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

GEOLOGICAL SURVEY
W. H. COLLINS, DIRECTOR

Summary Report, 1929, Part C

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OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
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MINERAL OCCURRENCES IN WOMAN RIVER DISTRICT, ONTARIO

By H. M. Bannerman

CONTENTS

INTRODUCTION

Investigations incident to geographical and geological mapping of Horwood Lake map-area, Woman River district, Ontario, begun by the writer in 1928, were continued during the summer of 1929. The examination of additional mineral occurrences within the area was thus effected, and, during the latter part of the field season, a brief visit was made to some of the more important known mineral-bearing localities in the Ridout quadrangle, and adjacent territories. Recent developments on lead-zinc-bearing properties located in Cunningham township were thus visited; copper-bearing deposits were examined in Horwood and Keith townships; and veins containing gold, copper, and telluride mineralization were investigated in Chester township. A brief account of the results consequent on this work is embodied in the following report.

The writer desires to express his warm appreciation of the many courtesies and the hospitality extended by the various prospectors and inhabitants of the district, with whom the party came in contact. In particular he would express gratitude to Mr. William Draper of Ridout Cunningham Mines, Limited, Messrs. J. A. Lefevre and H. D. Lane of Tionaga, and Mr. John A. Shannon of Sudbury, for kindly hospitality and much valuable information. Able assistance was rendered throughout the season by Messrs. R. E. Whiting, W. Tansley, and J. D. Turner.

Woman River district comprises a part of the western extension of Sudbury mining division. It is traversed in a general northwest direction by the main lines of the Canadian National and Canadian Pacific railways, and as the main waterways drain northward, the district is one of relatively easy access. Relief on the whole is low. The country is characterized throughout by hummocky ridges, numerous lake basins, and small valleys. Many of the streams wind sluggishly across the narrow valley bottoms to fall precipitously over rocky ledges to basins of lower altitude. Canoe travel is, therefore, comparatively easy. The main water routes are well cut out, and the portages, though inclined to be steep and in places rough, are usually relatively short. Moreover, at seasons of reasonably high water, side routes can be found through most of the townships, which

greatly facilitate exploratory work. During the autumn, however, the water in the smaller lakes and streams, and even in some of the main streams, drops so low that travel becomes much more arduous.

The Geological Survey Map 155A (2nd edition, 1929) is the only geological map that embraces the entire district, but various reports and maps are available that describe portions of it in more or less detail. Maps 230A and 231A and a description of the Woman River and Ridout quadrangles are embodied in Memoir 157, by Emmons and Thompson, published in 1929. A map and discussion of Groundhog River area, by E. H. Todd, are included in the 33rd Annual Report, Ontario Department of Mines, part 4, 1924. The eastern section of the iron ranges in Horwood Lake area is described in some detail by E. S. Moore, in the 35th Annual Report, Ontario Department of Mines, part 2, 1926, and in addition to these publications the following reports deal with mineral occurrences in the district.

Allan, J. A.: "Iron Formations of the Woman River Area"; 18th Annual Report, Ontario Bureau of Mines, vol. 18, pt. 1 (1909).

Tanton, T. L.: "Reconnaissance along the Canadian Northern Railway between Gogama and Oba; Geol. Surv., Canada, Sum. Rept. 1916.

Lindeman, E., and Bolton, L. L.: "Iron Ore Occurrences in Canada"; Mines Branch, vol. 2 (1917), Ontario.

Robinson, A. H. A.: "Investigations of Pyrite Resources"; Mines Branch, vol. 2; pp. 25-6 (1918).

Report of the Iron Ore Committee; Ontario Department of Mines, 1923, pp. 201-204.

Moore, E. S.: "A Lead and Zinc Deposit in Keewatin Iron Formation"; Trans. Can. Inst. Min. and Met., vol. 29 (1926).

Bannerman, H. M.: "Mineral Deposits of the Eastern Part of Horwood Lake Map-area"; Geol. Surv., Canada, Sum. Rept. 1929, pt. C.

In 1902, and following years numerous mining claims were taken up along the various iron ranges of the district. A considerable amount of work was done on several of these claims, but no iron deposits of commercial size and of grade amenable to development under present market conditions have been discovered. The failure of the efforts thus expended in the search for iron caused many of the claim owners to drop their holdings, and interest, for a time, waned. In recent years, however, the discovery of lead-zinc and copper mineralization, at many localities, and of gold showings in more restricted areas, has enlivened prospecting operations, and scores of claims have recently been staked, some of which are being vigorously prospected for ores of lead, zinc, copper, gold, and other metals.

LEAD-ZINC DEPOSITS

Claim W.D. 717 Jefferson Group, Genoa Township

The first discovery of lead-zinc mineralization within Woman River district, so far as the writer has been able to learn, was made in 1910, when stringers of galena and sphalerite were noted in a drill core taken from the iron formation on claim W.D. 717, Genoa township. Later, a vein of promising import was discovered in the iron formation about the centre of the claim, and in subsequent years some trenching and drilling have been done in an effort to determine the extent of the deposit.

The property has been described, briefly by Tanton,[1] in some detail by Moore,[2] and again by the writer.[3] It is owned by the Jefferson Mining Company, of which Mr. W. E. Smith, Duluth, Minnesota, is the representative. It is located near the eastern end of the main part of the iron range, about one mile northwest of the north end of Rush (Sahkatawichtah) lake. A good trail leading from the most western bay at the north end of this lake affords an easy approach to the prospect.

The bedrock geology of this claim is complex and can best be described by considering that of adjacent areas. The rocks consist of severely schisted rhyolite pyroclastics, quartzites, iron formations, basic lava flows and associated tuffs, all intruded by diorite, diabase, granite, and quartz-feldspar porphyry, which in turn are cut by dykes of comparatively fresh diabase. The siliceous iron formation occurs in two well-defined bands separated by about 750 feet of basic to intermediate flows and some banded tuffs. The northern band is small and in most places interbedded with a few feet of green, tuffaceous material. It strikes about north 85 degrees east, and lies just north of the north boundary of the claim. The southern band is much larger. It attains a maximum width of 190 feet on claim W.D. 717, trends about north 70 degrees east, and dips southward at a high angle. Eastward it turns slightly to the north, and a short distance east of the east boundary of W.D. 717, it is cut by a small dyke of altered diabase, dragfolded and apparently faulted northward about 100 feet. East of here it swings southward, and may be traced along a strike of about 110 degrees for a distance of 1,100 feet where it is cut off by granite. It is succeeded on the south side by a buff to creamy coloured rhyolite breccia-tuff, with which is associated some material that is probably of clastic origin. The rhyolite member is highly schistified, but does not display primary bedding. The northern iron formation band is composed of interbanded quartz and magnetite-amphibole layers, and the southern band is similar, except that a goodly quantity of pyrite and pyrrhotite is present. On claims W.D. 717 and W.D. 715 (adjoins W.D. 717 on the east), and for a considerable distance westward, the schists along the south contact of the iron formation are heavily impregnated and replaced with pyrrhotite, pyrite, carbonate, and some magnetite. On claims W.D. 717 and W.D. 715, pyrrhotite is abundant in these replacement deposits, but traced westward the amount of pyrrhotite tends to decrease and there is a corresponding increase in the pyrite and carbonate content.

Other patches of banded silica, apparently remnants of a once continuous band of iron formation, occur southeast and south of claim W.D. 717, on claims W.D. 716 and S. 3693. On W.D. 716 a band strikes 25 to 30 degrees west of south, and is bounded on the east side by an intrusive mass of quartz diorite. To the southwest, near the east boundary of S 3693, another small band has a somewhat similar trend and is in contact on the east with granite, and farther south, still another remnant is caught up in an intrusive mass of coarse-grained diorite. The area to the west of these disconnected fragments is underlain by the rhyolite tuff that lies

[1] Tanton, T. L.: Geol. Surv., Canada, Sum., Rept. 1916.
[2] Moore, E. S.: Op. cit., Ont. Dept. of Mines, 35th Ann. Rept., pp. 94-96, and Trans. Can. Min. Inst. Min. and Met., 1926.
[3] Bannerman, H. M.: Geol. Surv., Canada, Sum. Rept. 1928, pt. C.

south of the east-west band of iron formation on W.D. 717 and W.D. 715. It is probable, therefore, that the iron formations on claims W.D. 716 and S 3693 are to be correlated with the southern band on W.D. 717 and are fragments of the same band lying on the southeast limb of an asymmetric fold. If this interpretation is correct, it follows that the southern part of claim W.D. 717 is near the eastern end of the fold, at a place where the rocks are not only tightly squeezed, but where the formations of the fold are sharply curving from an easterly to a southwesterly trend. Any fissuring that may have taken place at the time folding took place, therefore, will have been due, in part at least, to strong torsional movements which would have had some bearing on the disposition of the veins of ore minerals which have been discovered in this locality.

