270-, and 390-foot levels. Milling equipment was installed, and in January, 1929, the mine came into production. Later in 1929, following the

(1) Op. cit., 1926, pp. 66-72.

discovery or re-discovery of a vein striking northeast, nearly parallel to the cross-cut driven south from *D* shaft, an extensive diamond-drilling campaign was carried out which proved the continuity of this and a parallel vein below it to vertical depths of 450 feet and over a length of 500 feet. The main vein is known as the *New* vein. It strikes northeast, nearly parallel to vein *C*, and dips 50°S.E. To the east, vein *C* dips west at about 40°. Midway between the two, a vertical, three-compartment shaft was completed in the spring of 1930 to a depth of 472 feet. From this, cross-cuts have been driven northwest on the 300-foot and 450-foot levels, and in these the *New* vein was intersected at distances of, respectively, 350 feet and 225 feet. Two additional veins were met with on the 300-foot level at distances of 50 and 100 feet beyond the *New* vein. The first has proved to be a branch of the latter and the second has yet to be explored. Since the writer's visit to the field, the *New* vein has been traced 75 feet to the northeast and 100 feet to the southwest. To the northeast it is still in the face ; to the southwest it is terminated by a fault.

Above the 3rd level, most of the *C* vein has been stoped out. Stopes were being opened between the 3rd and 4th levels—a narrow portion of the vein—and between the 4th and 5th levels. From the Central shaft, 300-foot level, workings have been driven east and connected with the 5th level of *C* shaft by an 85-foot raise from the latter. At the 450-foot level, a cross-cut has been driven east to intersect the *C* vein on this level, and drift No. 402 has been driven 300 feet to the northeast, of which 150 feet is reported in ore. A plan and section of the underground workings appear in Maps Nos 149 and 150.

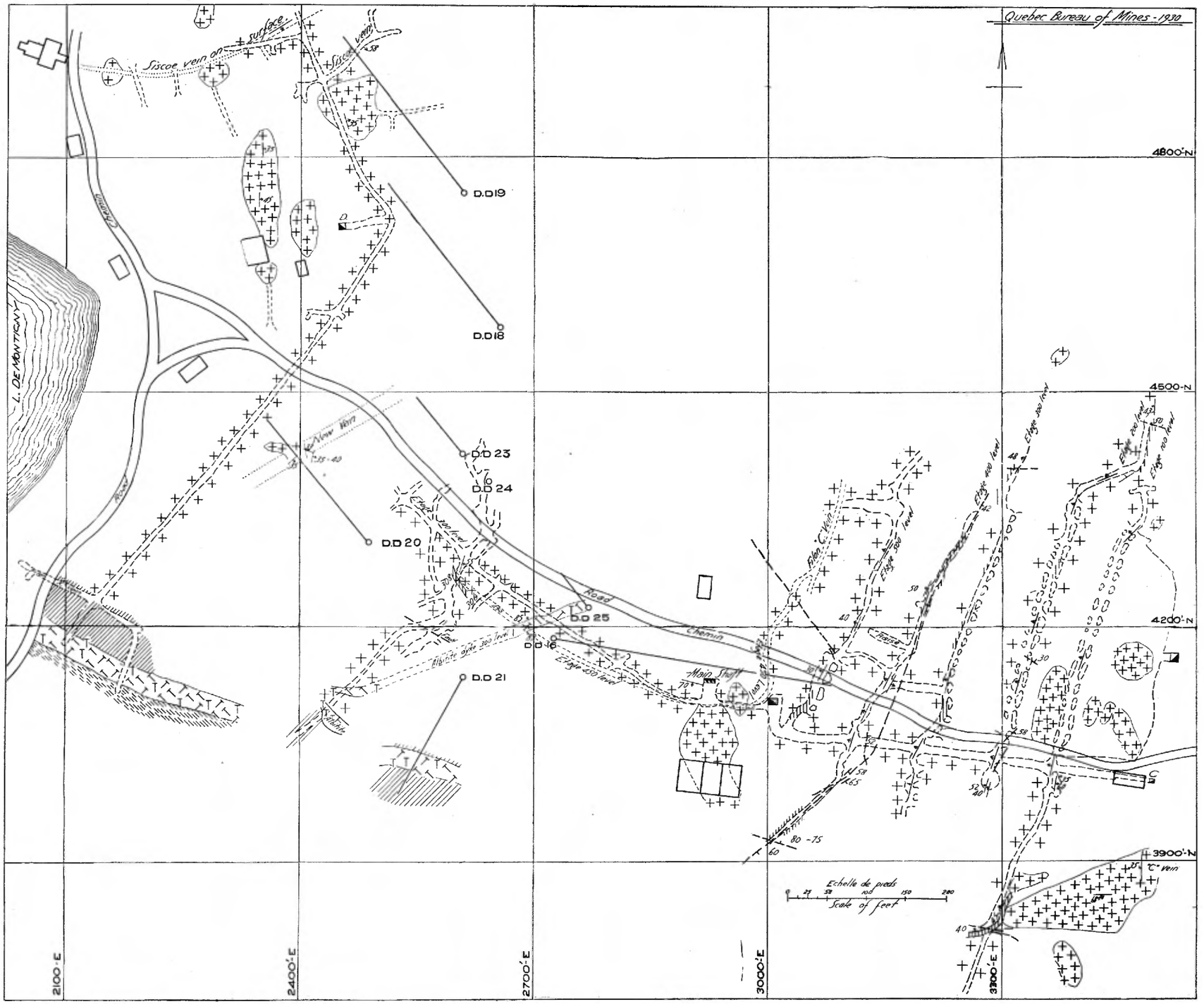
GEOLOGY :

The southern portion of Siscoe island is underlain by Keewatin volcanic rocks, chiefly pillow lavas and highly altered chloritic schists, which strike slightly south of east and dip nearly vertically. They are cut by a few altered basic dykes, now largely actinolite, and by younger feldspar porphyries, as at *B* and *E* veins.

The northern portion of the island is underlain by a peculiar phase of the granodiorite, which has been described in detail above

Legend—Légende

- Porphyry dykes. Dykes de porphyre.
- Andesite dykes. Dykes d'andésite.
- Altered Granodiorite or Quartz diorite. Granodiorite altérée ou diorite quartzifère.
- Talc, chlorite and actinolite schist. Schiste à talc, à chlorite et à actinolite.
- Keewatin, basalt, etc. Keewatin, basalte, etc.
- Geological boundary—assumed. Contact géologique—présumé.
- Outcrop boundary. Limite d'affleurement.
- Fault, strike and dip. Faille, direction et pendage.
- Vein, strike and dip. Filon, direction et pendage.
- Inclined drill hole showing direction. Sondage incliné montrant direction.
- Underground workings. Galeries souterraines.
- Shaft. Puits de mine.
- Buildings. Bâtiments.

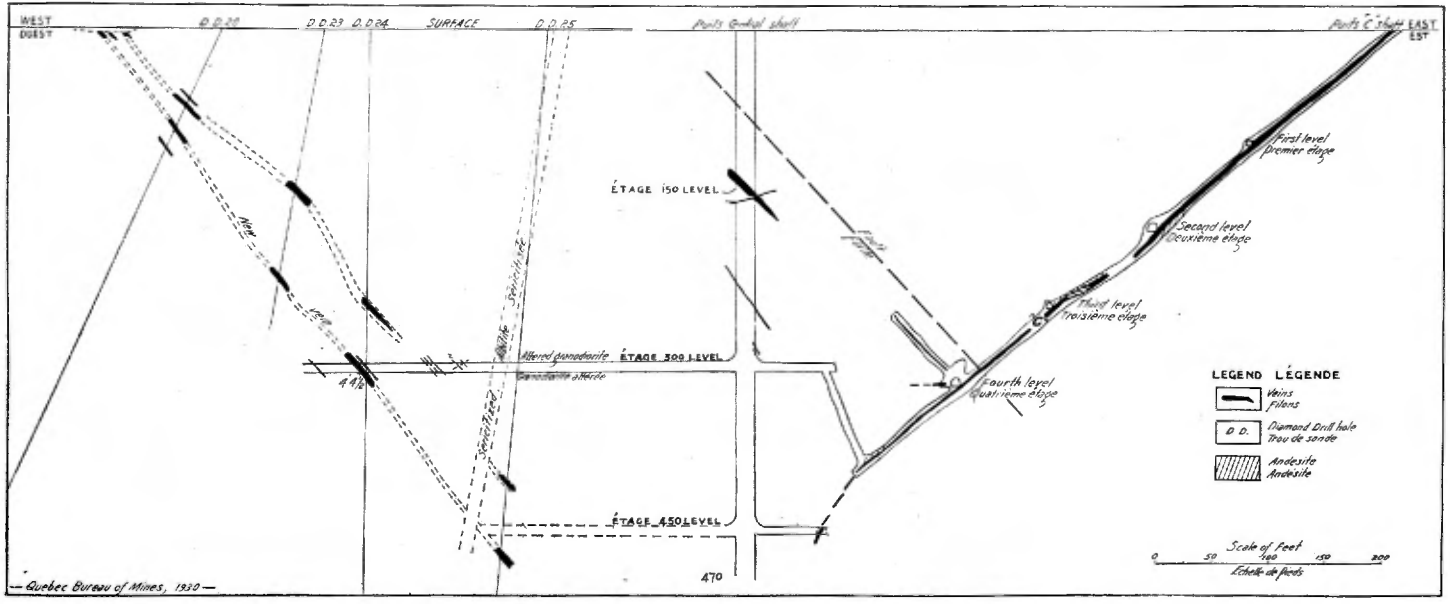


Map No. 149.—Plan of underground workings of Siscoe gold mine.

(page 22) and is perhaps best classified as a quartz-diorite. To avoid confusion, the earlier classification of granodiorite will be followed, though mineralogically the rock differs from the granodiorite of the Sullivan mine and Bourlamaque township. It is dark green, medium grained, and characterized by opalescent eyes of quartz and micrographic intergrowths of quartz and sodic feldspar. In the latter respect it resembles certain granophyres. Everywhere the intrusive is highly chloritic. In the vicinity of *D* shaft, carbonate alteration has prevailed, and the weathered, rusty-brown surface appears identical with similarly altered volcanic flows. Towards the west side of the island, the rock appears more basic, and only seldom are the typical blue eyes of quartz to be found.

The exposed length of the intrusive is about one mile in a N.E.-S.W direction, and the southern contact with Keewatin rocks lies 20 chains from the north tip of the island. It was thought this contact extended on the northwest across the east side of Powder island and islands Nos. 2 and 4. Outcrops on Powder island are so few and so altered that the intrusive could not be definitely identified there. In island No. 2, the strike of the contact is interrupted by a diabase dyke, and the other adjacent rocks cannot be distinguished certainly from the Keewatin. On the northeast side of island No. 4, a contact is suggested by a much altered and mineralized zone along the shore. This has been drilled and the cores show the presence of an intrusive rock, which, however, more resembles the feldspar porphyries described on an earlier page. The size of this mass and the northern contact of the main intrusive on Siscoe island are still to be determined. Magnetic surveys made with a dip needle by the writer's party along the southern contact of the Siscoe intrusive and across the granodiorite at the Sullivan mine indicate rather clearly that the two intrusives are not connected on the surface. That they are related, however, is well shown by chemical analyses. The Siscoe intrusive is thus considered a small stock.

The southern contact with the Keewatin, as indicated by workings from the *D* and Central shafts, and by drill cores, is highly schistose and probably faulted. It was not seen by the



Map No. 150.—Vertical cross-section, Siscoe gold mine.

writer, but, as described by James, it is marked by talc, actinolite, and chlorite schists of considerable thickness, which are eroded deeply at the surface and the depression filled with sand and boulders.

Intrusives cutting the chlorite granodiorite consist of micropegmatite stringers on the east, a quartz-feldspar-porphyry near and parallelling the contact, a finer grained feldspar porphyry, albitophyre or albitite, striking N.67°E., just west of the Central shaft, and several andesite dykes. Texture and composition of all but the andesites have been described above. The andesites are narrow dykes, one to three feet in thickness. They occur both above and below *C* vein, are parallel to and cut by it, and intersect the *New* vein. They contain andesine feldspar in laths which occasionally intersect and have a somewhat radial arrangement, secondary quartz, carbonate, and chlorite. The dyke cutting the *New* vein is slightly more basic, containing labradorite feldspar. With the exception of the micropegmatite and one altered andesite (?) dyke, none of these intrusives are exposed on the surface. Owing to the fact that these several intrusives have not been observed intersecting or in contact with one another, their relative ages are not known, but some relationships with the quartz-tourmaline veins have been noted. Briefly, the apparent age relations of the veins, in chronological order, are as follows :

4.—Quartz-tourmaline veins in albitite, *C* vein, and stringers in andesite.

3 and 2.—Albitite and andesites—inter-relations unknown.

1.—The *New* vein (older).

The dykes appear to occupy a unique position and are intimately related to the gold-bearing veins. Data as to these relations are given below.

THE GOLD-BEARING VEINS :

The most important known veins occur in the altered granodiorite, but there are a few in the Keewatin which have been explored in a preliminary way. The majority are characterized

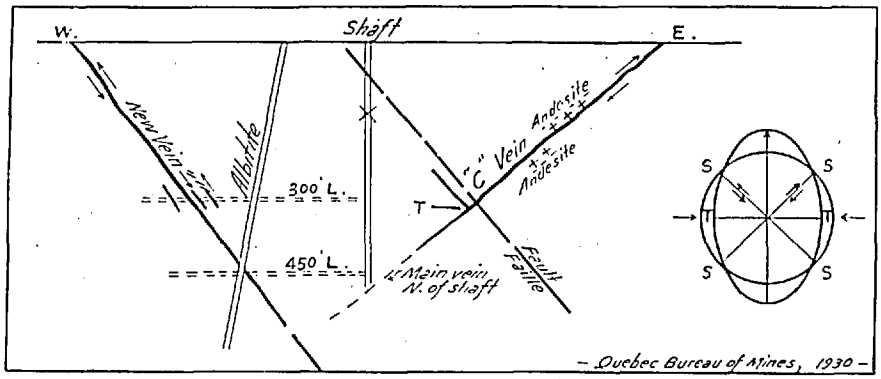


Fig. 1.—Diagram showing relation of fractures to strain ellipsoid, Siscoe gold mine.

by an exceptionally high content of black tourmaline and, locally, abundant pyrite. Most of the gold occurs in the native state, varying from very fine to moderately coarse, as is shown by the records, since 86 per cent is recovered by amalgamation. The richer portions of the veins are quartzose, but some gold occurs with the tourmaline, pyrite, and chalcopyrite. Small amounts are present in the tourmalinized wall-rocks. A minor part is present in *C* vein as the telluride, petzite, found in quartz with native gold.

The veins are of several different types and relative ages. Mineralogically, they fall into four groups : (1) white quartz with little original tourmaline, with or without chalcopyrite, and cut by tourmaline veinlets ; (2) tourmaline-quartz veins, locally rich in pyrite ; (3) later white quartz and tourmaline, with minor carbonate, filling fractures in the second type ; and (4) blue-grey quartz veins with minor tourmaline, pyrrhotite, chalcopyrite, and carbonate. This classification agrees approximately with one based on relative age, though the age of the fourth with respect to all of the earlier ones is not definite.

Structurally, the veins may be divided into two main systems. One includes the veins striking northeasterly (N.20°E. to N.40°E.), such as *C* vein and the *New* vein, and small stringers both to the

east of *C* shaft and west of *D* shaft. They fill fractures of three types or sets. One set dips east at 50° *(New)*, a second dips west at 35° to 40° (*C*), and a third occurs in horizontal sheet-like masses of small extent in the workings from *C* shaft. These are illustrated in Map No. 150 and Figure 1. Movements along the veins, denoted by arrows in Figure 1, are indicated by slickensiding, gouges, or gash veins. This system is a replica of fractures produced by either compressional or rotational stress exerted on the granodiorite, with the direction of easiest relief upward, and of greatest compression in an approximate east-west direction. The fractures dipping east and west correspond to planes of maximum shear (*S*—*S* in Figure 1), the horizontal veins to tension. Fractures with a northeasterly strike and vertical dip, as those occupied by veins in the Central shaft and by the albitite dyke, may be accounted for by variations in stress and direction of relief within the mass. Veins belonging to this system can be considered of essentially the same age, since they fit so well the one stress pattern, though apparent differences in age and even contradictory evidence as to age are to be expected.