The intrusive rocks vary in texture and composition. A relatively large body of diorite occupies a position marginal to the granite on W.D. 716 and east of W.D. 715. Rocks of a similar composition cut the iron formation and rhyolite tuff on S 3693, and numerous small dykes, sills, and irregular-shaped bodies of holocrystalline rock, dioritic to diabasic in composition, cut the iron formation and associated volcanics, at various places along this part of the range. These intrusive bodies have a marked tendency to follow the general structural lines of the older volcanics, in direct contrast with the dykes of olivine diabase which cut the entire complex in a general north-south direction. Moreover, all the diorite-diabase intrusives have undergone considerable thermal metamorphism. They are not schistose, but they have been subjected to local shearing. Many of the shear zones in them are partly occupied by small stringers of quartz and epidote, and in places pink orthoclase feldspar is also present. In thin section the intrusives are found to vary somewhat in composition, but are dominantly composed of bluish green hornblende, chlorite, a mesh work of altered lime-soda feldspar, some epidote, zoisite, and carbonate. Most of them contain quartz, which is sometimes strained, and some remnants of augite have been observed. Magnetite is present in most of the slides, both as well-formed euhedra and as fine, dust-like reaction products associated with chlorite; pyrrhotite and pyrite are also present in some quantities in most of the slides. These rocks are cut at various localities by small dykes of quartz-feldspar porphyry.

The granite is a massive, pink and greyish pink rock. It is not well exposed in this locality. The western outcrops are rich in quartz and contain considerable amounts of chlorite and hornblende, and some epidote. The quartz is sometimes strained, and small stringers of quartz and epidote have been observed to cut across the outcrops. To the east, along the north end of Rush lake, a few outcrops of syenite occur. The whole assemblage is cut by many dykes of fresh-looking diabase, which trend, in general, a few degrees west of north. The contacts of these later intrusives are sharp, and but little metamorphism has been induced by their introduction. They cannot be considered of any economic significance.

The first discovery of lead-zinc mineralization on claim W.D. 717 was made, as stated above, in drill cores which had been taken in quest of ores of iron. The holes from which these cores were taken are close to-

gether, at a point about 360 feet west of a small shaft since sunk on the main vein. The wall-rock of the vein is a garnet-bearing, chloritized quartz-actinolite schist, lying immediately south of the banded iron formation. The schist is profusely impregnated and replaced by pyrrhotite, pyrite, and some magnetite. The schists strike north 70 degrees east, parallel to the trend of the banded iron formation, and the strike of the vein is about north 65 degrees east. The small shaft which has been sunk on the vein was full of water when the property was examined by the writer. Moore,[1] however, reports it to be about 8 feet deep, and to be bottomed on a lens, 34 inches wide, of almost solid galena. The surface outcropping of the vein is 18 inches wide on the east margin of the pit. It pinches to 15 inches at a distance of 10 feet eastward, and beyond that it is not easily defined, but 50 feet east of the shaft there is an irregular zone 36 inches in width, which carries a fairly high concentration of galena, sphalerite, and chalcopyrite. Numerous small veinlets composed essentially of sphalerite permeate the wall-rock on either side of the vein. These are often accompanied by a gangue of calcite, dolomite, and epidote, and in some cases quartz and pink feldspar are sparingly present. In a cross trench 112 feet east of the shaft the main vein does not appear, but 25 feet northward across the strike, a number of veinlets of sphalerite occur.

In thin sections the wall-rock which contains the sphalerite veinlets is found to contain an abundance of chlorite, green fibrous radiating amphibole, and talc, together with some calcite and siderite all of which seem to have been introduced along with the ore minerals. Many of the garnets are found to be completely replaced by chlorite, and dust-like grains of magnetite. The sphalerite and galena are in many cases accompanied by a little pyrite, and are in some cases intricately intergrown with radiating aggregates of anthophyllite or occur as minute veinlets between fan-like structures in the latter. The anthophyllite replaces the chlorite, and seems to be the latest of the gangue minerals to crystallize.

Two generations of pyrite appear to be present. The older is abundantly present in iron formation throughout the eastern section of the iron range, it is distinctly earlier than the galena-sphalerite veins. Under the microscope it displays a broken and corroded outline, and in places is almost completely replaced by pyrrhotite. The younger pyrite on the other hand is associated with the galena-sphalerite veins, but in sparing quantities. It is fresh, relatively unbroken, and sometimes it is found as well-formed euhedra in the veinlets with anthophyllite and chlorite. The pyrrhotite is veined and replaced by chalcopyrite, and by sphalerite. The relative age of the chalcopyrite and sphalerite is doubtful, but the galena replaces both.

Some fourteen drill holes have been sunk on this property in an attempt to locate an ore-body of commercial size. Ten of these were driven under the direction of C. K. Leith, Madison, Wisconsin, in the spring of 1928, when the property was under option to a syndicate known as the Rush Lake Mining Company. The property was reoptioned,

[1] Moore, E. S.: Trans. Can. Inst. Min. and Met., vol. 29, p. 4 (1926).

early in 1929, to Canam Metals, Limited, Negaunee, Michigan, who drilled for additional holes. The drilling has all been done from the south side of the vein. The holes are ledged northward at angles varying from 60 to 75 degrees, and are staggered along the strike over a distance of 360 feet.

Claim S, Jessop Property, Genoa Township

This claim is on the small neck of land that separates the northeast bay from the main body of Rush lake. It was staked by Mr. Jack Jessop of Sudbury in the spring of 1928. In the summer of the same year impregnations of sphalerite were discovered in the iron formation bluff on the south shore of the northeast bay. Strippings reveal a zone 36 inches in width which is veined and impregnated by sulphides of lead, zinc, and copper, along with pyrite and magnetite. The sulphide veinlets tend to follow the bedding planes of the iron formation, but where the latter are crumpled the veins cut across and penetrate them at various angles. Sphalerite is the most abundant of the sulphides present, but their combined amount does not exceed 10 per cent of the rock. They are usually accompanied by a gangue of quartz. Assays made from samples of the deposit are said to have yielded values in silver and gold, along with their copper-lead-zinc content. The iron formation in which the ore minerals occur is comparatively small, and is intermixed with tuffaceous material, which is now converted into hornblende and chlorite schist. Dykes of quartz diorite and granite cut and greatly disturb the iron formation and its associated rocks on this claim.

Properties of Ridout Cunningham Mines, Limited, Cunningham Township

The lead-zinc bearing localities in Cunningham township can be reached by a wagon road that leads northward from Sultan Station, on the Canadian Pacific railway. The distance to the camps of Ridout-Cunningham Mines, Limited, on claim S 1243, is said to be about 10 miles, and the road leads directly past the properties of the other companies operating in that area.

In 1904 a number of claims were staked on the iron ranges of Cunningham township, by N. Cryderman of Sudbury, in behalf of G. B. Nicholson, of Chapleau, and others. A syndicate, known as the Ridout Mining Company, was formed for the purpose of prospecting the claims for iron. During the years 1904-07 some stripping was done on the claims, but as their iron content proved too low to consititute an ore, interest in the property waned. In the spring of 1927, however, the discovery of lead-zinc bearing veins, at several localities, in the iron formations of this township, led to a renewed interest. Promising veins bearing sphalerite, galena, and chalcopyrite were at this time discovered and staked, by Messrs. W. Draper and R. Allen, on the iron formation belt three-fourths mile south of Edwards lake, and out of these discoveries grew the Aldra Mining Syndicate which proceeded to do development work on a number of leads. In 1928 the Ridout Mining Company and the Aldra Syndicate, together

with a number of individual claim owners, merged their holdings to form the Ridout-Cunningham Mines, Limited, with Mr. G. B. Nicholson, Chapleau, as president. The company thus controls a block of seventy-four claims within the confines of Cunningham township, and during the autumn and winter of 1928-29 a systematic prospecting campaign was waged under the managership of Mr. Draper. Up to the time of the writer's visit some 8,000 feet of stripping, a considerable amount of trenching, and approximately 1,000 feet of diamond drilling had been completed. Owing to the short time spent in the area, it was found impossible to examine all the prospects thus opened up. Attention was directed rather to the more promising localities.

Group No. 1

Group No. 1 includes, in part, claims S 1986, S 1243, and S 1904. The main camps of the company are located on S 1243, near the eastern shore of a small lake. The geology of the claims is complex. A broad band of iron formation trends a few degrees north of west across claim S 1904 to the western boundary of S 1243 where it makes a sharp bend and is probably faulted northward for about 200 feet. Thence it strikes almost due west across claim S 1986. The band attains a width of about 350 feet on claim S 1243, and eastward it widens somewhat. Westward, across S 1986, it narrows rapidly, so that at the western boundary of the claim it is only 100 feet wide and ¼ mile farther west it was observed to have a width of only about 50 feet. The dip varies from 45 degrees to 65 degrees toward the south, the usual inclination being about 50 degrees.

The iron formation is composed of grey to white bands of silica interlayered with black slate. Trenches on claim S 1986 expose bands of argillaceous sediment 15 feet in thickness interbedded with bands dominantly silica which reach a maximum thickness of 9 feet. Toward the southern edge of the banded formation, in these trenches, the banding is much thinner and in places it is almost of paper thinness.

The term "iron formation" is applicable to these beds only by virtue of their characteristic banding. Not sufficient iron is present to seriously affect the compass needle, and although this section shows the siliceous bands to be composed of small, interlocking crystals of quartz with a minimum quantity of chlorite and actinolite scattered throughout, thus resembling very markedly the textural and compositional character of the metamorphosed cherty portions of iron formation, yet the black bands are of argillaceous sediment which in thin section proves to be a felted mat of carbonaceous matter surrounding more or less circular aggregates of sericite, actinolite, chlorite, and cyanite, with, in many cases, a small grain of fragmental quartz at their centre. Small lenses of fine-grained, banded pyrite were observed to parallel the argillaceous beds in several of the trenches, and rounded, concretionary balls of pyrite were noted which are quite comparable with those found in carbonaceous shales of more modern formations. These pyritic bands as seen in trenches near the claim line between S 1986 and S 1243, are distinctly cut by veinlets carrying

lead-zinc and copper minerals. The pyritic bands do not appear to have any genetic relationship to the latter sulphides, and though they may in part be replacements of the original sediment, the author believes them to have been formed during the early history of the deposits, before consolidation of the sediments.

The southern contact of the banded silica formation is not sharply defined, but tends rather to grade into banded greywacke-quartzite which in turn is succeeded by a rock composed of many fragments of quartz, together with some rounded to oblong fragments of rhyolite porphyry, found in a matrix of fine-grained quartzite. Fragments up to 6 inches in length were measured. The most of them are quartz and many resemble broken bands of chert. They are angular to well rounded. From the few exposures examined by the writer the rock is probably best considered as a breccia, but its composition and the relation of the fragments to the matrix strongly suggest intraformational conglomerate characteristics rather than a fault breccia.

On the north the banded silica is bounded by andesitic lava flows, which display well-preserved pillow structure. A large intrusion of basic rock, which varies from a medium-grained diorite to a coarse-grained feldspar porphyry, cuts the pillow lavas on claim S 1986 about 275 feet north of the iron formation boundary at the western boundary of the claim. The strike of the contact between this intrusive and the lavas is a little south of east, so that the boundary of the intrusive is only a few feet north of the iron formation at the east side of claim S 1243. The extent of this intrusive body has not been determined by the writer, but Map 230A shows it to be an arcuate body convex to the north, extending over a mile east-west and about $\frac{1}{4}$ mile in width. The rock is sheared locally, and permeated by many veinlets of epidote and quartz. Some of these veinlets carry quartz which displays, prominently, the rhombic cleavage of calcite. Near the eastern boundary of claim S 1243 a gabbro facies of this rock is in contact with the lavas. The gabbro is definitely intrusive into the lavas, and a dyke of drab salmon-coloured lamprophyre striking northwest cuts sharply across the contact. The lamprophyre is composed of orthoclase and some albite-oligoclase feldspar which forms an aphanitic aggregate around what were once apparently well-formed crystals of monoclinic pyroxene, but which are now altered to chlorite, uralite, carbonate, and epidote. The feldspars are slightly fogged by sericitization, but are still easily distinguishable. An abundance of fine-grained magnetite and closely associated pyrite occurs, in the groundmass, together with some well-twinned crystals of calcite, a little rutile, and topaz.

Another large, basic intrusive skirts the south boundary of the claims, where it cuts the quartzite breccia. This mass resembles in many respects the northern intrusive, in that it displays local shear zones similarly altered. It is not well exposed in the vicinity of the claims, but where observed it appeared as a medium-grained hornblende diabase.

Altered diabase which texturally and compositionally resembles the smaller bodies and border phases of these larger intrusives cuts the breccia and quartzites south of the iron formation on claims S 1986 and S 1904. One of these dykes may be seen in a trench on claim S 1986, 400 feet west of the east boundary of the claim. The dyke is 40 feet wide. It is com-

posed chiefly of chloritized hornblende, plagioclase—now largely altered to zoisite and carbonate—a little quartz, and a considerable amount of disseminated pyrite. Locally it is crushed, and veined by small quartz stringers. An outcrop of similar rock which occurs 100 feet west of this trench, is cut by a dyke of quartz-feldspar porphyry. The porphyry dyke is 15 feet wide, trends about north 78 degrees east, and may be traced in contact with the diabase over a distance of 60 feet. Small apophyses of the porphyry extend into the diabase, and several small fractures trending obliquely across the contact are filled by quartz. Similar intrusives of quartz-feldspar porphyry were observed in the area just south of this where they cut the quartzite breccia. These dykes are fine-grained rocks with a distinctly porphyritic texture. They weather light grey to buff. Under the microscope they are found to consist of numerous phenocrysts of orthoclase and oligoclase together with a little microcline and quartz, embedded in a fine-grained groundmass of intergrown quartz and feldspar. A small amount of biotite, now partly replaced by chlorite, together with a small quantity of magnetite and zircon, is present. The feldspar phenocrysts are slightly sericitized and some of the quartz phenocrysts display evidence of strain, but on the whole the rock is fresh.

The relation of the altered diabases which are cut by these porphyry dykes, to the main masses of gabbro-diabase that lie to the north and to the south of the claims, is not known. They are, in all probability, however, offshoots of the same magma, though possibly they are older and more closely related to the Keewatin igneous complex. In view of the limited amount of the exposures that occur in this vicinity, much more extended and detailed field work will be necessary to establish this relationship beyond the realm of doubt.

A dyke of olivine gabbro trends in a northerly direction near the west boundary of claim S 1986. The dyke is about 50 feet wide and is the youngest rock in the area. It cuts sharply across the bedding and secondary foliation of the sediments. Its boundaries are chilled, and little metamorphism has been induced by its intrusion. It is fresh in contrast with any of the other basic rocks in the area, and under the microscope it is found to consist of well-developed laths of labradorite, relatively fresh unaltered augite, an abundance of magnetite, and a few resorption remnants of olivine. These, along with a little apatite and a small quantity of uralite and serpentine which alter the pyroxene and olivine along tiny fractures, make up the mineral content of the rock.

Some 6,000 feet of stripping, a considerable amount of blasting, and some drilling had been done on these claims up to the time of the writer's visit. Most of the strippings were designed to cross-trench the banded silica formation, and demonstrate the persistence of lead-zinc and to some degree, copper mineralization along the strike of the bands for a distance of about half a mile. Unfortunately, however, the mineralization is light. It consists of an intricate network of small veinlets of sphalerite, galena, and, in some cases chalcopyrite and pyrite, which follow the bedding, cut across the bands, and penetrate in every conceivable manner the iron formation bands. Usually the ore minerals are accompanied by a gangue of vein quartz and calcite. On the whole, the veinlets are more prevalent in the more siliceous parts of the formation. In many cases small veins,

well defined in the silica bands, may be seen to die out quickly in the adjacent slaty band. The stronger veins, however, in many cases cut across from one silica band to the other.

Most of the trenches on S 1243 show two zones of mineralization separated in places by upwards to 40 feet of barren rock. These zones vary in width up to 12 feet, but usually are not over 4 to 6 feet wide. They are not strictly parallel, nor continuous along the strike, but seemingly, tend rather to occur haphazardly, presumably incident to local folds and crushing in the banded silica. The heaviest mineralization exposed on this group was in trenches near the boundary between claims S 1986 and S 1243. Veinlets composed chiefly of sphalerite, but containing some galena and a little chalcopyrite, are here scattered over a width of 9 feet and exposed continuously along the strike for a distance of 35 feet. Of this it was estimated that only about 2 per cent was composed of the combined sulphides. Within this zone, however, a band 2½ feet wide has considerably greater concentration, and probably as much as 6 per cent of this more restricted width is composed of the sulphides.

Group No. 2

Group No. 2 is located about 1¾ miles southeast of No. 1. It includes claims S 8176 and S 8177. A well-beaten trail connects the two groups. In all about 1,200 feet of trenching has been done on these two claims. The strippings are near the east side of the claims at the boundary between them, and on the southwest side of claim S 8177. At each locality the trenches are designed to crosscut banded silica iron formation, and the intervening area is largely underlain by a mass of altered diabase.

In common with the banded formation that occurs on group No. 1, the iron formations consist of interbanded silica and black slate. The strike here is approximately northeast and the dip, though variable, is about 45 degrees toward the northwest. The cross trenches reveal mineralization similar in almost every detail to that described from claim S 1243, and, except that the sulphide veinlets are, on the whole, more abundant in the eastern than in the western developments on these claims, the conditions exposed by the two sets of trenches on this group are identical.