The second system of veins is represented by a few that strike east, or slightly south of east, and dip about vertically. It is best illustrated by the Siscoe vein (blue-quartz type), and possibly by *K* vein. That this system is later than the first is suggested in several occurrences. Veins of blue-grey quartz cut white quartz stringers in samples at the *D* shaft. James and Mawdsley (1) cite evidence of easterly-trending veins richer in tourmaline and carbonate cutting the more northerly-trending veins. Figure 2 is a diagram of such veinlets exposed near the old dock, where the two types are found in contact. The older is cut by an altered dyke, probably andesite, and both of these are cut in turn by the easterly-striking veinlet. Since the veins in both systems are closely related in mineral content, it is possible that the fractures in both resulted from the continuation of one type of stress. That they are related to regional stresses rather than to the cooling of the enclosing intrusives is noteworthy, and the pattern of fractures resulting is worthy of careful study as an aid in the search for additional veins.

(1) Op. cit., pp. 66-72.

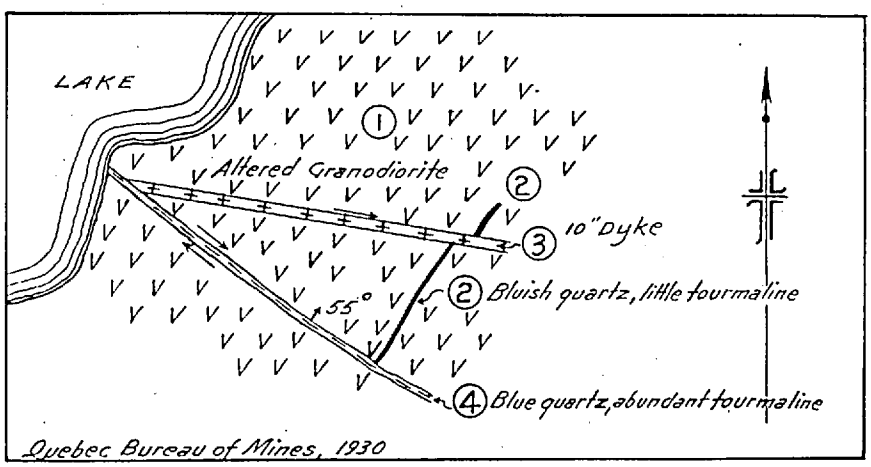


Fig. 2.—Diagram of veins and dyke, Siscoe island.

C Vein.—*C* vein strikes N.20°E. and dips at 35°-40°W. The surface exposure is most disappointing in size, consisting in its widest portion of a 10-inch stringer of banded quartz and tourmaline with a second stringer above. Underground, however, the vein opens up remarkably in the upper levels, attaining a width of 5 to 6 feet but averaging between 2 and 3 feet. Map No. 149 shows the nature of the vein on the several levels. At the fourth level it is narrower, 1 to 1½ feet, and changes rather from a dominantly quartz vein seamed with partings of tourmaline to a vein consisting, in places, of over 75 per cent tourmaline with abundant pyrite. This change occurs at a post-vein fault dipping east at 50°. The fault shows no vertical displacement, but a horizontal displacement of the west side northward with respect to the upper hanging-wall side is suggested by the occurrence of a greater abundance of quartz in the vein farther to the north on the lower levels.

Gold occurs in the quartz, in the tourmaline, and probably with some of the pyrite. The more quartzose portions of the vein are the richest. Assays of samples of almost solid tourmaline gave $1.72 in gold per ton. The tenor of the ore removed from the upper levels to date is indicated by the mill returns

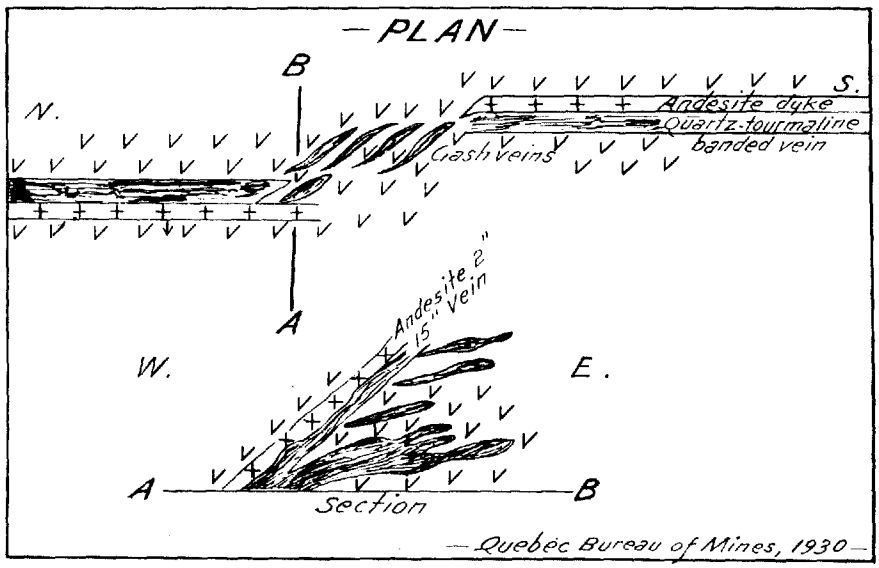


Fig. 3.—Diagram of "C" vein, 300-ft. stope, Siscoe mine.

given below, and averages around $10 per ton. In the lower levels, the grade does not appear as good.

Another feature worthy of note is the evidence of post-*C*-vein faulting and slipping. On the 1st level, slickensides and gouges in the vein itself indicate that the top moved upward and south with respect to the footwall. In the stope just above the 3rd level, an interesting section consists of a well-defined vein, banded regularly with tourmaline, which apparently cuts a 5- to 8-inch andesite dyke (Figure 3). Later, the vein was broken at this point by a shearing movement, and gash (tensional) fractures were filled with lenses of quartz carrying free gold, now lying in tourmalinized and pyritized granodiorite. Small gash veins of quartz and tourmaline also penetrate the dyke itself.

The New Vein.—The *New* vein is exposed at the surface 270 feet south of *D* shaft. It consists of four separate quartz veins which occur over a width of 16 feet, totalling 5 to 5½ feet of quartz. They strike at various angles, from N.-S. to N.E.-S.W.,

and dip easterly at 30° to 40°. Apparently they converge in part and dip more steeply at depth. Some tourmaline, chalcopyrite, and carbonate are present. Assays across different portions gave only low values in gold. The adjoining walls are highly carbonated and impregnated with ' cube ' pyrite.

On the 300-foot level, two veins occur close together : one main vein, with a width of 50 inches, is overlain by a 1½-foot band of diorite, above which is another vein eight inches to one foot in thickness. The strike is N.25°E. and the dip 55°E. The larger vein consists almost entirely of coarse, white glassy quartz and is cut by some fine tourmaline stringers. Free gold is reported, but most of it is very fine and invisible. Coarser gold occurs in the upper vein, with fine chalcopyrite. Assays of the main vein are reported to average $12 in gold per ton, though a grab sample taken by the writer yielded only a trace of gold. Including branch veins, the length of vein proved on this level as at January, 1930, amounted to 450 feet, reported of good width. No information is yet available concerning the character of the vein on the 450-foot level.

In the main vein, just south of cross-cut 302, a schistose andesite dyke, very similar to those near the *C* vein, cuts across the vein, striking S.15°E. with dip 85°S.W. It appears definitely younger than the vein here. Elsewhere in the new workings, Mr. Stee, the mine manager, reports other andesite dykes which appear to be later than the main veins but are cut by still younger quartz-tourmaline stringers.

Other Veins.—Other veins in the granodiorite, exposed on the surface or in *D*-shaft workings, include the *Siscoe, G, H* and *K* veins.

The *Siscoe* vein, northwest of *D* shaft, consists of dark bluish-grey quartz cut by tourmaline stringers and enclosing tourmaline needles. The quartz in places is coarse and massive ; in others, it has been granulated and has a sugary texture. The vein strikes N.70°E., dips 85°S., and is now exposed for a length of 100 feet ; but it is reported to have been uncovered for 500 feet in an east-west direction. In width, it changes from between 4½ and 5 feet

at the east end, where it carries pyrite, pyrrhotite, and some chalcopyrite, to 3 feet at the north of *D* shaft. Free gold is reported. The wall-rocks at the surface are highly carbonated. Underground, the vein was intersected to the north of *D* shaft, where it is reported faulted. A grab sample of blue quartz from the dump assayed $2.41 in gold per ton.

James and Mawdsley (1) report several veins striking slightly east of north and dipping east in the north workings from *D* shaft, one of them two feet thick. They consist of grey, glassy quartz, with pyrite in cubes, and are cut by three-inch stringers of tourmaline and still later calcite and pyrite.

G vein, now exposed only on the northwest shore of the island, is of the Siscoe-vein type and strikes south with an easterly dip. It is approximately two feet wide and is reported to have been encountered in pits dug some distance to the south. *H* vein is barely exposed beneath heavy clays to the west of *D* shaft. Its dimensions and mode of occurrence could not be determined. *K* vein was not available for examination, as *D* shaft is flooded. It has been described by James and Mawdsley as lying in the talc-chlorite schist contact-zone to the south. It is lenticular, parallelling the contact at S.63°E., and varies in width from 2½ feet to *nil*, with a proved length of 165 feet. It consists of white quartz with thin seams of chloritic material and small amounts of pyrite and chalcopyrite. Good gold values are reported from this vein. It is apparent from recent work that the vein does not continue towards the southeast as far as drift 315, driven from the Central-shaft workings, though 40 feet of talc-chlorite schist were cut there.

Veins in Keewatin Rocks.—Veins in the Keewatin rocks to the south and west have not been worked in recent years. James and Mawdsley (2) give a detailed account of *A* and *B* veins, which need not be repeated here. Vein A is of the quartz-tourmaline type, with coarse pyrite, some chalcopyrite, and good values in gold over small widths. Vein *B* lies beside a porphyry dyke,

(1) Op. cit., p. 69.
(2) Op. cit., pp. 70-71.

which is itself mineralized and carries low values in gold. The vein is composed largely of quartz and has a width of one feet.

Another quartz-tourmaline vein occurs on the mainland, on the shore of the lake, lot 39, range I, Varsan township. James (1) has described it as a zone 100 feet wide with a general east-west strike. It occurs in a carbonated granite, which has been described above (page 30) as corresponding closely with the quartz-feldspar porphyries. " Within the zone are numerous reticulated masses of glassy white quartz, enclosing elongated masses of the granite. The quartz carries some pyrite and a little free gold." (See Photograph, Plate II-B). Samples across small widths are reported to carry good values in gold.

SUMMARY OF RELATIONS OF VEINS AND INTRUSIVES :

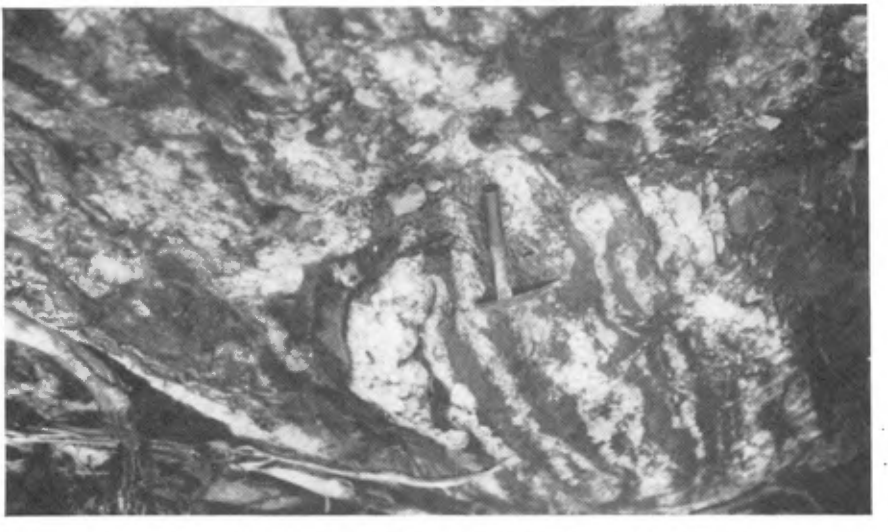
The important veins in the granodiorite, the intrusive dykes of albitite and andesite, and the fractures in which all of these occur, seem closely related in time. The fracturing may be explained best by external stresses exerted on the granodiorite. The *New* vein, *C* vein, and the flat tensional veins appear to be due to a stress with a strong east-west component, from which relief upward was gained. They are probably, then, not greatly different in age, and fracturing and vein or dyke filling was progressive. The *New* vein appears the earlier, since it is cut by andesite ; the *C* vein, the later, in part at least cutting the andesite. The albitite appears younger than the *New* vein, but clearly antedates numerous quartz-tourmaline veinlets. Andesites occupy the same fracture as *C* vein. The progressive nature of such fracturing may easily be demonstrated experimentally (2). That the dip of the fractures does not necessarily indicate their age, however, may be shown also experimentally and is illustrated by occurrences in the mine. Thus, in the 302 cross-cut, veinlets parallel to the *New* vein, dipping east, cut the *C* type, dipping

(1) Op. cit., p. 71.

(2) Leith, C. K., "Structural Geology"; Henry Holt and Co., New York, 1923.

Mead, W. J., "Notes on the Mechanics of Geologic Structures"; Jour. Geol.. Vol. XXVIII, pp. 503-505.

A.—Granodiorite breccia, with dark fragments of greenstone. This is cut by dykes of granodiorite porphyry.



B.—Siscoe Gold Mine.—Mainland vein of quartz and tourmaline in altered granite.

west. On the 4th level, *C* shaft, an unmineralized fault parallels in strike and dip the *New* vein and cuts the *C* vein, while below it, an easterly-dipping vein either is cut off by, or ends at, the *C* vein.

Vein and Mineral Sequence.—Following the consolidation of the granodiorite, external stresses on the mass produced abundant fractures and probably the schist zone along the contact. Into these, in relatively quick succession, came the early quartz veins with some gold values, then the albitite and andesites, and finally later veins. The greatest tourmaline and pyrite mineralization seems to have followed the dykes, but whether the gold was likewise more concentrated then is not yet known, though in polished sections of ore it is seen that it is usually one of the last minerals to have been introduced, with the exception of the carbonate. The extreme alteration of the enclosing rocks, and the typical development of albite, suggest the effect of the alkaline ore-bearing solutions.

FUTURE POSSIBILITIES :

Possibilities of discovering more ore-bearing veins in the Siscoe intrusive appear promising. The fact that, in the recent development work, several veins parallelling the *New* vein were encountered, suggests that the ground to the west will be the more promising, though some drilling below *C* vein might profitably be undertaken.

An interesting situation will be met with at greater depths in the New shaft, near the intersection of the *C* and *New* veins, though on the lower levels the *C* vein has not yet been proved as valuable as the upper portions, and at the 450 level it lies mainly to the north of the Central shaft. Depths to which the inclined fractures and veins may be expected to continue will probably not be as great as for more steeply-dipping veins.

GOLD PRODUCTION :

Since the completion of the 100-ton mill in January, 1929, the Company has been producing gold steadily, though the demands

of the mill have undoubtedly hindered development work until recently. In November, 1930, a new unit was added and a production of 160 tons per day was expected by January, 1931. This capacity may be further increased.

SISCOE GOLD PRODUCTION

Year	*Tons milled*	*Total Value*	*Average value per ton*
1929	29,836	$307,403.76	$10.33
1930 (six months)	16,836	$178,884.75	$10.62

MILLING COSTS AND METHODS :

Recovery of the gold is largely made by amalgamation, which accounts for 86.2 per cent. The remainder is recovered by cyaniding, the tailings running 21 cents in gold per ton.

Early milling costs, according to R. E. Sullivan, mill manager, ran $2.27 per ton during the first six months of 1930, but in July were down to $1.99. Power alone, supplied by Diesel engines, accounts for 74 to 76 cents per ton This could probably be lowered if development work here, and at other nearby properties in the future, should justify the construction of a transmission line from Amos or Noranda.

Other milling costs given by Mr. Sullivan are as follows :

Canadian-made balls for ball-mill (ball consumption, 2.5 lb. per ton of ore)	5	cents per lb.
Lime (1.2 lb. per ton)	2	cents per lb.
Potassium cyanide (0.7 lb. per ton)	9½	cents per lb.
Zinc dust (0.8 lb. per ton of solution precipitated)	13	cents per lb.