The chief ore mineral present in most of the trenches is sphalerite. It is commonly present as tiny veinlets which parallel and crosscut the bands of the iron formation. Some of them are almost pure sulphide of zinc, but usually the sphalerite is accompanied by some galena, a little chalcopyrite and pyrite, in a gangue of calcite and vein quartz. In other cases veinlets and impregnations of chalcopyrite and pyrite in the rock are sharply cut by veinlets of sphalerite and chalcopyrite. In the trenches near the eastern boundary of the claims mineralization of this nature is thinly scattered throughout widths of 14 to 15 feet, and within these zones bands 2 to 3 feet wide contain sulphide veins upwards to 1 inch in thickness, and concentrated so as to comprise about 2 or 2½ per cent of the rock. On the whole the copper content is higher in these trenches than at any other part of the area examined by the writer. One trench near the northeast corner of claim S 8177 exposes the iron formation almost to its contact

with the diabase. In this trench a zone 17 feet in width is profusely veined by tiny stringers of chalcopyrite, and contains many veins up to 2½ inches wide of almost pure sulphide of copper. Traced from one trench to another the ore minerals do not manifest a definite concentration along given horizons in the banded silica, but tend rather to undergo local increases wherever the siliceous formation is intensely crumpled.

Claim S 9240

This claim is on the northwest corner of Edwards lake, and is owned by Ridout Cunningham Mines, Limited. Strippings near the shore of the lake reveal a band of cherty iron formation, 5 feet in width, which is sparsely impregnated with pyrite and veined by sphalerite-galena-chalcopyrite stringers. The iron formation is chiefly composed of silica, and is bounded by ellipsoidal lava flows. The lavas are rusty, but do not seem to contain any appreciable amount of the ore minerals. A heavy mantle of glacial till blankets the area round, so that the immediate relations of the deposit are obscured. A short distance south, however, a high ridge of diabase occurs.

Claim S 9237

This claim is also the property of Ridout-Cunningham Mines, Limited. Trenches in a gully 100 feet northeast of the eastern end of a small lake expose a shear zone in tuffaceous sediments. The zone is coincident with bodies of quartz that resemble very strikingly the siliceous portions of banded iron formation. The main body of quartz apparently antedates the shearing, as it has been severely crushed and brecciated, but a considerable number of later quartz stringers permeate the schisted wall-rock in some of the trenches. The mantle of glacial till here is from 5 to 14 feet thick, so that the wall-rock relations are not well exposed except in the trenches. It is apparently in part a coarse pyroclastic, or volcanic breccia. A fragmental facies exposed on a small ridge south of the trenches contains angular fragments, up to 15 inches in diameter, of greenstone embedded in a greenstone matrix. To the northwest of the gully a long cross trench reveals conditions similar to that found south of the banded silica on claim S 1986, in that over 200 feet of quartzose sediments containing fragments of rhyolite porphyry, and cherty quartz, are found to grade into 100 feet of banded silica. The banded silica is flanked on the northwest side by a mass of diabase, which bears an intrusive relationship to it.

The shear zone strikes north 60 degrees east and has been traced by cross trenches throughout a distance of 225 feet. The mineralization is spotty, but in some of the trenches the quartz is profusely permeated by veinlets of sphalerite and galena. In one trench 20 inches of quartz was estimated to contain to 10 per cent of these sulphides, the greater part of which was galena. As a rule the heavier mineralization is confined to the quartz, but in some of the trenches veinlets and impregnations of the ore minerals were observed in the sheared wall-rock.

Anglo-Sudbury Mines Property, Cunningham Township

A group of claims located along the iron formation bands west of Isaiah creek, are owned and being developed by the Anglo-Sudbury Mining Company. They were staked, in the early part of 1927, by Dr. Smilie of Toronto who is directing the development work for the company. Work has thus far been concentrated on discoveries of lead and zinc minerals on claims S 9320, and S 9351, just south of the eastern end of Peter lake. Considerable stripping and some drilling have been done on these claims in search of ore.

The greater part of the ore minerals exposed when the author visited the property was contained in the siliceous portions of the iron formation. A large band of these sediments trends approximately east across the southern part of claim S 9320. The band is about 900 feet wide and stands out prominently as a high, abrupt ridge, south of Peter lake. It is cut by dykes of altered diabase and quartz-feldspar porphyry. Its southern boundary is covered by a heavy blanket of glacial debris. On the north it is in contact with a mass of diabase which is similar to the coarse-grained intrusive rocks that occur in the vicinity of the Ridout-Cunningham Mines Group No. 1.

On claim S 9320, just south of the east end of Peter lake, a number of trenches expose beds of quartzite and argillite, which are crushed and impregnated with small veinlets of quartz and calcite along with small quantities of sphalerite, galena, chalcopyrite, and pyrite. These beds are cut off at the north and northeast by a large mass of intrusive diabase, and they seem to give place southward to banded silica, which, in turn, is sharply bounded to the south by a dyke of diorite. A trench which followed the contact between the diorite and the banded silica at this place, exposed the heaviest concentration of ore minerals noted on the property. Veins, up to 2 inches in width, of almost pure sphalerite, parallel the strike of the contact and numerous smaller veinlets of sphalerite, with galena, chalcopyrite, and pyrite, penetrate the broken silica bands across a maximum width of 9 feet. A sample representative of the best mineralization in this trench across a width of 3 feet yielded on assay 0·21 per cent copper; 1·00 per cent lead, and 5·79 per cent zinc. This block of iron formation and its associated sediments have presumably been separated from the main body of iron formation, which forms the ridge to the south, by the intrusion of diorite. The maximum width of the sedimentary complex is not in excess of 300 feet. The intrusives join toward the west so as to still further limit its extent; its eastward extension is covered by swamp and the flood-plain deposits of Isaiah creek, beyond which, to the east, is a large body of granite. Two diamond drill holes ledged toward the northeast have been driven to explore the swamp-covered area east of the trenches. Another hole is ledged in the diorite just south of the trenches at the edge of the swamp and dips toward the northwest, while a fourth is located 300 feet southwest of this point and dips toward the north.

Strippings across the high ridge of iron formation at the south side of the claim reveal scattered mineralization at various horizons within the banded silica. The veinlets are composed chiefly of sphalerite. A drill

hole, ledged at 38 degrees to the north, is located on claim S 9651, on the south side of the ridge, and is said to have been driven to a considerable depth. The data derived from these drilling operations are not at hand.

Copper Chief Mining Company's Property, Cunningham Township

A block of eight claims located about ¾ mile south of Anglo-Sudbury Camps is controlled and being developed by the Copper Chief Mining Company, under the managership of J. B. Terry of Toronto. Most of the work done to date is confined to claim S 9144 and S 16716. Near the southern boundary of the latter claim, and directly west of the roadway leading to Sultan, a small pit has been sunk in a shear zone at the contact between chloritic and graphitic schists and an intrusion of altered diabase. The pit is about 12 feet deep and penetrates greatly crumpled, almost pulpy, schists which carry small amounts of calcite. No appreciable quantities of sulphides are present either in the walls or in the material on the dump. South of this a trench exposes a sedimentary complex of argillaceous slates, greywacke, and banded silica for a distance of 250 feet and, southward, a small depression intervenes between these and a large body of granite porphyry. The schists strike northeast and dip toward the northwest. Southwest along the strike a number of trenches have uncovered small stringers of lead-zinc and copper sulphides filling fractures in the banded silica and associated sediments. Unfortunately, however, the veins are small. The best showing, at the time of the writer's visit, was in a trench near the north boundary of S 9144, where veinlets up to one-fourth inch wide, of sphalerite and galena in a calcite gangue, penetrate a conglomeratic facies of the greywacke, near the boundary of a dyke of altered diabase. The veinlets at this locality were observed to cross the boundary between the sediment and the intrusive and some of them lie entirely within the igneous rock. The diabase is here cut by a small dyke of quartz-feldspar porphyry.

Claim S 16981, Heenan Township

A block of five claims, staked in 1928 by M. D. Fisher, is located just south of the Heenan-Newton township boundary between mile-posts 4 and 5. They can be most easily approached by means of a canoe route that leads westward from the big bend in Woman river, about 2 miles south of its junction with Rush river.

On one of these claims a small stockwork of veins is exposed by stripping and carries small quantities of pyrite, sphalerite, and a little galena. The veins occur in a crushed portion of a relatively coarse-grained mass of gabbro-diorite. This mass is of considerable dimensions. It is intrusive into the Keewatin lavas, and has been traced from the northwest corner of Marion township westward for a distance of about 4 miles. Between mile-posts 4 and 5 on the Heenan-Newton boundary, the northern contact of the body is only a chain or two south of the line. The body is approximately 45 chains wide at this place, and after the manner of other gabbroid intrusions in the area it exhibits a great variation in texture and composi-

tion—ranging from a coarse-grained feldspar porphyry with plagioclase crystals up to three-fourths inch in length to a medium-grained quartz diorite. Sometimes these changes are abrupt, as though the mass were made up of composite intrusions, and in other cases the transition seems to be more or less gradational.