Ore from the new workings is to be lowered or raised to the 300 foot-level, run to the chute connecting this level and the 5th level of *C* shaft, and there raised to the surface. The following account of the mill is given by R. H. Taschereau (1) :

" The mine skip dumps the ore into a 70-ton bin, from which it is delivered, by pan feeder, to the primary (12 in. by 20 in)

(1) Que. Bur. Mines, Ann. Rept., 1928, p. 127.

jaw-crusher. An inclined belt takes this product to the 200-ton mill bin. The ore is fed from this bin to a 6 ft. by 4½ ft. ball-mill, in closed circuit with a duplex classifier. The classifier over-flow goes to No. 1 thickener and the solution from the thickener goes to a re-pulper. The spigot product goes to agitation. The product from the last agitator is clarified and the solution goes to the precipitating presses. The pulp from the presses goes to tailings ".

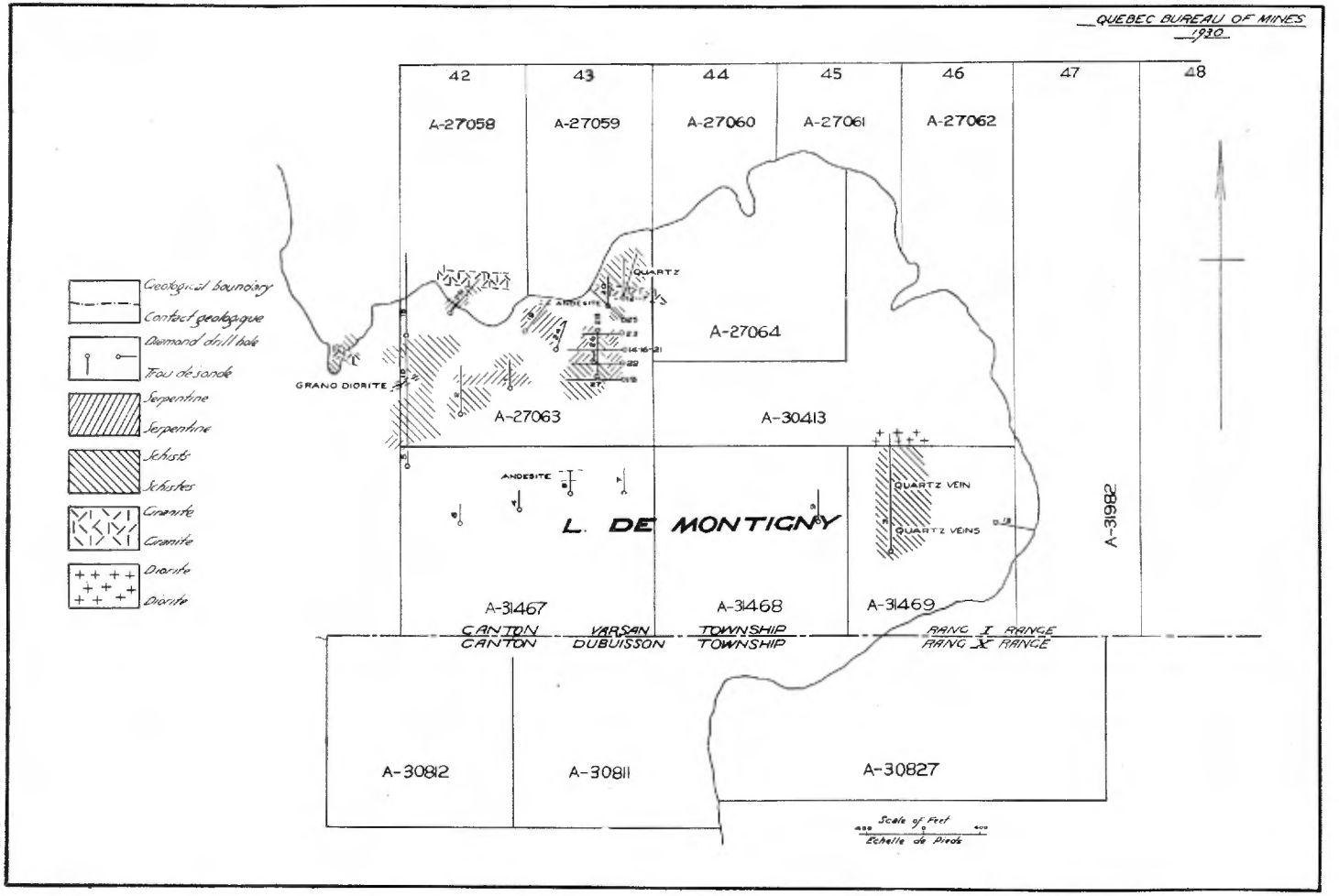
Stanley Siscoe Extension Gold Mines, Limited

This Company holds mining claims on lake DeMontigny north and east of Siscoe island, including lots 42 to 49, 52 and 53, and the south half of 50 and 51, range I, Varsan township, and adjoining lots in range X, Dubuisson township. Four mining claims, A.27063 and 31467 to 31469, cover the bay of the lake east of lot-line 41-42, range I, Varsan township.

The only surface exposures located on the Company's property consist of a few outcrops of Keewatin chloritic schists along the north line of range I, and on the north shore of the bay. The general strike is N.85°E.

During the winter of 1929-30, some 10,000 feet of diamond drilling was undertaken by the Company on the four claims mentioned. The location of the drill holes and the general character of some of the rocks intersected are shown in Map 151. Cores of a large number of holes were examined. It is reported that some holes were lost, probably Nos. 4, 6, and 7, owing to the fact that, after encountering bed-rock, they passed again into boulders and sand, apparently due to a sharp rock depression in this portion of the bay.

Drilling was undertaken in the hope of picking up the eastern extension of the Siscoe granodiorite and possible veins, and to trace eastward the Siscoe mainland vein that occurs on the shore of lot 39, range I, Varsan. From the Company's point of view the results were far from promising, though much valuable information has been gained.



Map No. 151.—Plan showing claims and diamond-drill holes of Stanley Siscoe Extension gold mine.

The Siscoe granodiorite intrusive clearly does not extend on the surface of the lake bottom to the area drilled. However, an untested zone, 800 feet wide, lies on the south, and it is possible some granodiorite might be found on the southwest claim, A.30812.

The major portion of the area drilled is underlain by black serpentine and chlorite schists. These are intruded by relatively narrow dykes of either fine grained fresh andesite or somewhat coarser diorite (related to the granodiorite), and, on the north shore of the bay, by medium to coarse grained porphyritic granite of the type enclosing the Siscoe mainland vein. Adjoining these small intrusives, the Keewatin volcanics and augitites show considerable contact alteration to either actinolite or chlorite-talc schists or a peculiar biotite-magnetite schist. Near and in some of the intrusive dykes, quartz veinlets with either tourmaline, or pyrrhotite and chalcopyrite, occur, with some values in gold. In no case, however, have these veinlets been traced for any distance. The number of small intrusive dykes, the alteration of the enclosing rocks, and the local occurrence of sulphides, indicate the proximity of a larger intrusive, but the depth at which this might be encountered is probably too great to warrant further exploration in this direction.

Dark bluish-black serpentine or soapstone occurs in most of the cores, but is particularly prevalent in Nos. 10, 15, 23, 24 and 28. Sharp changes between this rock and green chlorite schist in hole No. 21 suggest that the former is intrusive into the Keewatin and is related to the ultra-basic augitite or peridotite intrusives noted elsewhere in lake DeMontigny. Other Keewatin rocks intersected vary between chlorite-talc and biotite-magnetite schists. Some of them appear tuffaceous, but the majority are andesites.

Dykes of fine diorite or granodiorite occur in the cores of holes Nos. 1, 3, 10, and 20. The lengths of these in the cores range from 10 to 120 feet. In all of them, these fine grained rocks are clearly intrusive into the Keewatin, as shown by contact alterations, such as the development of actinolite and biotite-magnetite schists. In hole No. 20 small quartz-tourmaline stringers are associated with the dyke.

Holes Nos. 12, 17, 20, and 29, drilled northward near the north shore, intersected a fairly steady band of the porphyritic granite referred to above. Hole No. 29, after passing through 150 feet of this rock, ended in it. The granite is cut by small six-inch to one-foot quartz veins and smaller stringers. Tourmaline cuts the quartz, which contains pyrite. The granite becomes waxy and sericitized near the south contact with chlorite schist and is mineralized with fine cubes of pyrite. It is cut by fine grained pink aplite or feldspar-porphyry dykelets.

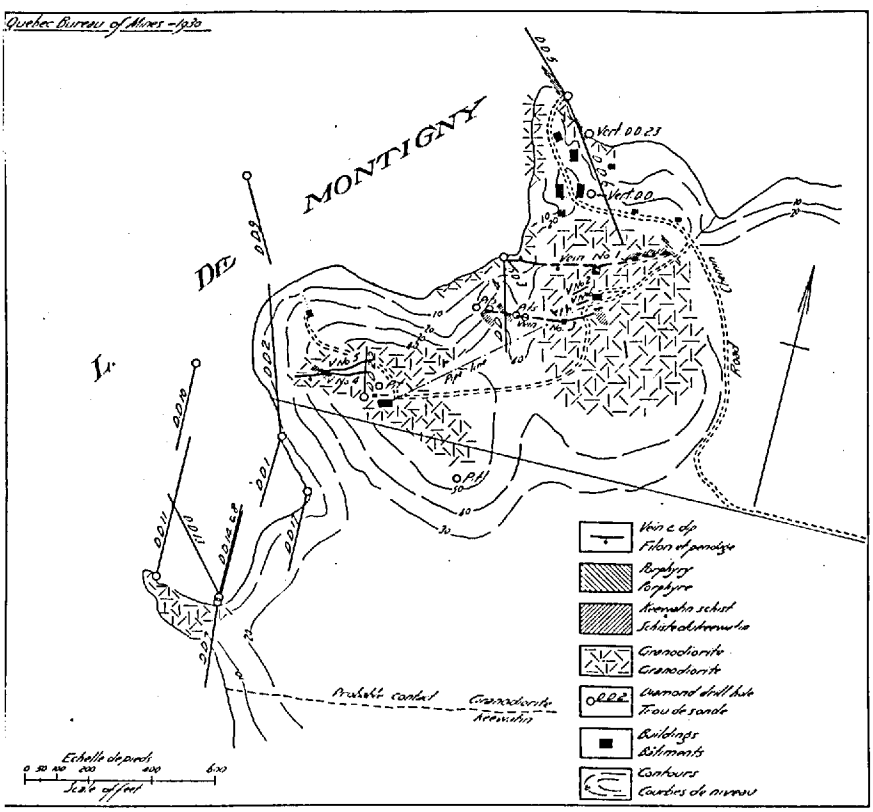
The only cores with mineralization of any importance are those of holes Nos. 12 and 14. The former lies near the porphyritic granite dyke, and at 174-177½ feet the schist in the core is traversed by quartz-tourmaline veinlets in which native gold is reported. In the core of No. 14 hole, free gold is reported in quartz stringers which carry chalcopyrite and pyrrhotite, magnetite octahedra, and minor carbonate. Above is talc schist. Assays of this core gave values in gold up to $40 per ton, in silver up to 0.59 ounces, and 3.9 per cent copper, with traces of nickel and platinum. Holes Nos. 16, 18, 21, 22, 23, 26, 27, and 28, drilled in the same vicinity as No. 14, failed to show the continuation of this ore zone.

A somewhat similar mineralization occurs in the case of hole No. 3, where 7½ feet of sheared andesite contains quartz stringers with some chalcopyrite and pyrrhotite.

Sullivan Gold Mines, Limited

General Description :

The Sullivan gold mine is situated on the southeast shore of lake DeMontigny, 1½ miles southeast of Siscoe. The property includes the north part of lots 47, 48, 49, 50, and 51, range IX, and the west part of lot 53, range X, Dubuisson township. Mr. Pierre Beauchemin made available plans of the mine and drill cores for examination. Flooding of the mine prevented any underground examination by the writer.



Map No. 152.—Plan, Sullivan gold mine, Dubuisson tp.

The outcrops on the property are limited largely to the sodic granodiorite, narrow dykes of porphyry and aplite, green schist inclusions, and some peculiar dyke-like rocks now highly carborated and schistose, as well as several auriferous quartz-tourmaline veins. These are shown on the outcrop-map No. 152. Map 153 gives the geology underground, as worked out by J. C. R. MacPherson, former manager of the mine.

The granodiorite has already been described, and an analysis of the rock is given on page 24. It is greenish-grey and considerably altered. Near the veins and shear zones it has been

mineralized with ' cube ' pyrite. Alteration consists chiefly in the development of chlorite, carbonate, and epidote. This intrusive appears to be the westward extension of the larger mass occurring to the east in Bourlamaque township, as shown by magnetic surveys made across the intervening drift-covered area. Its resemblance in hand specimen and in chemical composition to the granodiorite at Herbin lake is marked, and, moreover, samples of quartz-tourmaline veins from the two localities are indistinguishable. The north and south contacts of the intrusive here, as suggested by magnetic surveys, indicate that the surface portion of the intrusive ends between the mainland and island No. 21, and does not continue northwestward to Siscoe island.

The porphyries of granodiorite composition are in nearly all cases schistose, consisting of red-weathering feldspars oriented in a fine chloritic groundmass. Their contacts are often barely discernible. As shown in Figure 4, some quartz stringers on the surface appear to be cut by a dyke of this rock, though the relation to other veins is not known.

Some pink, fine-grained feldspar-porphyry or aplite dykes occur in drill cores from holes put down at the west end of the property. About 190 feet southwest of the shaft are some peculiar one-foot dyke-like bodies, resembling Keewatin, but with very constant widths and walls. They are now so highly altered to carbonate and chlorite that determination of their original nature is not possible.

SURFACE VEINS :

The veins exposed at the surface have been mapped by Mailhiot (1) and described by him and also by Cooke (2). Numbers assigned by the former to the several veins are retained here. On the surface, the majority are very narrow stringers in tight easterly-trending fractures in the granodiorite, and, though their lengths range as high as 300 feet, their narrow character does not recommend them.

(1) Op. cit., p. 24-25.
(2) Geol. Surv. Can., Sum. Rept., 1923. p. 96-97.

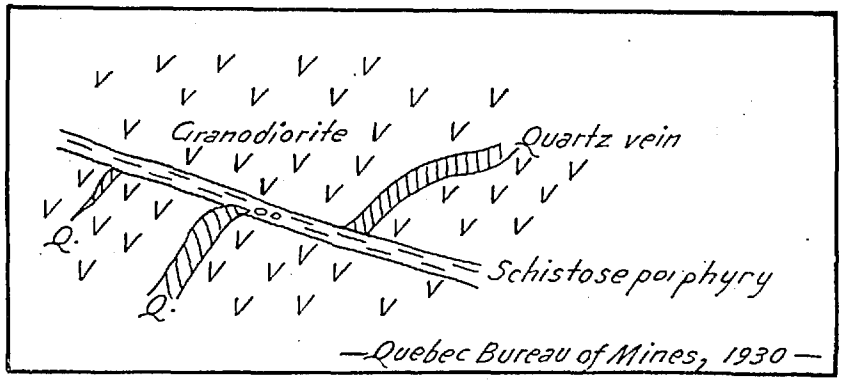


Fig. 4.—Diagram showing relation of porphyry dyke to quartz vein, Sullivan gold mine.

Vein No. 1, on which the shaft was sunk, consists of two portions, one at the shaft, No. 1, and one at the lake shore to the west, No. 1a. The former extends eastward for 300 feet as a one-foot to seven-inch stringer, and in places dies out. At the east end it is interrupted by a lenticular mass of porphyry which lacks well defined walls. At a depth of 20 feet in the shaft, the vein is reported by Mailhiot to average 5 feet wide, containing pyrite, a little chalcopyrite, galena, sphalerite, and gold, with black tourmaline. At a point 100 feet to the west, it is seen to be cut off by a fracture dipping 70°N. Possibly *C* vein in No. 4 drift is an extension of this vein. It consists of one- to two-inch stringers of quartz in silicified and pyritized granodiorite.

Vein No. 1a dips 48°N. and strikes east-west, swinging more to the south of west as it approaches the lake. There it consists of one foot of rusty quartz and three feet of sheared granodiorite, two feet of which are mineralized with pyrite. Quartz on the side of the pits carries a little galena, sphalerite, chalcopyrite, and free gold.

Vein No. 3 consists of quartz and tourmaline, and is traceable for about 200 feet, swelling locally from a few inches in width to 2½ feet. A sample from a quartz lens 2½ feet by 6 feet assayed $30 in gold per ton, but the average width of the vein is too low for this to be of much significance.

Vein No. 4 strikes N.75°E. and dips 70°S. It has been uncovered for about 300 feet and is irregular in width, being 2 feet wide at the east end and 6 to 12 inches at the west. The vein material is quartz, with some tourmaline and pyrite. Pyrite in the wall-rock is reported to carry up to $3 in gold per ton. The tourmaline cuts the quartz as fine seams. Diamond-drill hole No. 22, drilled northward at an inclination of 45°, intersected two porphyry lenses near the surface and the vein at 96½ to 100 feet. The vein there consists of fine siliceous granodiorite with small quartz stringers and leaves of chlorite schist. Pyrite, tourmaline, and moderate values in gold, are present.

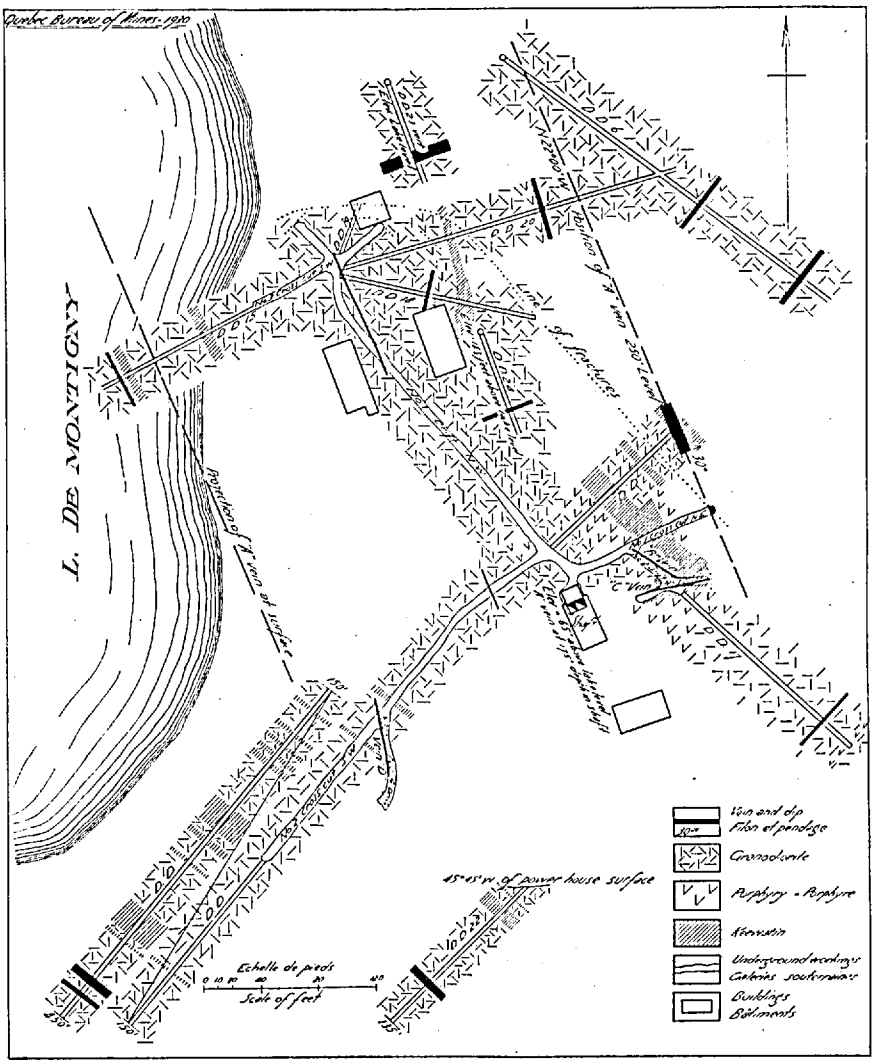
Vein No. 5 is a lenticular mass of quartz nearly joining No. 4 at its west end. It averages six to eight inches in width, with a maximum of two feet in places, and has a length of 170 feet. It consists of bluish quartz cut by thin seams of tourmaline, and has nests of white quartz in the centre. Tourmaline stringers branch off and cut the granodiorite, which is brecciated on the hanging-wall.

Other veins have been reported on the property, along the west shore of the lake, but none of these were exposed even at low water in August. Discoveries of veins in underground work and by drilling are mentioned below.

VEINS FOUND BY DEVELOPMENT WORK :

In November, 1928, a diamond-drilling campaign was begun, and a shaft was sunk to a depth of 250 feet on vein No. 1 from an elevation of 60 feet above the lake. Drifts and cross-cuts completed are shown on map No. 153. Total footage drilled is approximately 6,000 feet.

Vein A.—The most important results of this work have been the discovery of one promising vein underground, and of other veins off the west shore of the lake. The former, designated vein *A*, strikes N.22°W. and dips 30°E., and is reported to have been proved for a length of 500 feet. It was encountered in the shaft at a depth of 175 feet and in No 1 cross-cut, 113 feet from the station, as well as by drill holes Nos. 16, 17, 20, 23, and 24. In



Map No. 153.—Plan of underground workings, Sullivan gold mine.

the shaft it has a width of 3½ feet, and eight samples are reported to have averaged $19 in gold per ton. In the cross-cut, good values are reported across a width of 3 feet.

Vein *A* consists of greasy to glassy white quartz with fine chloritic partings. Tourmaline is present along slickensided surfaces as well as in fractures in the quartz. Between one and two per cent of pyrite accompanies the quartz, and a little chalcopyrite is also present. Drill-core intersections of vein *A* appear as follows :

Hole	*Footage*	*Description*
6	483-485 553 671-675	Quartz stringers in granodiorite 1½ ft. glassy quartz 1½ ft. quartz in mineralized granodiorite
15	105-108	Sheared granodiorite with 60% quartz, tourmaline, and pyrite
16	114-124	Granodiorite with sparse sulphides and tiny quartz stringers with tourmaline
17	.....	No distinct vein observed
18	66- 67	10 inches quartz, tourmaline, and calcite
20	146-148	10 to 12 inches quartz with over 50% tourmaline in granodiorite with 'cube' pyrite and cut by tourmaline stringers to 168 feet; free gold reported
23	148-156½	Granodiorite mineralized with fine pyrite
24	122-145 2/3 147	Granodiorite and fine suphides, 2 inches tourmaline and 6 inches quartz replacing schisted granodiorite
	147-152	21 inches quartz, tourmaline, pyrite, with walls carrying pyrite

This vein apparently occupies a fracture or shear zone, which, in attitude, is similar to some of the Siscoe veins. Its gentle dip does not suggest any great extent downward.

Vein B.—This has the same strike as vein *A*. A sample labelled as coming from this vein shows four inches of quartz mineralized with pyrite, particularly in included green schist folia. A few specks of galena and chalcopyrite were also noted.

Vein D, striking N.9°W. and dipping 30°E., is exposed for a length of 40 feet. It consists of greasy white quartz with chlorite partings, partly tourmalinized and containing small cubes of pyrite. The width is not known.

To the southwest of the shaft, in a small bay, diamond-drill holes Nos. 8, 10, 11, 13, and 14 encountered quartz veins and stringers in either mineralized granodiorite or pink aplite. In hole No. 8, 24 feet of quartz were encountered between 261 and 285 feet, some of which is reported to have given exceptional values in gold. Hole 14, drilled in the same direction, showed six veins or mineralized portions between a few inches and two feet wide, from 247 feet to 508 feet. Further drilling is required to determine the trend of the veins and to ascertain the true size and extent of the one found in hole No. 8.

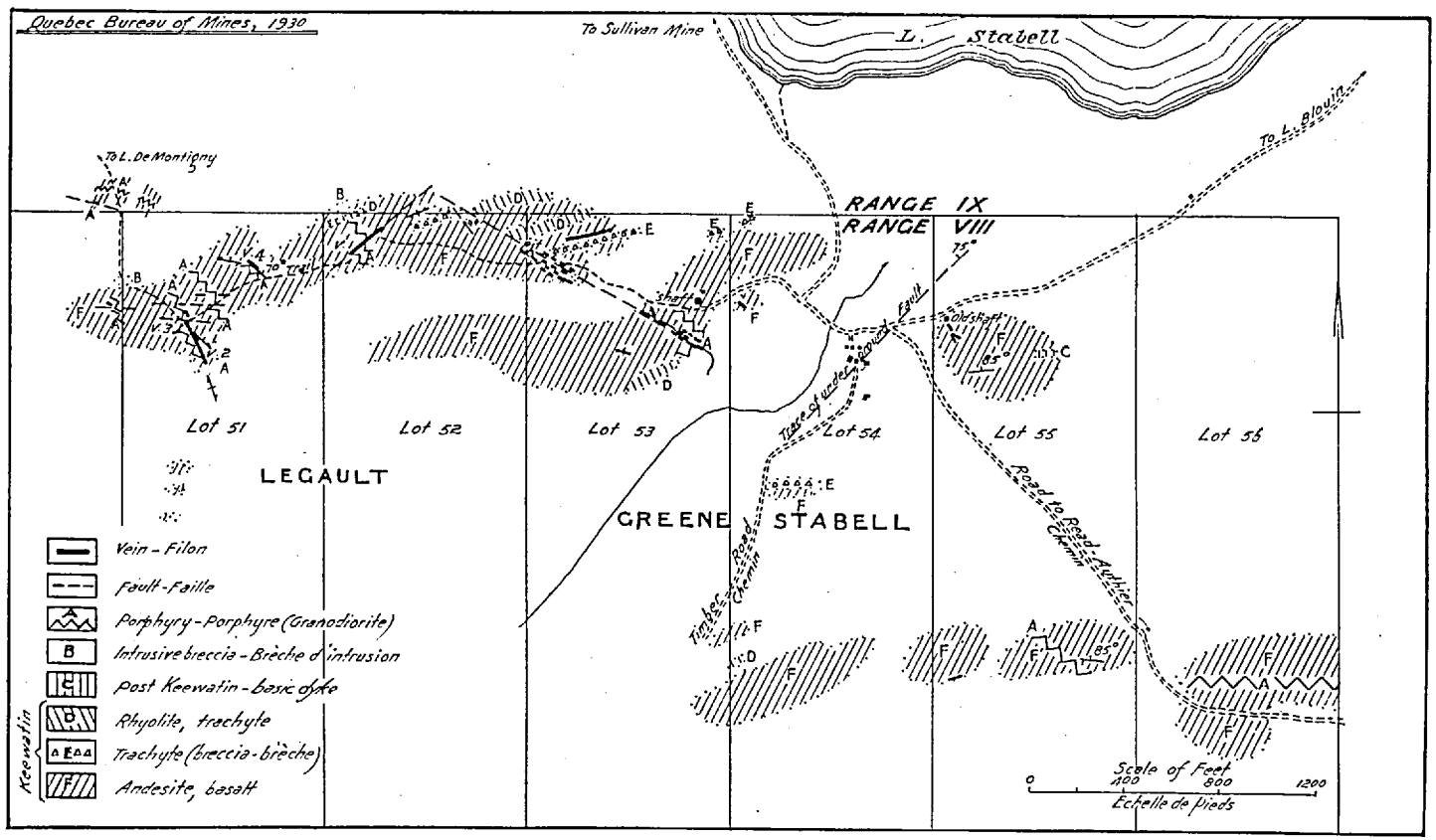
FUTURE POSSIBILITIES :

The Sullivan mine was closed down late in 1929. Development work has shown the presence of only one vein of appreciable size. Drill records suggest the presence of others to the west. Vein *A* has an attitude similar to some of the Siscoe veins, and also the characteristic quartz-tourmaline association. Fractures of this type, dipping gently east, are not very noticeable on the surface, where tight east-west shear zones mark what veins are present. It has yet to be proved that other parallel or opposite dipping veins occur here, but the pattern should be kept in mind if future work is undertaken. Since considerably more exploration work is required before mining appears justified, attention is directed to the contact zone in lake De Montigny to the west as a favourable area. Particularly should other intersections of vein *A* be made from the underground workings before much further work is comtemplated.

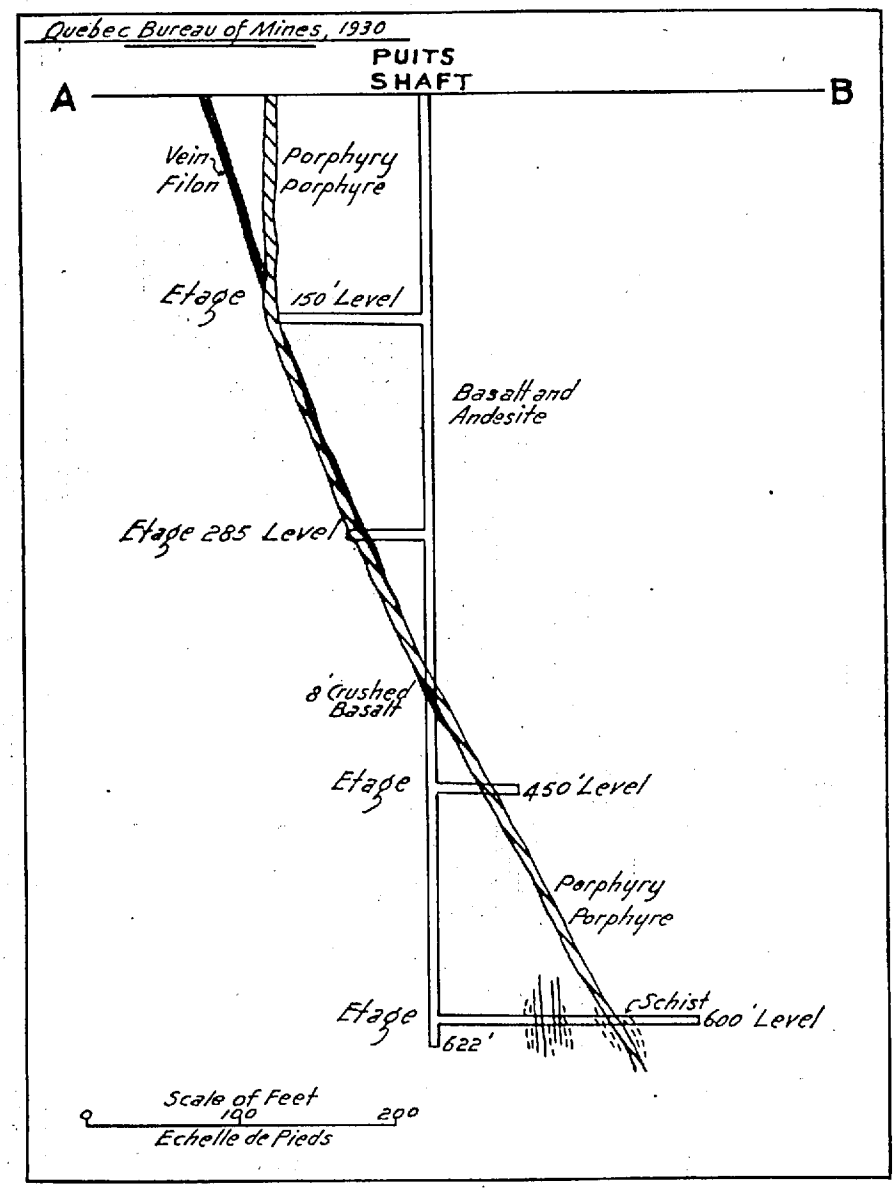
GREENE-STABELL MINES, LIMITED

GENERAL DESCRIPTION :