The veins are in a brecciated zone which seems to trend east. The rock is severely crushed over a width of 20 feet, and the mineral-bearing veins occur throughout, but make up a relatively small portion of the rock. They are composed of quartz, axinite, and carbonate, and carry small quantities of pyrite, magnetite, sphalerite, and a little galena. The relative percentage of sulphides is low and of these pyrite is by far the most abundant. The wall-rock in the vicinity of the veins is altered to a striped mass of yellowish and reddish hue, in marked contrast with the black to dark greenish grey colour of the unsheared wall-rock. Under the microscope these brighter coloured portions are found to be made of up sericite, carbonate, secondary albite intergrown with quartz, axinite, a little chlorite, and hematite.

The gabbro-diorite underlies the greater part of the claim, and it is doubtful if a sizable body of lead-zinc ore will be found within this rock. The size of the mass, however, and the attendant evidence of mineralization, suggest that the contact zones might be favourable prospecting grounds.

The Ore Minerals, Cunningham Township Deposits

Microscopic examination of a number of polished sections of the ore minerals taken from the different properties in Cunningham township, described above, indicates that the ore minerals are everywhere similar and essentially constant in relationship. All sections contain the common sulphides of lead and zinc, together with more or less chalcopyrite, and usually some fresh-looking veinlets of pyrite. In the majority of cases both quartz and calcite occur as prominent gangue minerals, and of these quartz is the most abundant. Of the sulphides, the pyrite crystallized first, and, in the majority of cases, was succeeded by sphalerite, chalcopyrite, and galena in the order named. The relationships of the chalcopyrite and galena are, however, not always easily determined, and are probably not constant. Specimens taken from a trench on claim S 8177, show intergrowths of chalcopyrite and small quantities of sphalerite, replacing graphitic and chloritic schist; tiny veinlets composed essentially of sphalerite, with a few grains of chalcopyrite, cut sharply across the foliation of the partly replaced schist, and in other specimens, taken from the same set of trenches, the larger veins of sphalerite contain numerous rods and dots of chalcopyrite. Covellite and bornite are sparingly present as secondary sulphides of copper, and a minor amount of copper carbonates is present. Some of the ore minerals which penetrate the silica bands are found, in thin section, to have small amounts of such minerals as chlorite, sericite, carbonate, or epidote, in association, but many of them are accompanied exclusively by quartz. The stringers are sharply bounded, and the wall-rock has suffered little or no alteration as a result of the invasion by mineralizing solutions. Many of the smaller stringers and isolated bodies of sulphide

which, in the hand specimens, look like metasomatic replacements, prove in thin section, when subjected to strong light, obliquely applied, to be local precipitations in tiny fractures, the remaining part of the fracture having been healed by the accompanying quartz, so as to entirely resemble the mosaic of quartz which makes up the siliceous wall-rock. A limited amount of replacement was noted where the ore minerals invade the argillite bands, but, on the whole, the iron formations have proved inhospitable hosts.

COPPER DEPOSITS

Claim S 11994, Horwood Lake

This claim is on the peninsula between the two northern arms of Horwood lake, at a point almost due east of the mouth of Doré river. The rocks on the peninsula are a complex assemblage of andesitic flows, tuffs, and quartzites. They are greatly deformed and erratic in structural disposition, manifested by abrupt changes of strike, and heavy shearing. They are cut by several small dykes of altered diabase, quartz porphyry, and olivine diabase, and locally, particularly in the tuffaceous sediments, carbonate is abundant.

Claim No. S 11994 was staked in 1928 by J. A. Lefevre of Tionaga. It is underlain, for the greater part, by sheared andesite flows interbedded with local bands of carbonated tuffs. The strike of the rocks is about 100 degrees and the dip is northward at a high angle. On the top of a small ridge near the southwest corner of the claim a band of highly crenulated and sheared tuff, 16 feet wide, contains small stringers and impregnations of pyrite and pyrrhotite over its entire width, and at the south side, where shearing and drag-folding are maximum, 15 inches of fairly solid sulphides occur, which are exposed along the strike a distance of 10 feet. The sulphides are predominantly pyrrhotite and pyrite, but in places as much as 10 per cent of the total sulphide content is chalcopyrite together with a little sphalerite. The gangue minerals consist of chlorite, talc, carbonate, and quartz. The greater part of the sulphides fill cavities in the shear zone, but a considerable amount of replacement has taken place along the walls. The quartz occurs sporadically, usually filling cavities, particularly in the crests of drag-folds in the schist, and the zinc and copper sulphides display a marked tendency to accompany the quartz.

A chip sample taken from the more heavily mineralized portion was analysed for gold, silver, and copper. It yielded 0·27 troy ounce of silver, 1·87 per cent of copper, but no gold.

Claim S 17557, Keith Township

Claim S 17557 is located immediately south of the railroad about ¼ mile east of Groundhog River Crossing. It is one of a group of claims staked in January, 1929, by Mr. Silas Cook, of Haileybury, Ontario.

The rocks that underlie the greater part of the claim consist of tuffs, and quartzites with a minor amount of black slates, interbedded with thin

flows of andesite. They strike east-west, dip northward at a high angle, and are cut by small bodies of diorite. The sediments and lavas have been severely schistified, and the diorite though not schistose has been sheared and, locally, brecciated.

Two shear zones have been exposed by stripping near the western boundary of the claim, about 400 feet south of the railway. One of these trends east parallel to the schists, the other strikes northeast. They intersect a few feet east of the north-south claim line. The ore minerals occur as replacement bodies along these lines of shear, and as cementing media around fragments of brecciated diorite. Pyrrhotite and pyrite are the dominant sulphides present, but in some of the trenches, especially those located near the intersection of the shear zones, chalcopyrite is present in considerable quantities. The latter mineral occurs in intimate association with the pyrrhotite in many of the trenches, but the best showings of chalcopyrite are present in the brecciated diorite, where the cementing material is in some cases almost pure sulphide of copper. Quartz is usually present as an important gangue mineral associated with the chalcopyrite—especially where the latter is more or less free from the other sulphides. A few small veinlets bearing sphalerite and specks of galena were noted in one of the trenches to cut across the pyrite-pyrrhotite body, and some well-formed crystals of arsenopyrite were observed in the quartzite schist along with the pyrite and pyrrhotite.

The mineralized zone as exposed by the trenches is 30 feet wide over all, but the distribution of the sulphide minerals is sporadic, and it is probable that they do not constitute over 10 per cent of the total within this width. The more massive bands of sulphide seldom achieve a thickness greater than 2 feet, though in some of the trenches sulphides totalling to 20 per cent extend over widths of as much as 15 feet. The east-west shear zone has been traced about 400 feet eastward by cross trenches, but, though pyrite and pyrrhotite mineralization extends throughout this distance, they tend to become more sparsely distributed, and the copper sulphide is not present in the eastern trenches in any noticeable quantities.

A dyke of carbonated quartz porphyry cuts the schist complex about 100 feet north of the trenches. It is up to 140 feet wide, and is replete with quartz veins. They do not appear, however, to be mineralized. It is probable that this dyke is an offshoot of the relatively large mass of granite that occupies the area around Kukatush, about ½ mile east of the claim.

GOLD-COPPER DEPOSITS

Shannon Property, Chester Township

A block of claims in the vicinity of Clam lake, near the western boundary of Chester township, were staked in 1927 by Mr. J. A. Shannon of Sudbury. In subsequent years work done at different parts of the claims has proved the presence of gold-copper mineralization which though light so far as discoveries to date are concerned, is of a nature that warrants further search.

The property can be most easily reached by a water route starting southward from Canadian National Railway mileage 101½, Ruel subdivision, by way of Mesomikenda lake to about the southern boundary of Neville township, whence a portage, 1½ miles in length, leads westward to a small lake on the township boundary, from which a lift over is all that is required to gain access to the waters of Bagsvert lake. Thence a short portage southward from a small creek that flows into the southwest corner of Bagsvert lake suffices to reach Mr. Shannon's camp on Little Clam lake.

Claim S 8995

A considerable part of this claim is under the waters of Clam lake. The rock exposed on the shores at this part of the lake is a granulose, even textured type, composed largely of quartz and light coloured feldspar, with a little mica and chlorite. The fresh surface has a drab grey colour, and it weathers to a dusty brown or buff. The westward extension of this rock has been mapped as granite by Thompson, but no specific mention has been made of it in his report. It differs very markedly from the coarse-grained pink granite that occurs to the northeast, on the shores of Mesomikenda lake, and from the massive hornblende granite that occurs south of Clam lake in the vicinity of Owl creek. In part it looks like a sheared quartz porphyry, but in part it displays many of the characteristics of a highly metamorphosed arkose. Northward on Little Clam lake it changes without apparent contact to a greenish chloritic quartzose facies which 28 chains east of Little Clam lake contains remnants of rhyolite porphyry pebbles. It is cut by dykes of quartz porphyry that resemble it in appearance, and east of Clam lake it is intruded by a mass of diorite.

In thin section the rock is found to consist of over 40 per cent quartz, much of which is so crushed as to present a granulose texture between crossed nicols, and it is commonly found to be surrounded by a meshwork of sericite and chlorite. The feldspars, which originally comprised more than 50 per cent of the rock, are apparently largely of the potash species, but they have been so altered by sericitization as to make positive identification difficult. Many of them are broken, and some are irregular in form. Varying quantities of chlorite and biotite occur together with a little apatite, sphene, epidote, rutile, zircon, a few flakes of hematite, and some carbonate.