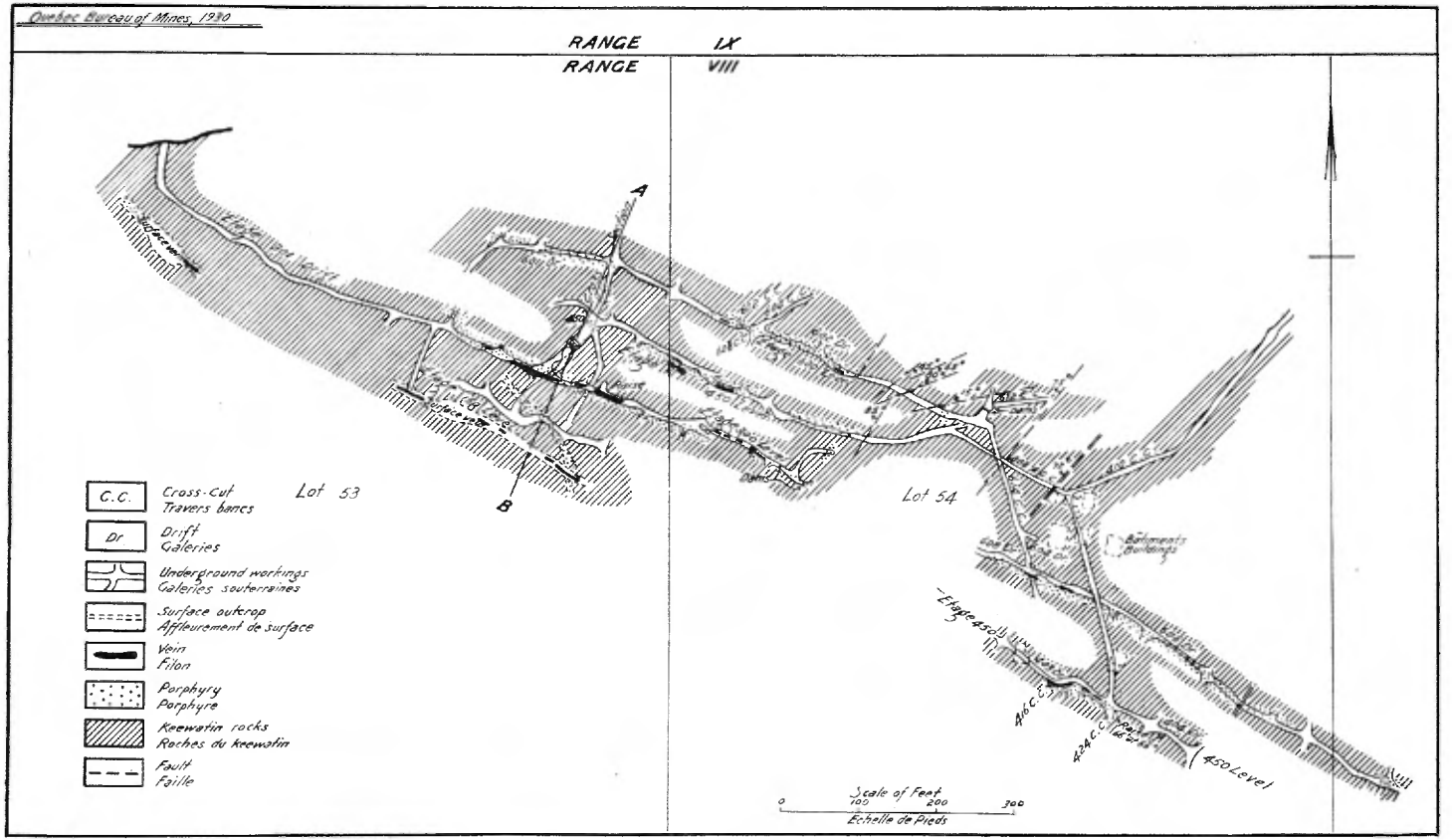
The property of this Company, formerly the Stabell Gold Mines, Limited, includes the northern half of lots 53 to 56, range



Map No. 154.—Map of Greene-Stabell and Legault properties, Dubuisson township.



Map No. 155-A.—Vertical section of underground workings of Greene-Stabell mine, Dubuisson township.



Map No. 155.—Plan of underground workings of Greene-Stabell mine, Dubuisson township.

VIII, Dubuisson. The property is reached by a log-rail road from the southwest end of Blouin lake, or by trail from either the southeast shore of lake De Montigny or the Sullivan mine.

Development work, begun in 1923 and carried on over varying periods of time till December 9th, 1929, has shown the presence of a limited body of gold ore. Accounts of this work are given in annual reports of the Quebec Bureau of Mines, particularly for 1925 and 1928. The mine has been closed since December, 1929, and was not examined by the writer.

The surface geology has been described in detail by Mailhiot (1) and Cooke (2). The surface and underground workings are shown in Maps Nos. 154 and 155. The underground geology is taken from plans at the mine.

The deposit lies in a fault zone striking N.60°W. and dipping 65° to 75°N. On the surface this cuts across a series of Keewatin volcanics ranging in composition from basalt to trachyte and trending almost due east. As shown by volcanic breccias, there has been a horizontal displacement of 400 feet, with the north side moving southeast. Cutting the fault is a dyke of granodiorite porphyry which has a winding form at the surface but is more regular at depth, crossing and apparently joining the fault zone at a depth of 150 feet. Below this level the strike and dip of the porphyry is approximately parallel to the fault zone on the surface, so it may be assumed the one follows the other. To the north, between 20 and 30 chains distant, in Stabell lake, is the contact between the granodiorite and Keewatin volcanics.

Values on the surface are confined to a portion of the fault zone, 270 feet long and mineralized over widths of 20 feet or less To the northeast, across 300 feet of drift, the fault zone continues. There, small blebs of a highly altered porphyry containing sulphides are present in the fault itself. Mineralization of the fault zone appears of two types, one of pyrrhotite and pyrite, evident along and co-extensive with the fault where exposed, and another of quartz, chalcopyrite, and gold, which is limited in extent, being

(1) Op. cit., pp. 32-34.
(2) Op. cit. 1923, pp. 80-87.

localized near the porphyry dyke as small lenses. Cooke has shown how the gold occurs with the chalcopyrite and that values decline sharply as the distance of the fault from the dyke increases. The wider distribution of the first type and the local nature of the second suggest some difference in age. The latter, in particular, clearly has followed closely the intrusion of the porphyry. Not only were fractures in the porphyry found mineralized with chalcopyrite, but on the surface, at the intersection of dyke and fault, small lenses of quartz partly interrupt the course of the former (See Figure 5). Bain (1) states that the main fracture passes through the dyke.

DEVELOPMENT WORK :

From the vertical shaft on lot 53, sunk to a depth of 620 feet, lateral workings were opened up on the 150-, 285-, 450-, and 600-foot levels, totalling 6,551 feet. On the 285-foot level, quicksands were encountered 350 feet east of the shaft. On the 450- and 600-foot levels, continuation of the workings in this direction disclosed the existence of a large post-mineral fault striking N.40°E. and dipping 72° to 75°N.W. This is parallelled by minor faults across a zone 200 feet wide. To the southeast, the porphyry was encountered with an offset on the fault of at least 120 feet.

As shown by mine plans, the ore zone and dyke meet at the 150-foot level. Below, to a vertical depth of 330 feet, the ore occurs in two lenses. To the east, on the 285-foot level, it lies above the dyke, and to the west, below it. Apparent relations are of dyke cutting the ore, but the latter may be so localized as a result of the dyke having re-opened the previously existing fault zone, with subsequent deposition of the values.

GOLD VALUES AND RESERVES :

With regard to ore between the surface and 3rd level, W. E. Todd (2), consulting geologist for the Company, states : " The ore on the 285-foot level is practically identical with the shoot

(1) Bain, G. W., Can. Min. & Met. Bull., No. 178, Feb. 1927, p. 235-6.
(2) Que. Bur. Mines, Ann. Rept., 1928, p. 125.

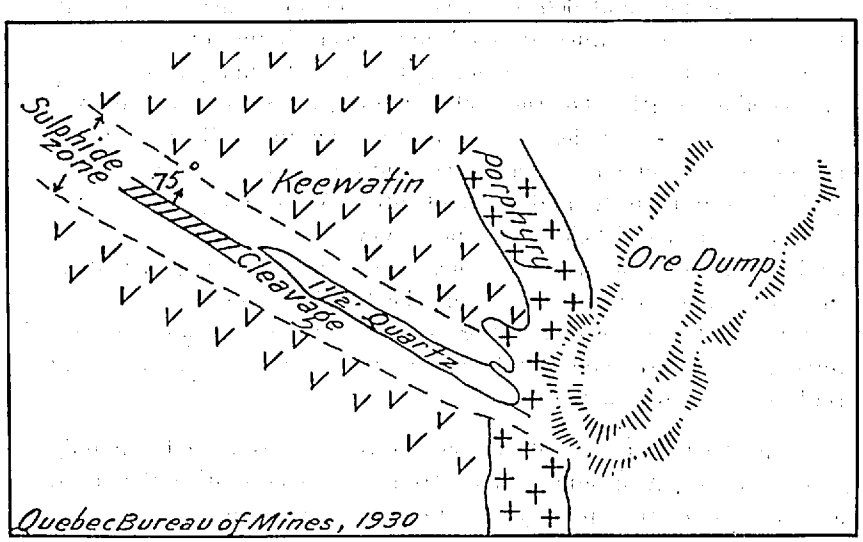


Fig. 5.—Diagram showing relation of porphyry and fault at Greene Stabell mine.

as exposed on the surface, where it shows a continuous outcrop for 270 feet. On the 285-foot level, the average value is approximately $13 across 48 inches for a length of 350 feet. The remaining 40 feet next to the fault (on the east) is of somewhat lower grade ".

Gold mineralization on and below the 450-foot level appears unimportant. A raise put up 60 feet from this level, after passing through a flat fault, is reported to have encountered commercial ore.

Estimates by Mr. Todd of ore from the 450-foot level to the surface are as follows (1) :

450-foot to 285-foot	12,100 tons	$13.15 per ton
285-foot to 150-foot	9,585 tons	15.20 per ton
150-foot to surface	8,550 tons	15.00 per ton

A sample collected by the writer from the mine ore-dump assayed $13 in gold per ton.

(1) Personal communication from Greene-Stabell Mines, Ltd.

On the 450- and 600-foot levels, to the southeast of the large fault zone, some values in gold have been found on either the hanging- or foot-wall of the porphyry dyke, though not over any appreciable length. On the 450-foot level, an 80-foot lens of ore, one to three feet wide, occurs on the hanging-wall side of the porphyry. Specimens from here contain grey to white quartz with both pyrrhotite and chalcopyrite. A specimen from the 410 cross-cut consists of grey porphyry with a fine plaster of chalcopyrite on one side and tongues of this mineral penetrating the rock. Another specimen, from the 402 drift, contains granular and brecciated quartz carrying pyrite, pyrrhotite, and chalcopyrite. The last named follows fractures in the quartz and replaces chlorite schist inclusions.

On the 600-foot level, assays showed values in gold in only a few places. A specimen taken from this level, east of the fault, consisted of quartz and pyrrhotite replacing green schist, with a very little chalcopyrite.

No explanation is here offered for the apparent disappearance of values along the porphyry dyke at depth, since the mine could not be examined. The explanation by Bain (1), that the ore was concentrated at the intersection of dyke and fault, depends on their being separated at depth, but it was not possible for the writer to verify this.

While possibilities from further development work at depth do not appear promising, the proximity of the main granodiorite contact, and the occurrence of the one ore-shoot, suggest that further exploratory diamond drilling between the mine and the contact might profitably be undertaken.

Legault Gold Mines, Limited

This property adjoins the Greene-Stabell on the west and consists of the north half of lots 51 and 52, range VIII, Dubuisson township. Mr. Pierre Beauchemin, Amos, is president of the Company.

(1) Op. cit., p. 236.

Cooke (1) has described the geology, which is very similar to that on the Greene-Stabell property (See Map 154). The easterly-striking Keewatin andesites and schists are cut by several dykes of granodiorite porphyry containing phenocrysts of both feldspar and hornblende. These strike northwest and have been displaced small distances by easterly and northeasterly trending faults. They cut fine non-porphyritic granodiorite which has invaded the Keewatin as irregular tongues and has included many angular fragments of it as a breccia (See Plate I-B). Four veins occur on the property. No. 1 vein, in lot 52, lies in a fault which strikes N.50°E. and cuts off, apparently, the Stabell fault. The vein, of white glassy quartz with minor amounts of tourmaline and pyrrhotite, invades adjoining Keewatin and granodiorite-porphyry dykes as small stringers. It dips southeast at 65° to 75° and has a length of 200 feet, with average width of about 4 feet. To the northeast, it dies out in the fault, and to the southwest is poorer because of porphyry inclusions in the fault zone. No values of importance are reported.

Veins Nos. 2 and 4, in lot 51, have a northwesterly trend, parallel to dykes of granodiorite porphyry. No. 2, as described by Cooke, is a true fissure-vein, consisting of dark grey, somewhat glassy quartz with fair amounts of pyrrhotite and pyrite. Some chalcopyrite is reported from the deeper pits, which were filled with water when seen by the writer. The vein has a constant width of 4 feet over a length of 200 feet. At the south end, the strike swings more southerly, and here the vein is reported by Cooke to disappear beneath the drift. At the north end it is cut off by an easterly-trending fault, which probably joins that in which vein No. 1 occurs. No extension of this vein could be found to the north, though a small bleb of glassy white quartz, similar to that in vein No. 3, does occur to the northeast. Samples taken from the two most southerly pits gave only traces of gold on assay. A grab-sample from the dump, containing chalcopyrite, pyrrhotite, and pyrite, gave one dollar in gold per ton.

Vein No. 4 occurs in a shear zone in Keewatin schists paralleling the strike of the Stabell vein and dipping northeast at 70°.

(1) Op. cit., pp. 85-87.

The exposed length is only 50 feet, and it consists of green schist impregnated with fine pyrrhotite and pyrite along the sides of a granodiorite-porphyry dyke which cuts across the Keewatin. The dyke rock is characteristically free from sulphides. Mineralized widths range from four inches to four feet. Where narrower, the sulphides are very abundant. No values are reported from this vein. Though it is similar in strike and resembles the pyrrhotite-rich portion of the Stabell fault-zone, it is probably not a continuation of the latter, since displacements along the easterly and northeasterly striking faults which terminate the Stabell fault show a movement of the north side towards the east.

As noted by Cooke, the veins are of interest since they fill faults of different ages and themselves differ in age, No. 1 being younger than No. 2 or No. 4. There has been some small displacement of the porphyry dykes by northeasterly and easterly trending faults. The prevalence of faulting suggests that any possible gold-bearing veins would be difficult to follow any great distance.

Unison Gold Mines, Limited (Lorette Mines, Ltd.)

Originally the Foisie-Kengrow claims on lots 27 and 28, range VIII, Dubuisson township, then the Union Mining Corporation, this property was transferred to the Unison Gold Mines, Limited, in 1925. It is now held by the Lorette Mines, Ltd., though still known locally as the Unison mine.

The deposit, near which a vertical shaft was sunk to a depth of 100 feet in 1925, consists of a vein about 200 feet long. This follows a tortuous path, striking N.45°W. at the east end, N.20°W. at the shaft, and, at 100 feet to the west, swinging abruptly to the north for a distance of 25 feet. The enclosing rock has been variously described as an altered Keewatin basic lava, a quartz diabase, and a phase of the granodiorite. The northern portion of the small outcrop does resemble certain phases of the last named, particularly a one-foot tongue which seems to intrude a more basic rock ; but, as Cooke (1) has stated, the rock is now so

(1) Op. cit., p. 91.

A.—Martin Gold mine.—Shaft and old buildings.

B.—Unison gold mine.

altered that its original character is open to question. A thin section made from one specimen showed it to be now a biotite-chlorite schist with nothing to mark it either as an intrusive or an extrusive. Drill cores, described by Cooke as from near the veins, consist of chlorite schist impregnated with albite, which gives the rock a pseudo-porphyritic appearance. A few small dykes of pink aplite are found cutting this rock.

The vein quartz, exposed now only at the west end, is bluish-grey and much fractured and cut by fine tourmaline stringers. Adjoining the vein, the country rock has been much carbonated. Samples on the dump show quartz slightly mineralized with pyrite, chalcopyrite, and a little pyrrhotite. Free gold is reported in the vein. Diamond drilling in 1922, according to Cooke, " established the fact that the vein maintains its width to a depth of 400 to 500 feet ". The average width reported is 10 feet. Assays on a sample across 4 feet of quartz on the surface gave only $0.50 in gold per ton.

Thirty chains to the southeast is a definite intrusive stock of very hornblendic diorite. This consists of hornblende (50 per cent), oligoclase feldspar, and secondary epidote and carbonate. Small amounts of tourmaline occur in the rock, apparently replacing hornblende. Across the outcrop, towards the north, the rock becomes more acidic, with decreasing hornblende and increasing quartz, and at the northern edge it much more resembles the granodiorite.

Martin Gold Mining Company, Limited

The property formerly held by this Company, including parts of lots A and 37, ranges VIII and IX, Dubuisson township, has been described in detail by H. C. Cooke (1). At the time of the writer's visit, the mine was in much disrepair, and many of the outcrops had become grown over and the trenches filled in. For the geology and a map of the property, the reader is referred to Cooke's report.

(1) Geol. Surv. Can., Sum. Rept., 1923, Part C, pp. 87-91.

The vein, consisting of "white, sugary quartz, with a little calcite and pyrites" impregnating carbonated and chloritic Keewatin schists, strikes N.43°W. and dips about 80°N.E., and has an average width of one to two feet and a length of 500 feet. Values in gold are reported as rarely over $3 per ton. A chip sample across 2½ feet at the north end of the vein gave only $0.70 in gold. The only intrusives near the vein are irregular dykes of syenite porphyry; a larger body of this porphyry is reported intersected in drill holes.

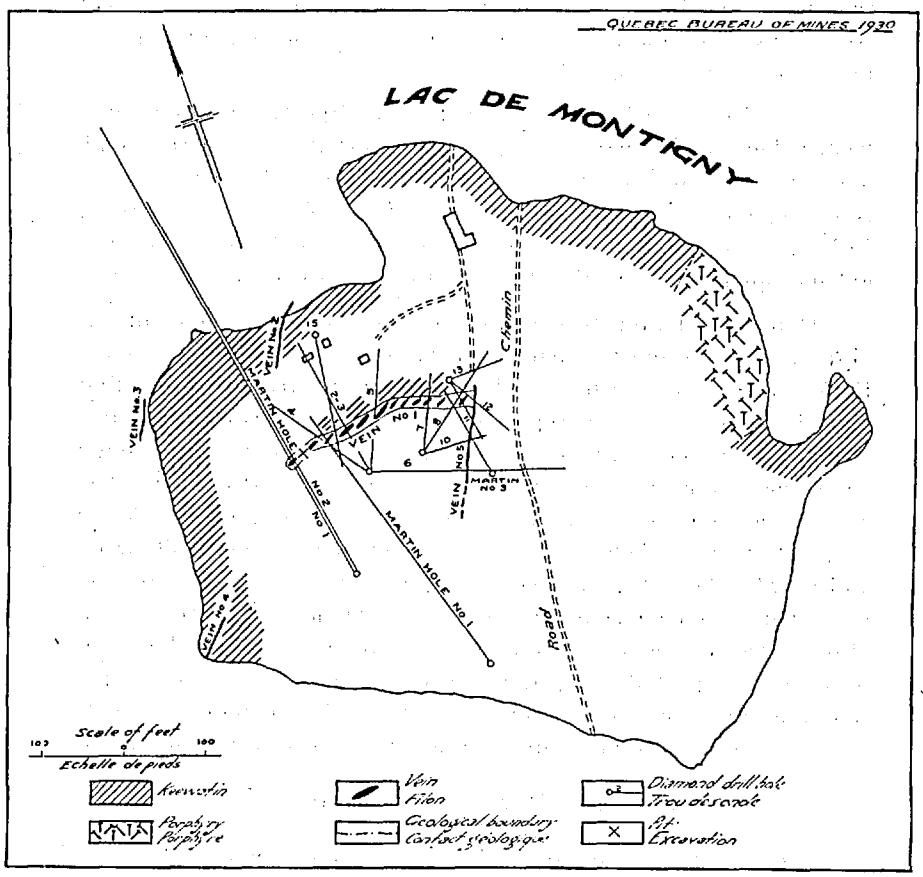
Underground work from the 300-foot shaft, and diamond drilling, have tested the occurrence probably as much as it merits. Near the shaft is a small dump of ore taken from the Siscoe mine. This is reported to have been sent over for a mill test. The tourmaline-quartz-gold association of the Siscoe ore is in distinct contrast to anything found on the Martin property.

Parker Island Gold Mines, Limited

Parker island lies two miles southwest of Siscoe island, in lake De Montigny. Holdings of the Company include this and adjacent islands.

Outcrops consist chiefly of light green andesite flows with a southeasterly trend. At the northeast end of the island these are cut by a sericitic, fine grained dyke of feldspar porphyry striking southwest. Along the north shore are pronounced fractures in the volcanics striking S.10°W. and dipping 70°W. (See Map No. 156).

The vein deposits, though all small, are distinctive for their content of galena, sphalerite, and pyrrhotite. All occur in Keewatin andesite. Veins Nos. 1 and 5 are the most important. No. 1 vein, uncovered for 150 feet, consists of small quartz stringers and veins occupying fractures in an easterly-trending shear zone. The quartz lenses are arranged *en échelon*, striking N.65°-70°E. The shear zone has a width of three to seven feet. Some of the veins have folded contours and pitch southwest at 30°. The quartz is white and sugary, carries pyrite, chalcopyrite, galena, sphalerite, and free gold, and cuts minor veinlets of



Map No. 156.—Plan of Parker Island, De Montigny lake, Dubuisson township.

carbonates. The schistose andesite is mineralized sparingly with pyrrhotite or pyrite. One lens of quartz at the west end of the vein is exposed for 25 feet and is between two and three feet wide. To the east, the lenses, though numerous, seldom exceed six inches in width.

At its east end, vein No. 1 abuts against vein No. 5, which lies in a narrow fracture that has been traced for 200 feet at S.25°W., with dip 80°W. Small lenses of grey quartz follow these fractures southward for 60 feet, with widths up to one foot. Sulphides in

the quartz are fine pyrite and pyrrhotite. Some stringers in vein No. 1 pass through vein No. 5, while others end abruptly at the north-south fractures.

Vein No. 2 strikes at N.35-40°E. and dips 65°W. It is only 25 feet long and 6 inches wide, but is reported to carry free gold. Vein No. 3, also a small stringer, at the west side of the island, is of sugary quartz with a little pyrite. No. 4 vein, striking N.25°E., is of similar dimensions, but, like No. 1 vein, it carries galena, sphalerite, pyrite, chalcopyrite, and some gold.

Diamond drilling was carried out by the management of the Martin Gold Mining Company, and later by N. O. Lawton for the Parker Island Gold Mines. Three holes were drilled by the first named Company. It is reported hole No. 2 intersected a fairly large quartz vein. Later drilling failed to check this, though veins Nos. 1 and 5 were intersected at shallow depths, where they are of the same nature as at the surface. Free gold was found in quartz veins in hole No. 1 in a one-foot quartz vein at 360 feet, and at 233-235 feet in quartz and schist mineralized with pyrrhotite. Quartz stringers in the core of No. 11 hole, at 77 to 82 feet, also carried free gold. Assays of the vein intersections, however, in all cases reported, gave only low values in gold, and occasional traces of silver, over widths up to five feet. The extent and grade of the deposits does not appear sufficient to justify further work.

Dubuisson Development Company

(Formerly the Malartic Extension Gold Mines, Ltd.)

This Company holds lots 13 to 16, range X, Dubuisson township. A cabin has been built on the property, near lake DeMontigny. Outcrops occur along the shore and 26 chains west of the cabin. They consist chiefly of andesite lava flows, some of which are porphyritic and others pillow lavas. On the west and northwest are small masses of medium-grained rocks rich in hornblende, probably related to amphibolites, which are more abundant to the west. They are close to diorite in composition. In the centre of the outcrop an irregular dyke of feldspar porphyry cuts across the andesites. On the east are several irregular masses of dark serpentine accompanied by minor lenses of actinolite schist.

Trenches across the outcrops have disclosed a few small lenticular quartz veins. One of these strikes S.25°E., dips 60°W., and follows a shear zone for a distance of about 200 feet, with widths varying from a few inches to three feet. Another vein, 8 inches wide, strikes at N.40°E. and dips 60°S.E. It consists of sugary quartz and carries only minor amounts of pyrite.

Lots 11 to 16, Range VII, Dubuisson Township

In 1929, the Sladen-Malartic Company is reported to have taken up these lots for prospecting. Lines were cut north and south between range lines, and outcrops were cleared off by shallow trenches. All rock exposed consists of well-bedded Témiscamian sediments, which contain a few grey quartz stringers following the bedding. These are of the same type as the beds abundantly exposed on the burnt ridges east of Lemoine lake.

Canada Mines Syndicate, Limited (Defunct)

This property, formerly known as the Saint-Germain-Gale claims, is on lots 38-41, range VII, Dubuisson township, on the east shore of the northern portion of Lemoine lake. It has been described by A. Mailhiot (1) and H. C. Cooke (2). No work has been done on this property in recent years. The veins are associated with syenite porphyry dykes similar to those at the Martin property, and consist of quartz with minor pyrite.

Lorette Mines, Limited

(Lots 38 to 43, Range VIII, Dubuisson Township)

On lots 42 and 43 of this group, a quarter of a mile from The Narrows of lake Lemoine, a considerable amount of trenching has been done on outcrops of Keewatin lavas which are cut by several dykes of syenite porphyry striking northwest. Descriptions of the old Saint Germain-Gale claims, mentioned above, fit this

(1) *Op. cit.*, p. 153.
(2) *Op. cit.*, p. 97.

property. Some trenching on the west side of the outcrop appears fairly recent, but it has disclosed only some small quartz veins and a shear zone, in massive basalt, striking N.40°E. with a dip of 60°N.W. The schist carries fine pyrite across a width of four feet. The lengths exposed are only one chain or less.

Farther east on the rocky ridge, two other shear zones, with a similar northeasterly strike, occur in Keewatin lavas. They carry sparse sulphides and are cut by dykes of syenite porphyry striking at S.40°E., which, though fractured, show no displacement.

Copper Basin Gold Mines, Limited

This property is on lots 58, 59, and 60, range X, Dubuisson township, at the southwest end of Blouin lake. Only one small outcrop occurs on lot 58, near the lake. It consists of coarse grained granodiorite. A few short trenches across the rock failed to disclose the presence of any veins. Magnetic surveys across the northern part of the property suggest the contact of the granodiorite and Keewatin occurs there. The heavy cover of drift, however, precludes the discovery of any vein deposits, except by diamond drilling.

Harricana Amalgamated Gold Mines, Inc.

Mining concessions held by this Company lie east of the Greene-Stabell property and cover lots 59, 60, 61, and 62, range VIII, Dubuisson, and blocks 13 and 14 in Bourlamaque township.

Outcrops of Keewatin lavas occur on the northern portion of the claims, about half a mile south of the granodiorite contact. On lot 62, a one-foot quartz vein is exposed for 100 feet, lying along the contact between a trachyte breccia and a green carbonated andesitic or basaltic flow. The quartz carries moderate amounts of chalcopyrite and a little pyrite. It strikes S.72°E. and dips 88°N. On lot 59, an easterly-trending shear zone in pillow lavas is injected with several parallel quartz stringers and minor amounts of pyrrhotite and chalcopyrite. The sulphide

impregnation may be traced for about 100 feet. On the north hanging-wall, quartz stringers appear, striking N.20°E for a distance of 120 feet. One of these is displaced by a fault striking N.80°E., the north side of which has moved 15 feet west. A sample of quartz carrying abundant chalcopyrite was assayed to determine whether gold values accompanied this mineral, as is the case at the Greene-Stabell. It gave only 50 cents in gold per ton.

READ-AUTHIER MINES, LIMITED

(Blocks 3, 4, 11, and 12, Bourlamaque Township)

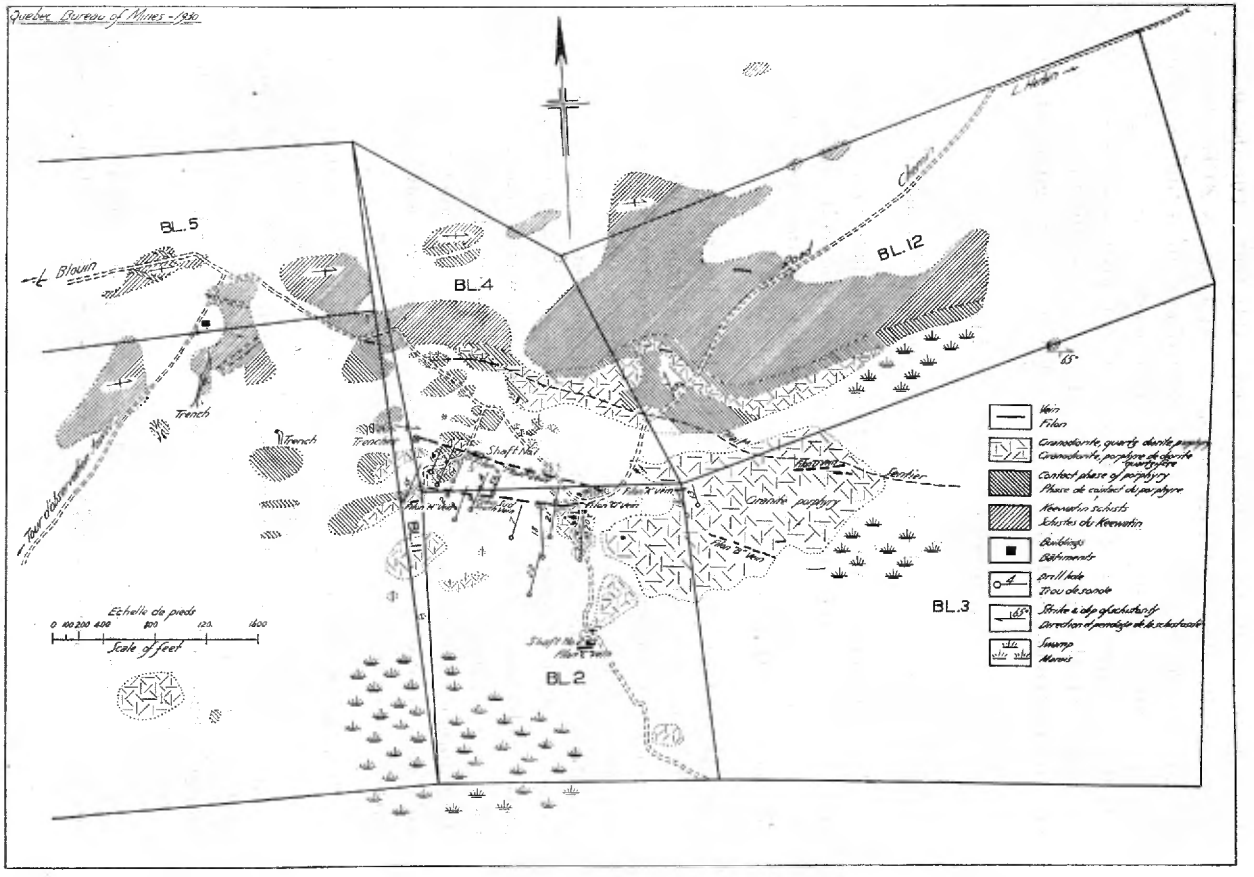
This property lies to the south of Blouin lake and is reached by a road, 3½ miles long, from the Greene-Stabell mine or the lake. Details of the geology and location of the vein deposits are shown in Map No. 157.

The geology of this property has been described above, page 25. It is open to different interpretations. That made by earlier examiners (1) is that the rocks are almost entirely Keewatin lavas and tuffs. The interpretation of the writer, which is not to be considered as final, is that the central portion consists of an elongated stock of granite porphyry bordered by a dioritic contact phase including irregular remnants of Keewatin schists. The rocks vary rapidly in this zone, and necessarily the mapping is diagrammatic. The variation is explained by the conception that an intrusive stock underlies the area and is either barely or only partly uncovered by erosion of the Keewatin lavas.

Should the majority of the rocks, exclusive of definite intrusive porphyry dykes, be proved Keewatin, the structure is that of an anticline, the crest of which is just north of Shaft No. 1. Such a structure may well have exerted a control on both intrusive magmas and vein forming solutions, and is worthy of further investigation.

Nine veins have been located on the property and are confined largely to the main porphyry intrusive or its schistose phases.