Strippings on a small neck of land that juts out into the lake near the centre of the claim expose a zone of sheared rock which contains disseminations of iron and copper sulphides and veins of quartz. The total width of mineralization cannot be stated precisely owing to the fact that the disseminated sulphides tend to grade out into unmineralized rock. Near the east end of the stripping, however, appreciable quantities of ore minerals occur over a width of 28 feet. Chalcopyrite is the chief sulphide present, and is principally concentrated along a line of shearing that trends southeast. It manifests but little tendency to occur in veinlets, but is present rather as metasomatic replacements of the wall-rock. In this section it is found to be accompanied by a gangue of chlorite, carbonate, and some quartz, which sometimes vein and fill fractures in the feldspars and the older quartz of the wall-rock. A chip sample taken across a width of 9 feet of the more heavily mineralized part near the eastern part of the stripping is said to have yielded on assay 5·04 per cent copper.

Small, branching quartz veins penetrate the rock along the broken zone. These trend erratically and do not parallel the main shear in which the greater part of the chalcopyrite occurs. The largest vein trends 120 degrees and parallels the lake shore on the southeast side of the point where it appears for a distance of about 90 feet, whence it disappears again into the lake. Near the western end it is cut and slightly offset by a small dyke of diabase. The vein is 5 inches wide where it is cut by the dyke. It maintains this width eastward for a distance of 8 feet, where it is joined on the north side by another smaller vein, and the confluent system thence assumes a width of 8 inches for a distance of 13 feet. East of this it scatters and is ill-defined. Other small stringers of quartz occur at different parts of the crushed zone. They are composed of glassy to milky quartz and carry a little calcite and sericite. The vein quartz is fractured but not crushed, and the veins have a tendency to display a crustiform structure which is sometimes vuggy. Copper and iron sulphides, which permeate and replace the wall-rock between the veins, are also present in goodly quantities in the veins. Free gold is visible throughout a considerable part of the quartz, and, though the most of it is fine dust-like colours, in places gold particles up to $\frac{1}{32}$ inch in diameter may be seen. No gold could be discerned in the wall-rock with the unaided eye, nor has any been found by microscopic study of the disseminated sulphide deposits, but assays made from representative samples of this part of the deposit are said to have yielded fair values in gold.

Small specks of steel-grey minerals noted in hand specimens of the quartz, have proved, on microscopic study, to be tetradymite (telluride of bismuth). The mineral is soft, has a brilliant lustre, occurs in tabular crystals, and displays a perfect basal cleavage. In the field it could easily be mistaken for molybdenite. In smaller quantities but closely associated with the tetradymite is another telluride compound which is believed to be kalgoorlite. Under high-powered binocular this mineral is found to be black with a slightly bluish brown tarnish. It is slightly brittle, and seems to have a platy structure. Under reflected light, the mineral in polished section is creamy white in colour; is negative to most re-agents, but tarnishes slowly when treated with HNO_3. It is readily soluble in aqua regia, and microchemically it yielded positive tests for mercury, gold, and tellurium, but no satisfactory test for silver could be obtained.

Small quantities of sphalerite occur in association with the chalcopyrite, and to a lesser extent in the quartz unaccompanied by any other ore mineral. It is usually attended by a gangue of calcite. Covellite, bornite, and other secondary copper compounds occur sparingly.

Claim S 9221

On the southeast corner of claim S 9221 a small stripping exposed a shear zone trending east which contains fairly strong disseminations of chalcopyrite over a width of 7 feet. The wall-rock here is identical with that of claim S 8995 described above. The ore minerals are present as finely disseminated crystals in the broken rock and as small veinlets which

at points of intersections may reach a thickness of as much as 8 inches. A vein of carbonate impregnated with quartz stringers cuts across the chalcopyrite zone at the edge of the stripping. A heavy blanket of glacial debris covers the eastward extension of this zone. Fair values in copper and gold are said to have been derived from assays of samples taken across the face of this exposure.

Claim S 10375, Chester Township

This claim is the property of Mr. Charles Coté of Ottawa. A stripping near the centre of the claim exposes three small veins which have a general eastward trend but tend to diverge slowly toward the east. The wall-rock is granitic in appearance similar to that exposed on the shores of Clam lake. The largest of the veins is only 2 inches wide, and the walls are sharply defined. The westward continuation of the veins is interrupted by a fault that trends northwest, and eastward they are covered by a heavy mantle of boulder clay. The quartz is vuggy, and displays a well-developed comb structure. Small quantities of chalcopyrite and pyrite occur in the veins, together with specks of free gold and tellurides.

OBATOGAMAU RIVER AREA, ABITIBI TERRITORY, QUEBEC

By C. Tolman

CONTENTS

Illustration

INTRODUCTION

During the field season of 1929 geological exploration and mapping were carried on in Obatogamau River area, Abitibi territory, Quebec. In recent years prospecting has been very actively carried on in Chibougamau district and as a natural result, in the course of time, prospectors have extended their activities more and more into adjoining areas. Obatogamau area adjoins Chibougamau area on the southwest and it was largely in response to this extended activity on the part of prospectors into territory surrounding Chibougamau that the work was undertaken.

The area mapped has an east-west length of about 60 miles and a width of about 24 miles and comprises about 1,400 square miles lying mostly between latitudes 49° 30′ and 49° 55′ and longitudes 74° 10′ and 75° 30′. The western boundary is 175 miles east of the Ontario-Quebec boundary and the southern boundary 120 miles north of the Canadian National railway. The area lies between Eagle River area and Lake David area, both mapped by J. B. Mawdsley in 1927. The drainage basin of Obatogamau river comprises most of the area. An eastern prolongation of the area extends beyond the height of land and includes Whitefish and Branch lakes and associated streams, the waters of which drain southeastward to lake St. John and thence by Saguenay river to the St. Lawrence. The northern part of the area includes part of lakes Merrill, David, Simon, and Asinitchibastat drained by Chibougamau river.

Track surveys of some of the rivers and lakes of the area were made for the Quebec Government in 1899 and 1900 by Henry O'Sullivan and in 1899 by C. E. LeMoine. H. C. Cooke[1] made a geological reconnaissance of Obatogamau river and some associated lakes in 1916. J. M. Roi carried on topographic mapping in the area for the Quebec government during the summer of 1928 and the following winter. The mapping done by the writer in 1929 was confined to the watercourses, except in the vicinity of lakes Deux Orignaux, Presqu'ile, Muskosho, and Eau Jaune where a few bush traverses were made. The accompanying sketch map (Figure 1) gives a general idea of the geology and drainage features of the area.

[1] Geol. Surv., Canada, Sum. Rept. 1916, p. 228.

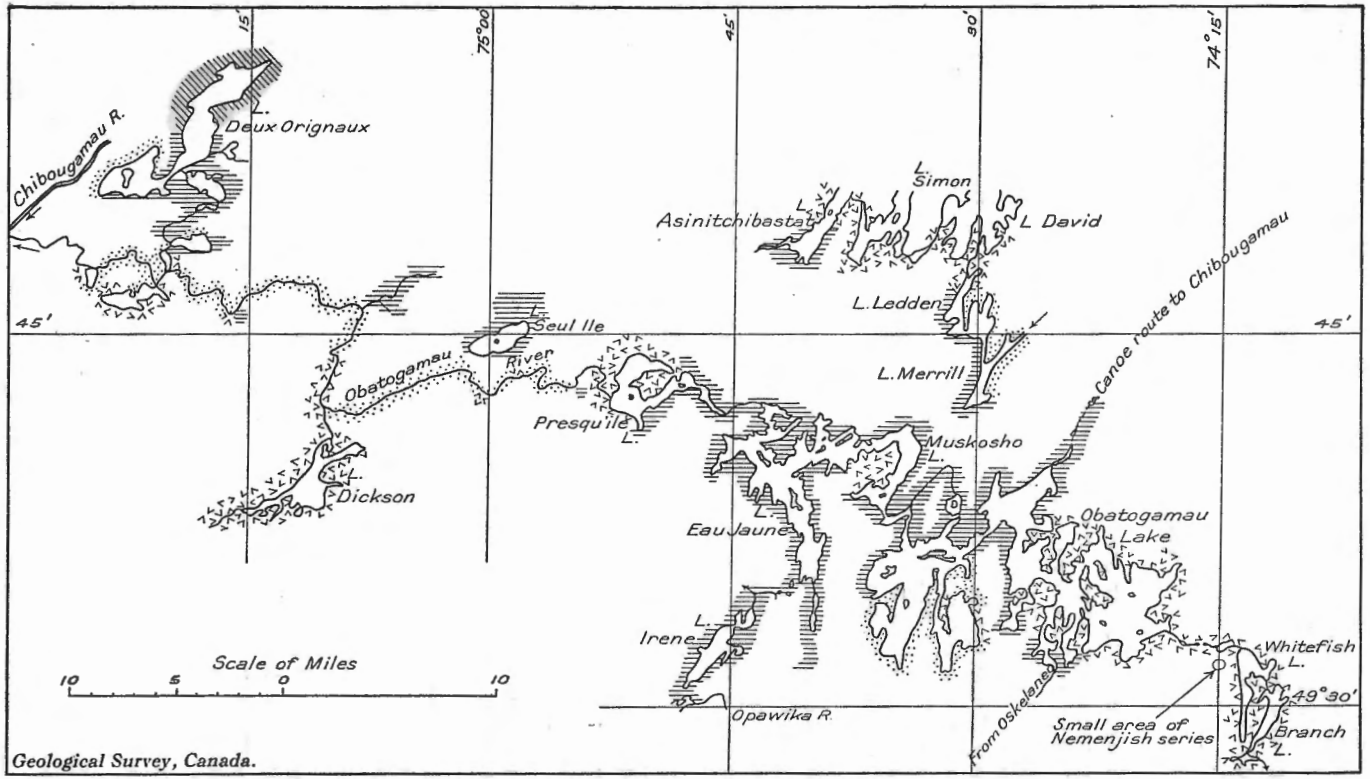

Figure 1. Sketch map showing the drainage and geology of Obatogamau River area, Abitibi territory, Quebec. Recent alluvium and glacial drift shown by stipple; granitic intrusives shown by angle pattern; Brock series shown by diagonal lines; volcanics shown by horizontal lines.

Mr. George Coté, Director of Quebec Surveys, much expedited the work by furnishing the writer in the field, from time to time, with copies, as draughting progressed, of the recent surveys made by his department.

Frank C. Foley and Donald J. MacNeil rendered able assistance in the field.

MEANS OF ACCESS

Obatogamau River area may be entered by three main canoe routes which traverse the area. Each is between 140 and 160 miles in length to the central part of the area. Two of these routes are shown on the 3 miles to the inch St. Maurice sheet issued by the Quebec Department of Lands and Forests. The other route, from lake St. John, is shown on a special route map of the Quebec Department of Lands and Forests. The Quebec Department has also issued a special route map of the Oskelaneo route on the scale of 3 miles to the inch. A route map of the Oskelaneo route on the scale of 10 miles to the inch accompanies a report on Chibougamau district recently issued by the Natural Resources Intelligence Service, Ottawa.

The Oskelaneo route, which is the best canoe route into Chibougamau, crosses lake Obatogamau in the eastern part of Obatogamau River area. This route leaves Oskelaneo on the Canadian National railway and for a distance of 12 miles to lake Bureau the only obstacles are a lock over a cascade and a half-mile wagon road portage at the head of lake Bureau. From that lake the route crosses 60 miles of continuous lakes to lake Verreau. These lakes constitute part of the reservoir created by the Gouin dam on St. Maurice river. In the 60 miles from lake Verreau to Obatogamau River area there are twenty portages the longest of which is 1¼ miles. With few exceptions the portages are dry and in fairly good shape.

A well travelled, fairly easy route enters the area from the west. It begins at the Canadian National railway about 4 miles west of Monet station and follows Susie river and Cedar lake to Migiskan river and down that stream to the mouth of St. Cyr river. The latter river, which has no rapids, is ascended for 30 miles to lake Bailly in Bailly township nearly 80 miles by water from the railway. From lake Bailly a portage leads to the headwaters of Eagle river which empties into the northeast part of Father lake.[1] From Father lake, Opawika river is ascended through lake Bras-Coupé to Windy lake. Just beyond the head of Windy lake a portage leads into lake Irene, from which, by a number of small streams and lakes with intervening portages, the southern tip of lake Eau Jaune is reached. Lake Eau Jaune is part of the Obatogamau River system and lies well within the area. From lake Eau Jaune the Oskelaneo-Chibougamau canoe route can be reached by way of Muskosho and Obatogamau lakes.

The third route, a more difficult and arduous one, is from St. Félicien, lake St. John, by way of Ashuapmuchuan river and is now relatively little used. Before the building of the Canadian National Transcontinental line it was the main route into Chibougamau district, but is now superseded

[1] Mawdsley, J. B.: "The Eagle River Area, Abitibi Territory, Quebec"; Geol. Surv., Canada, Sum. Rept. 1927, pt. C, p. 23.

by the much easier route from Oskelaneo station. The St. Félicien route passes through Obatogamau River area by way of Branch and Whitefish lakes to Obatogamau lake where it joins the Oskelaneo route to lake Chibougamau.

Two airplane freight and passenger services were maintained into Chibougamau, one from Oskelaneo and the other from St. Félicien. The Chibougamau terminus is at Merrill island, lake Doré, about 20 miles north of Obatogamau River area. Airplane freight charges range from 20 cents to 25 cents a pound, which is practically the same as the charge for summer freighting by canoes. During the winter freight can be brought in from St. Félicien, lake St. John, for 15 cents a pound. Tractors were tried on this route during the winter of 1929-30, but at that time the road was found unsuitable for their use so they were discarded in favour of horse-drawn sleds.

GENERAL CHARACTER OF THE DISTRICT

Obatogamau River area is part of a broad region of little relief which to the north, beyond the map-area, rises in a range of hills along the north shore of lakes Chibougamau, Doré, David, and Simon. Over one-third of the area is water and much of the remainder is low lying and poorly drained. Accordingly rock outcrops are scarce throughout much of the area. At a small number of widely separated points very prominent hills or ridges rise as much as 400 feet above the general level. Among the most prominent are: Patrick mountains extending about 2 miles along the west shore of Whitefish lake, and a hill on the west shore of lake Eau Jaune, each with elevations about 400 feet above the respective lake levels. A number of low hills and ridges occur along Obatogamau river between lake Presqu'ile and lake Durocher. They are prominent because of their isolation and the general flatness of the surrounding country.

The rocks of the area show a mild topographic expression. In most places areas of granite and other plutonic rocks are characterized by low, rounded hills and small, intermediate depressions. A number of hills or ridges are underlain by small rock bodies of diabase or diorite type. Areas of volcanics and sediment with few exceptions tend to be flat.

The largest body of water in the area is Obatogamau lake, which is approximately 1,120 feet above sea-level and, except for short minor streams flowing into the lake, represents the headwaters of Obatogamau river. The lake has an area of about 70 square miles with a very irregular shoreline and contains many islands. It drains westward by a circuitous route, including Muskosho lake, into lake Eau Jaune. Lake Eau Jaune is similar in general character to Obatogamau lake and has an area of about 25 square miles. Other large lakes tributary to Obatogamau river are Presqu'ile, Dickson, and Deux Orignaux. Obatogamau river flows into Chibougamau river just beyond the map-area and the waters eventually find their way to James bay by way of Nottaway river. The area extends eastward from Obatogamau lake over the height of land, elevation about 1,275 feet above sea-level on the canoe route, and includes Whitefish lake, elevation 1,180, and Branch lake, elevation 1,164, of the Saguenay drainage system. Lakes Merrill, Ledden, David, Buckell, Dulieux, Simon, and Asinitchibastat, parts of which are in the area, are lakes connected and drained by Chibougamau river.

Glacial striæ are numerous on the rock outcrops along the shore of the lakes. They show uniformity in strike from place to place, about 45 degrees magnetic.

GENERAL GEOLOGY

All the consolidated rocks of the area are Precambrian. These are overlain by variable amounts of Pleistocene and later unconsolidated material. The most widespread, and presumably the oldest, formation, is a series of old lavas with minor amounts of tuffaceous material and possibly some interbedded non-volcanic sediment. This formation has the characteristics of the Keewatin of Ontario and western Quebec. The term Abitibi volcanics has been applied to this and other occurrences of old lavas in this part of Quebec.[1] Two widely separated areas of altered sediments, which have been folded with the older volcanics, occur within the area. One, outcropping in the extreme southeastern part of the area, is referable to the Nemenjish series.[2] The other in the northwest part of the area is probably equivalent to the Brock series which has been correlated with a number of other patches of sediment throughout this part of Quebec under the term Mattagami series.[3] A number of plutonic masses, of various petrographic characters and intrusive into the old volcanics or the altered sediments, occur in different parts of the area. In most cases their relative ages are not known. Because of their petrographic differences and geographic isolation each mass is described separately. The granites are, in general, high in plagioclase and some trend toward the quartz monzonite and granodiorite classes. Dioritic or diabasic dykes intrusive into the volcanics and sediments occur generally.