(1) Memoir 166. Geol. Surv. of Canada, pp. 261-262.



Map No. 157.—Map of Read-Authier property, Bourlamaque tp.

They are, in part, of the quartz-tourmaline type and have a general trend of S.70°E. They have been explored to some extent by diamond drilling.

The Float Vein.—The most important vein, designated the *Float* vein, is exposed only in three places, in the southwest corner of block 4. Shaft No. 1 was sunk in this vein, which has a strike of S.70°E. and a dip of 40° south. At the shaft, the vein was under water when seen by the writer, but it has a width of about five feet consisting almost wholly of white to waxy quartz. Samples on the dump showed some of the quartz fractured and penetrated by numerous stringers of tourmaline which, in turn, suffered later fracturing and movement. Near and in the tourmaline, fine pyrite occurs as small seams or pockets. Minor amounts of rusty carbonate are also present. The wall-rock is a chlorite-sericite schist, and is penetrated by small seams of quartz and tourmaline and mineralized with ' cube ' pyrite. One sample was found with small specks of chalcopyrite. A sample of the dump at the shaft gave, on assay, $33 in gold per ton.

The shaft is reported (1) to have been sunk vertically for the first 25 feet, then at an inclination of 60 degrees south for 80 feet, following the footwall of the vein. A cross-cut, 8 feet long, was driven at the bottom of the shaft. Free gold is reported to have been particularly abundant in this vein.

To the southeast, 400 feet distant, the apparent continuation of this vein is exposed for 30 feet, with a width ranging between 14 and 8 inches. It is seamed with black tourmaline and dips at about 50°S.W. The hanging-wall is of schist mineralized with pyrite and contains minor quartz stringers. At 550 feet from the shaft, on the same strike, the vein is again exposed for 35 feet and ranges in width from one to three feet, the greater width occurring where the vein has been crumpled and faulted, slickensiding appearing on tourmaline-coated quartz. Diamond-drill holes are reported to have intersected this vein along its strike, but as all vein sections were missing in the core seen by the writer, its width and nature at depth cannot be stated.

(1) A. O. Dufresne, Que. Bur. Mines, Ann., Rept., 1925, p. 147.

South Vein and Vein G.—About 300 feet to the south of the *Float* vein is another nearly parallel vein, designated the *South* vein. It was encountered only in drilling. Vein *G* may be an extension of this, though it strikes N.80°E. and dips about 65°S. This latter vein consists of a schistose shear-zone two to five feet wide, penetrated by numerous quartz-tourmaline veinlets, half an inch to four inches in width, which parallel the schist and on the east are drag-folded and pinch out near the road. Associated with the quartz and tourmaline are some very coarse crystals of pyrite and brown carbonate.

Vein E was encountered in drill holes Nos. 11, 18, 20, 21, and 22, dipping south at 43°. On the surface, it should be 105 feet north of hole No. 11. Hole 22 encountered it at a depth of 325 feet, where it consists of a 3½-foot quartz vein with five feet of altered schist with quartz stringers. In hole No. 18 it consists of a 25-foot zone, made up of two feet of quartz and tourmaline with 20 per cent schist, and 23 feet almost all quartz cut by tourmaline seams, with sparse pyrite.

Vein H, on Block 11, is exposed by only one trench. It strikes N.75°E. and dips 80°S. The main portion consists of 19 feet of white glassy quartz with a very little tourmaline and sulphides. This is bordered on the south by a 9-foot section of sericite schist, which, next to the main quartz vein, is penetrated by several quartz-tourmaline veins up to one foot in width. Both types of vein show evidence of later fracturing and in the cracks thus developed are numerous cross stringers of quartz. Slickensiding suggests that there has been movement of the north side of the vein towards the east. Samples of the quartz and quartz-tourmaline portions of the vein gave only low values in gold on assay.

Vein A lies at the northeast corner of Block 12. At its east end it is cut off by a fault striking S.15°E. From there it trends S.88°W. for about one chain, then swings to S.67°W. and disappears beneath the drift. Its west end is also reported to be faulted off. The vein dips at 55° to the south. It consists of quartz with abundant tourmaline, about one foot wide, with the hanging-wall heavily mineralized with pyrite and cut by branching quartz stringers lined with rusty carbonate. Midway along its

exposed length, it widens to about 5 feet and a flat 6-inch vein takes off on the footwall side. A sample across 6 feet of vein and schist gave only 34 cents in gold per ton. Diamond-drill holes Nos. 12 and 13 do not seem to have intersected the vein at depth, probably due to its faulted condition.

Veins B and *D* lie in Block 3. Both fill distinct shear zones in the porphyry and consist of small lenses of quartz in sericitic schist, which is mineralized with ' cube ' pyrite. A sample taken across 50 inches of schist and 9 inches of quartz in vein *B* gave $1.03 in gold per ton. Some tourmaline is present with the quartz in vein *D*.

Vein C, near which No. 2 shaft was sunk, occurs in the central part of Block 12 in highly carbonated quartz-feldspar porphyry. It strikes at N.75°E. and is exposed for only 95 feet. In width it ranges from five feet (at the west end) to two feet. Quartz, tourmaline, and a minor amount of pyrite, make up the vein filling. At the east end it breaks up into several smaller veins arranged *en échelon* to the north. Here again there is evidence of post-vein faulting, in the slickensided surfaces of the quartz and tourmaline. The shaft is reported to have a depth of 75 feet. There is no evidence on the dump of any large vein having been encountered at depth.

The occurrence of quartz-tourmaline veins on this property suggests a genetic relation between them and the porphyry, with its granodiorite intrusives, to the north and west. The gold has been shown by Bain (1) to occur in fractures in, and also replacing, the quartz, which has in part been granulated. Minor amounts of galena have been noted by Bain as occurring in these deposits along with chalcopyrite and pyrite. The deposits are of sufficient size to warrant careful investigation.

Claims Nos. A.23903, 23904, and 26181

To the east of the south boundary of the Read-Authier property, a narrow belt of fissile sericite schists strike at N.80°E. On

(1) Op. cit., p. 241.

claim A.26181 these are intruded by a small mass of greenish quartz diorite or granodiorite resembling the Siscoe intrusive, with graphic intergrowths of quartz and plagioclase. The schists are probably altered acidic volcanics, but metamorphism has been so intense that their original character cannot be determined with certainty. They are cut by many small quartz-tourmaline veins, some of which are nearly flat, suggesting a much larger mass of quartz than is really present. The schists adjoining are mineralized with fine pyrite. On claim A.23904, a one-foot quartz vein carrying chalcopyrite and pyrrhotite is exposed in the schist for a length of 60 feet. Flat quartz-tourmaline stringers occur just to the west.

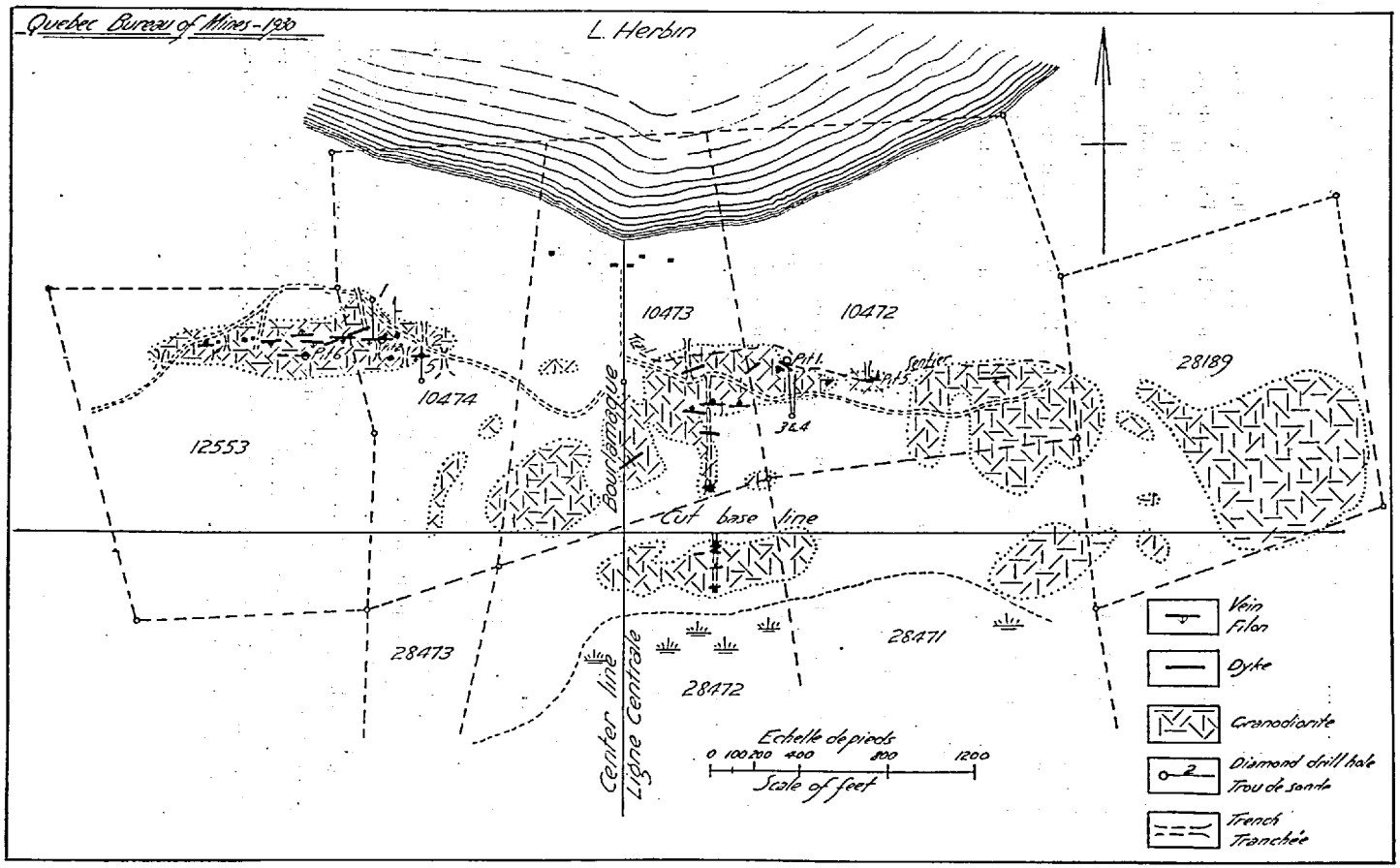
Herbin Lake Claims (W. J. Sparks)

The Herbin Lake property includes claims A.12553, 10474, 10473, 10472, 28189, and 28471-3, distributed to the east and west of the north-south centre line of Bourlamaque township. A detailed plan of the property appears in Map No. 158. The property was explored by the Greene-Stabell Mines, Ltd., and in 1929 by La Reine Mines, Ltd., the latter Company doing some 2,000 feet of diamond drilling. No vein intersections were left in the cores, so the results of the drilling cannot be stated.

Rocks exposed on the property consist almost entirely of medium to coarse grained granodiorite, some phases of which are slightly porphyritic and others characterized by an abundance of dark, unaltered hornblende. An analysis of a core sample of the rock has been given on page 24. Cutting the granodiorite are several small aplite dykes, generally less than one foot in width.

Small inclusions of Keewatin chloritic schist are found within the granodiorite, and since the nearest Keewatin-intrusive contact is about a mile to the southwest, their presence suggests that the top of the batholith was not so far above the presently exposed surface.

Of particular interest are several gold-bearing quartz-tourmaline veins which occupy easterly-trending shear zones and in



Map No. 158.—Claims at Herbin Lake, Bourlamaque township.

places are identical in type of mineralization with veins of the Sullivan mine. The veins, however, appear too discontinuous to give promise of any large amount of ore.

A prominent shear zone known as vein *A*, 900 feet long, extends across claim 12553 and into claim 10474. This is in part occupied by lenticular quartz veins dipping south at 50° to 75°. The maximum width of quartz exposed is 45 inches, at pit No. 2. Short, flat-lying or gently dipping quartz-tourmaline stringers are of common occurrence along the shear zone, which has a width of about five feet. These cut the pink aplite dykes and in places have been faulted with small displacements. The quartz lens at pit No. 2 is seamed with black tourmaline and contains sparse pyrite. The granodiorite walls are mineralized with pyrite for only a few inches away from the vein. A chip sample across this portion of the vein gave only a trace of gold.

About 75 feet to the south of vein *A*, on claim 10474, another vein, *B*, was found beneath the drift. At the time of the writer's visit, this was under water, but, on the sides of the pit, fragments of the vein were seen, consisting of quartz cut by abundant tourmaline and holding large nests of pyrite crystals. This vein is reported to have a width of 10 feet and to carry free gold.

Along the strike of vein *A*, on claims 10472-3, other quartz-tourmaline veins occur, but clearly are not themselves continuous nor can they be considered a part of vein *A*. At pit No. 1, one of these dips northeast at 30° but has not been followed along the strike. About 400 feet to the east, an easterly-trending shear zone again appears, with similar quartz-tourmaline veins, six to ten inches wide, dipping north at 20° to 40°. On the hanging-wall, schistose granodiorite is mineralized with pyrite and badly decomposed. The quartz carries some free gold, as does the rusty schist. Some chalcopyrite is also present, and in specimens examined was found to be replacing tourmaline. Still further east, about 500 feet, another 60-foot lens of quartz, dipping south at 58°, carries some tourmaline but little pyrite.

As indicated above, the mineralization here is in places identical with that at the Sullivan mine to the west, and shows an intimate connection between the gold-bearing, quartz-tourmaline veins and the granodiorite magma.

Beauchemin Claims

Just to the northeast of the falls on the Bourlamaque river, in an outcrop of granodiorite, are five short quartz-tourmaline veins on which shallow pits or trenches have been opened. They are identical in mineralization with those at Herbin lake and resemble the latter in filling irregular shear zones and in continuing along their strike for only short distances, seldom as much as 50 feet. Free gold is reported in some of these veins.

The outcrop is within half a mile of the southwest contact of the granodiorite, and further prospecting may reveal the presence of more persistent veins. The locality is somewhat promising, as the main contact near here takes a sharp bend to the west.

II.—COPPER PROSPECTS

Hughes' Claims (A.32917 to 32931)

On the south of the Bourlamaque river, about one mile due west of its confluence with the Sabourin river, is an interesting occurrence of chalcopyrite in brecciated, light green lava consisting now largely of hornblende, epidote, sericite, and chlorite. It is either a rhyolite or trachyte. The main outcrop lies 20 chains south of the river and is completely surrounded by swamp. To the north, near the river, is a small intrusive stock of diabasic diorite, described above as the 'older' diabase. To the south of the main showing a similar rock is just exposed amidst a heavy mantle of drift.

Trenches and pits have been made across the outcrop and have disclosed at least three breccia or schistose zones in the green

lava which are mineralized with pyrrhotite and chalcopyrite over widths of 10 to 17 feet. At the south end, a 15-foot band of decomposed schist distinctly affects the compass. The lengths of these zones are difficult to determine because of overlying drift. They appear somewhat lenticular but are found across the outcrop in an east-west direction for 250 feet. The longest single zone is about 50 feet.

Associated with the chalcopyrite is a minor amount of pyrrhotite and pyrite, and more abundant dark red hematite, green epidote, and grey carbonate. In places, at the east side of the outcrop, hematite and epidote are the most prominent minerals, forming a cement for angular fragments of the lava. In a large pit in the centre, the epidotic lava is intensely fractured and brecciated for a width of 17 feet. Chalcopyrite, hematite, and carbonate fill the fracture and cement the small fragments of the breccia. The chalcopyrite is confined largely to a two-foot zone in the centre, where it occurs in small nests and forms a selvage around fragments in the breccia.

The source of the copper is not known. It may possibly be related to the nearby intrusions of diorite. Two and a half miles to the southeast, small shear zones in rhyolite and in the diorite itself carry small amounts of chalcopyrite, suggesting that the still later granodiorite and porphyry intrusions, or their magmas, may have been responsible for this type of mineralization.

Caribou Copper Corporation, Limited

The Caribou Copper Corporation, Ltd., holds a group of claims comprising 560 acres in the east-central part of Bourlamaque township. The property is reached by a trail 4¼ miles south from the Colombière river. A branch trail leads west to the first rapids on the Bourlamaque river and a winter road has been cut through to the Read-Authier property.

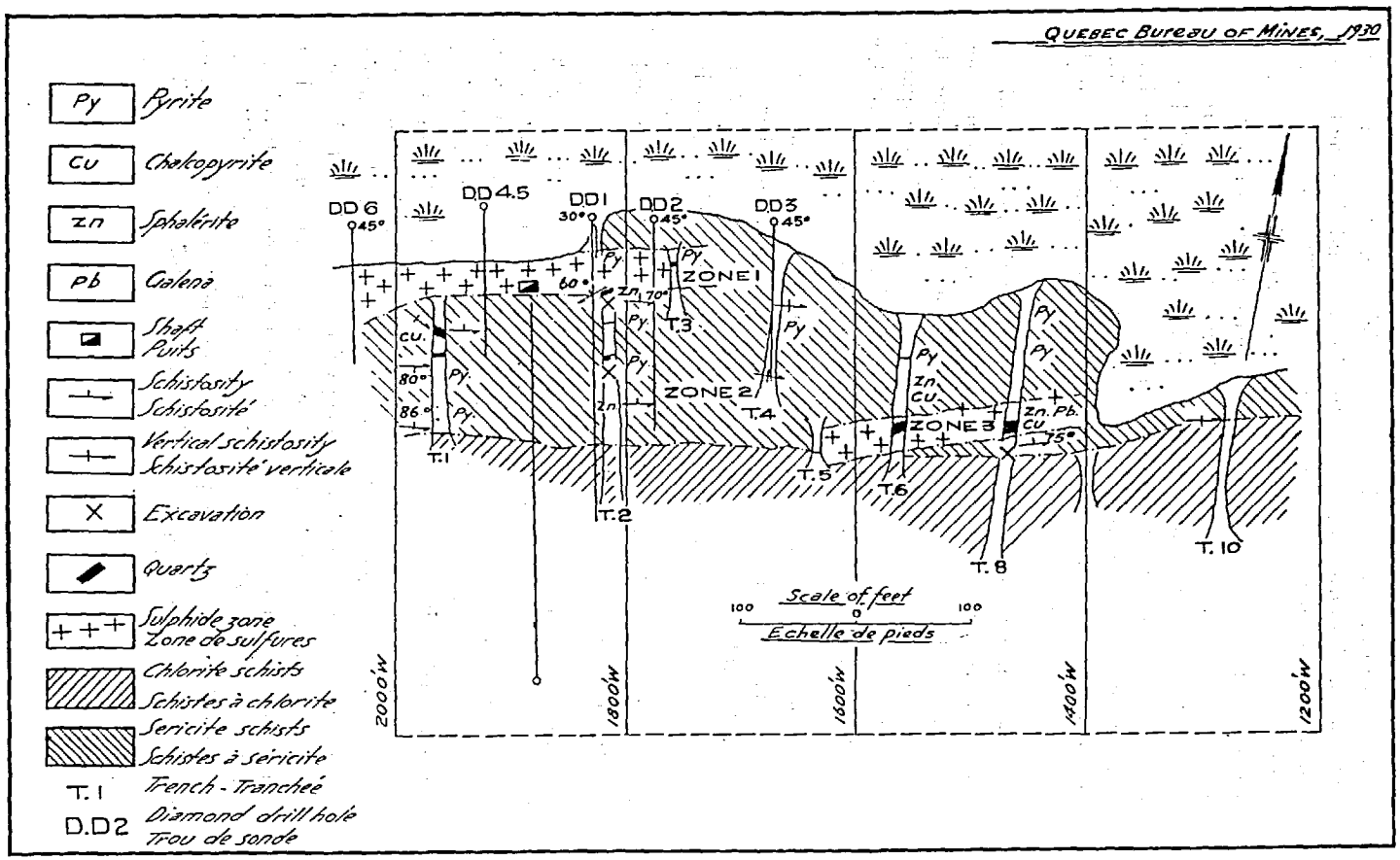
Showings of copper are confined to a narrow belt of sericite schists which lie just south of the granodiorite batholith contact. On the northern edge of the outcrop the rock is more massive, white to bluish in colour, and exceedingly fine grained. This

grades southward into highly fissile sericite schists which, to the southeast and southwest, pass into finely banded sericite and chlorite schists, in places highly carbonated. Thin sections of the more massive rock show it to consist now of over 95 per cent quartz, the remainder being fine sericite. No feldspars are present. Since there are no visible traces of sedimentary textures in the rock, it is probable it represents a highly silicified lava or tuff, locally being almost pure quartz, and grading off into less replaced lavas as represented by the interbanded chlorite and sericite schists. In the latter, the white-weathering sericite bands appear to be intrusive and to replace the chloritic schist.

The general strike of the schist is N.80°E. and the dip is steeply north. , Flow-cleavage indicates a major movement along this zone of the north side eastward and upward. Crossing the schist in an east-west direction are several small lenticular quartz veins filling what appear to be gash or tension fractures. At the east these are drag folded and pitch west at 35°.

Chalcopyrite is confined largely to the quartz veins but is also disseminated in small amount in the schist, together with sphalerite, galena, and more abundant pyrite. A plan of the trenches and strippings appears in Map No. 159. Three principal mineralized zones are present, though on the surface they are difficult to trace along the strike, both on account of their lenticular nature and the sparseness of the mineralization.

No. 1 zone lies to the northwest with a length of over 200 feet, but is probably lenticular, the eastern portion not being traceable to that on the west. It is exposed in a vertical shaft 26 feet deep, in trenches Nos. 1, 2, and 3, and was prospected by diamond-drill holes Nos. 1 to 4 and 6. Good values in copper and gold are reported from the zone, which dips steeply north, where encountered in the shaft. This could not be examined. Samples on the dump showed the best chalcopyrite in quartz. At the west, in trench No. 1, is a 12-foot zone about 35 per cent of which consists of irregular quartz veins striking both across (S.60°E.) and parallel to the sericite schist. The latter strikes at N.80°E., and dips steeply north. A sample across 46 inches of schist gave, on assay, 0.6 per cent copper and 69 cents per ton in gold, while a



Map No. 159.—Map of Caribou Copper Corporation, Ltd, property, Bourlamaque township.

grab sample of the quartz contained 4.05 per cent copper and $1.38 per ton in gold.

In trench No. 2, at the north end, a 2½-foot lens of quartz carries chalcopyrite and nests of black sphalerite. A sample gave on assay 5.4 per cent copper, 0.5 per cent zinc, and 69 cents in gold per ton. In trench No. 3, a six-inch quartz vein in schist lies to the north of the others. Results of diamond-drilling this zone, in part reported, are as follows :

Hole No.	*Footage*	*Remarks*
2	42-48	Reported: $1.60 Au, 4.35% Cu
	79-82	" $2.80 Au, 6.41% Cu
	88-89	" $4.40 Au, 7.86% Cu
3	50-51½	Mineralized schist, chiefly pyrite, and 1-2% Cu
	138	1½-foot quartz vein with sparse chalcopyrite
4	65-93	Chalcopyrite confined to several bands of schist 1½ to 2½ feet wide; not over 3% Cu

Zone No. 2, a so-called zinc-lead-silver zone, is reported to lie about 120 feet south of the shaft. In trench No. 2 it is represented only by highly fissile sericite-schist with sparsely disseminated pyrite and sphalerite. At a point in this trench 60 feet south of the shaft is a one-foot quartz vein carrying chalcopyrite. This wedges out to the east. It is reported that this zone was intersected at 190-200 feet in diamond-drill hole No. 1 and at 200-206 feet and 224-229 feet in hole No. 2. Only the core of hole No. 2 was seen, specimens of which showed the presence of sphalerite, pyrite, chalcopyrite, and a very little galena. Assays of core from these holes are reported to have given values in both gold and silver. These assays are as follows :

Hole No.	*Footage*	*Assay*
1	190-200	$0.70 Au, 1.96 oz. Ag
2	200-206	$1.00 Au, 3.42 oz. Ag, 4.37% Zn
	224-229	10.35% Cu, 8.56% Zn, 4.25% Pb

As sections of the core were missing, no accurate idea of the percentages of minerals present could be formed by the writer.

The third zone appears to the southwest of the shaft, in trenches Nos 6 and 8. There, it has a width of at least 10 feet and consists of mired sericite and chlorite schist, with quartz lenses carrying chalcopyrite, sphalerite, galena, and, locally, segregations of pyrite. The length of the zone exposed is at least 150 feet. A sample taken across 16 inches of quartz in trench No. 8, gave, on assay, only a trace of gold and copper. A sample across 6 feet of schist gave : gold $0.69 per ton, silver 3.0 oz. per ton, and copper 0.48 per cent.

The proximity of these deposits, in what is probably a silicified volcanic schist, to the southern contact of the large granodiorite intrusive on the north suggests an intimate relation between them. The fact that the best copper mineralization is with the quartz suggests that further search should be made for larger quartz bodies. While development to date has not proved the presence of deposits of commercial size and grade, it is possible that further work at greater depths and towards the granodiorite contact on the north might yield better results.

F. C. Bidgood Claims (A.30427, 30428, 30501, 30503)

On these claims, which in part include the south contact of the Bourlamaque granodiorite, are several small outcrops of schistose rocks resembling fine contact phases of the granodiorite and admixed Keewatin schist. On claim 30427, a quartz vein occurs in a schist band striking N.80°E. and dipping 65°-75°N. The vein is exposed for about 200 feet, and varies in width from 1 to 3½ feet. Chalcopyrite occurs in fractures in the white quartz and is present in small amount with pyrite in the walls. Chlorite also is present as small inclusions in the quartz. An assay of a representative sample of the vein quartz gave 1.8 per cent of copper and a trace of gold. The heavy drift covering the contact along this zone precludes the possibility of discovering more veins on the surface.

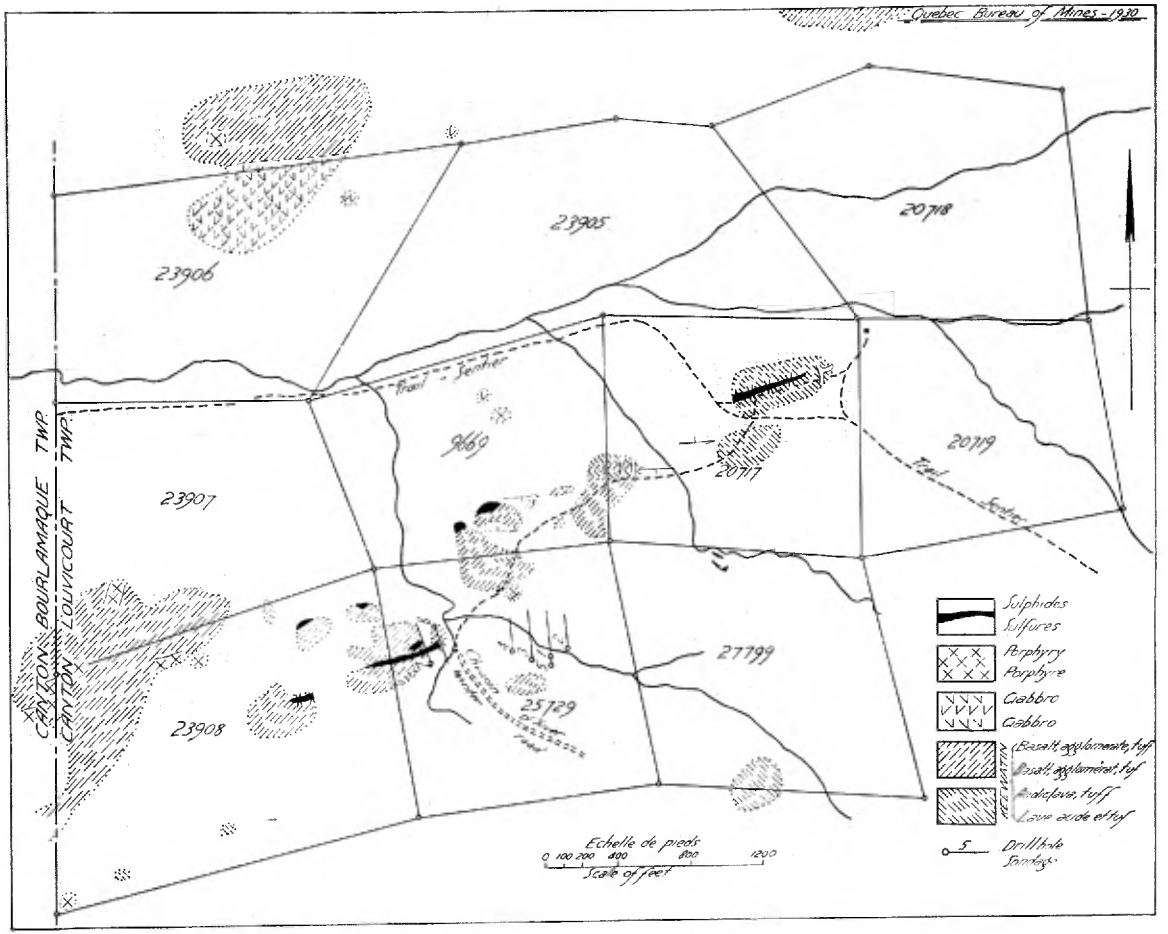
OBASKA MINES, LIMITED (A.25729)

In the southwestern part of Louvicourt township, a large block of claims held by this Company adjoins the west township-line between mile-posts III and IV, extending approximately 2½ miles to the east, half a mile to the west into Bourlamaque, and a mile north and south. The property, in part, was originally staked by Messrs. Rickaby and McNiven. In 1928, surface work was undertaken by Messrs. Heisey and Cleary, and in 1929 a diamond-drilling campaign was carried out.

Rocks exposed on the principal claims—A.25729, 27820, 27821, 27799, and 27822—consist mainly of Keewatin acidic and basic tuffs and interbedded basaltic or andesitic flows (See sketch map No. 148). Cutting the volcanics are several dykes of very coarse-grained granodiorite (acid plagioclase) porphyry, while to the north is a small stock of diabasic diorite which is probably older.

Five mineralized zones occur on the property, principally in shear zones in either acidic or basic tuffs. These strike east and west, and have lengths on the surface up to 600 feet, with a range in width from one to ten feet. Pyrrhotite is the principal mineral introduced into the schists, but small amounts of chalcopyrite are locally present and some gold has been reported. In only a few places does quartz occur in the mineralized zones, but epidote forms a prominent alteration product in the volcanics, particularly where they are basic. In one place, small amounts of black tourmaline are present with quartz stringers cutting an acidic tuff.

At no place on the surface was chalcopyrite seen in amount sufficient to warrant any detailed description. Diamond drilling was confined largely to the sulphide zone just southwest of the camps and over a distance of 800 feet along the strike. Examination of the core available showed the holes had intersected several zones mineralized with pyrrhotite and minor amounts of pyrite and chalcopyrite. A sample of the best looking core, from hole No. 9 at 148-150 feet, assayed 1.48 per cent copper and a trace of gold. Other mineralized sections that were seen carried probably less than one-half of one per cent copper.



Map No. 148.—Geology of Obaska Mines, Ltd. property in Bourlamaque township.

Pascalis Township (Claim A.33726)

Since the writer's visit to the area some activity has been reported in the southwest corner of Pascalis township, and on claim A.33726 a discovery of mineralized replacement zones was made in what appears to be a highly altered contact phase of the granodiorite. Dr. W. F. James kindly supplied the writer with a specimen of the rock and a description of the occurrence.

The rock is fine grained and greyish-white in colour. It consists chiefly of quartz, albite, and carbonate, and carries about 10 to 20 per cent fine pyrite. This rock is almost identical with that of the quartz and albite replacement zones adjacent to quartz-tourmaline veins at the Siscoe property. Similar material was noted by Dr James to follow small fractures and to die out away from them. Small segregations of quartz carrying tourmaline were also observed in the country rock. The mineralized sections were exposed in trench No. 3 with a width of 14½ feet, and also in trench No. 2, 150 feet to the east. They did not appear in an intervening trench, however, and the bodies are apparently irregular in shape. The general strike is N.W.-S.E., but it may be noted, on the areal map, that two directions of schistosity occur in this area, an older one striking N.W.-S.E cut by a younger one trending N.E.-S.W. The former conforms approximately to the contact of the granodiorite. The latter is represented also by small shear zones in the granodiorite to the southwest.