Table of Formations

Quaternary	Post-glacial.....	Peat, clay, silt, sand, and gravel
	Glacial.....	Unsorted morainic material
Precambrian	Granitic intrusives	Albite-oligoclase granite, Oligoclase anorthosite, Oligoclase granite and syenite } Lake David area
		Hornblende-augite syenite, lake Durocher
		Biotite granite, lake Dickson
		Biotite-hornblende granite, Presqu'ile lake
		Hornblende granite, Muskosho lake
		Biotite granite, Obatogamau lake
	Dykes.....	Diorite and gabbro
	Brock series.....	Metamorphosed arkoses, greywackes, and argillites
	Nemenjish series.....	Banded hornblende schists
	Volcanics (Abitibi).....	Altered volcanic flows, chiefly andesite, and minor amount of tuffs

[1] Cooke, H. C.: "Some Stratigraphical and Structural Features of the Pre-Cambrian of Northern Quebec"; Jour. Geol., vol. 27 (1919).
[2] Loc. cit., p. 188.
[3] Loc. cit., p. 268.

VOLCANICS

The volcanics are the predominant and most generally distributed rocks of the area. They give way to metamorphosed sediments in the western part of the area in the region of lake Deux Orignaux and in the southeastern part of the area just west of Whitefish lake and south of lake Obatogamau. Elsewhere they are interrupted by a number of igneous intrusions, namely: by a large mass of biotite granite in the region of Obatogamau lake, hornblende granite at Muskosho lake, biotite hornblende granite at lake Presqu'ile, biotite granite at lake Dickson, hornblende augite syenite at Durocher lake, and the oligoclase granite, oligoclase anorthosite, and oligoclase granite of Mawdsley in the region of lakes Merrill, Ledden, David, Simon, and Asinitchibastat.

Outcrops over the greater part of the area apparently underlain by volcanics are very sparse. Much of the country is uniformly flat. The most common exposures are the small ones occurring intermittently at the water's edge of some of the lakes. However, a number of widely separated localities do afford good exposures. Among the best are, the region immediately north of lake Seul Ile, north of lake Eau Jaune and near its outlet, and a prominent ridge 5 miles up Obatogamau river from Durocher lake.

Within Obatogamau River area the volcanics have in general an east-west strike with steep dips. In the region of Obatogamau lake there is much discordance in strike indicating prominent cross-folding or faulting. Determinations of attitude, based on bun structure shown by pillows and the textural and structural relations shown in a succession of flows, were made, on the north shore of lake Eau Jaune, just off Obatogamau river 2 miles west of lake Presqu'ile, on the north shore of lake Seul Ile, and along Obatogamau river about 5 miles above Durocher lakes. These, supplemented by many strike and dip observations, indicate that an anticlininal axis extends east-west in the vicinity of Obatogamau river and the northern parts of lakes Presqu'ile, Eau Jaune, and Obatogamau.

The volcanics have been generally altered and the different varieties would, in most hand specimens and thin sections, be best called greenstones, greenstone schists, and hornblende rocks or schists. Most of the original textures have been obliterated and superseded by metamorphic ones. Coarse porphyritic texture is retained in some cases at least, despite more or less complete recrystallization, and shows up particularly well on weathered surfaces. Structures have persisted in many places. These include pillow structures, swirls, and other volcanic flow structures, and amygdaloidal structure. Some tuff beds retain a finely banded character and some coarse fragmentals retain their clastic appearance. Notwithstanding metamorphism, resulting in most cases in practically complete mineralogical reconstitution, the general type of volcanic rocks whether acidic, basic, or of intermediate basicity, can be inferred from the relative proportions of salic and mafic constituents in the present rock.

Lavas of intermediate basicity, namely andesites and related types, greatly predominate. There appear to be few basalts and even fewer of the siliceous varieties. These rocks are usually massive, but locally they may be sheared. The colours of the freshly broken surfaces are generally

various shades of green. Microscopically all stages are represented between a rock consisting of little else than chlorite with or without schistosity to hornblende rocks with feldspar more or less masked with alteration products. Thin sections of rhyolite are relatively fresh, showing phenocrysts of quartz and feldspar in a fine-grained groundmass of the same constituents interrupted here and there by particles of epidote, chlorite, and white mica. Fragmental beds associated with the lavas vary greatly in character. They range from the brecciated tops of flows and "pebble tuffs" consisting of rhyolitic pebbles ranging in diameter from a fraction of an inch to 3 inches in a chlorite schist matrix, to beds that are composed of fine, thinly bedded material which was probably fine volcanic debris deposited in water.

NEMENJISH SERIES

Just west of Whitefish lake small outcrops of hornblende schist and gneiss occur intruded with pegmatitic material. This rock is identical with some outcrops of the Nemenjish series exposed on lake Nemenjish. It was not determined whether these outcrops represent the eastern boundary of a large mass extending towards lake Nemenjish or isolated bodies of Nemenjish material included in the granite. The rock has a well-defined schistosity and also a definite lamination parallel to the schistosity caused by alternation of light and dark bands a fraction of an inch in width.

BROCK SERIES

The northern part of lake Deux Orignaux is underlain by metamorphosed sediments. These rocks, outcropping on the shores of the lake, were originally interbedded argillaceous sediment and feldspathic sandstone. Imperfect cleavage planes have been developed in the fine sediment and the rock has something of the appearance of a phyllite due to the sheen on the cleavage surfaces caused by the development of fine white mica and chlorite along them. The feldspathic sandstones are now feldspathic quartzites consisting of rounded to subangular particles of quartz and feldspar. The feldspar is much altered to secondary mica.

These sediments are no doubt continuous with those encountered by H. C. Cooke on Chibougamau river to the west.[1] A somewhat similar sediment, suggested by Cooke to belong possibly to the same series, outcrops about 25 miles north at the mouth of Brock river. A conglomerate is described at the base of these sediments and they are placed unconformably overlying the volcanics.[2] The conglomerate was not noted on lake Deux Orignaux and no decisive evidence was obtained indicating an unconformable relation between the sediments and volcanics. There is very little, if any, discordance between the strike and dip of the sediments and the volcanics and the possibility that the sediment may be a younger conformable member of the volcanic series is not precluded. Outcrops are intermittent, generally narrow, and occur at the water's edge. The sediment and volcanics look very much alike in outcrops in the region of

[1] "Some Stratigraphic and Structural Features of the Pre-Cambrian of Northern Quebec"; Jour. Geol., vol. 27, p. 191 (1919).
[2] Loc. cit., p. 191.

the contact. Outcrops of fine-grained igneous rock, resembling the lavas but possibly dyke rock, occur among those of the sediments in such a way as to suggest that the lavas may be interbedded with the sediments in the vicinity of the contact.

DIORITE AND GABBRO DYKES

Dyke-like masses, ranging in width from a few feet to probably 300 feet, were noted in different parts of the area. They have intrusive contact with the old volcanics and sediments. In places they occur as isolated outcrops in regions that are most probably underlain by volcanics or sediments. None was noted intruding the plutonic rocks of the area.

Most of these rocks seem to belong to one general type and can be best designated as diorites or quartz diorites. They are usually medium grained and dark grey to green in colour. No definite types could be distinguished on a basis of field relations or microscopic characters. Hornblende usually comprises 20 to 40 per cent of the rock and plagioclase, about Ab60+An40, makes up most of the remainder. In detail there is extreme variation in the relative amounts of hornblende and plagioclase, in that both basic segregations or phases, made up almost wholly of hornblende, and acidic phases, made up almost exclusively of plagioclase, occur. The plagioclase is usually considerably masked with the alteration products, epidote, zoisite, and secondary mica. A little microcline, quartz, or biotite usually chloritized are, exceptionally, present. As accessories magnetite is most common; apatite and titanite are present in some slides. Titaniferous magnetite or ilmenite is in some places rimmed with leucoxene. Only one specimen was obtained that could properly be called a gabbro or diabase. It was from a dyke along Obatogamau river. The rock was comparatively fresh and the feldspar had the percentage composition Ab40+An60.

BIOTITE GRANITE, OBATOGAMAU LAKE

All but the western part of Obatogamau lake is underlain by a biotite granite which extends an indefinite distance eastward beyond the map-area. The rock is light flesh to grey in colour and is characteristically medium-grained, equigranular. Typically the rock appears to have about the following mineral percentages: oligoclase (Ab85+An15) 40 per cent, microcline 15 per cent, quartz 25 per cent, biotite 15 per cent, with the accessories titanite, magnetite, apatite, and zircon. Most sections show flakes of muscovite, which do not appear secondary, associated with the biotite. The quartz is markedly strained. The oligoclase particles contain considerable epidote and secondary mica within them which has masked the twinning. The biotite is generally fresh and in some sections shows pleochroic haloes surrounding zircon inclusions.

HORNBLENDE GRANITE, MUSKOSHO LAKE

In the vicinity of Muskosho lake a considerable body of granite outcrops. It is intrusive into the volcanics and appears wholly surrounded by them. It is a medium-grained, equigranular rock typically with light salmon-coloured feldspar, abundant quartz, and about 15 per cent dark

mineral including both hornblende and biotite. The microscope shows the feldspar to be almost wholly oligoclase (Ab85+An15) making up about 40 per cent of the rock. It shows the usual alteration to epidote and secondary mica. Of the sections examined, relatively fresh microcline constitutes about 10 per cent, quartz 30 per cent, and hornblende 15 per cent. Biotite seems to be always present. In a few localities it appeared to be present in an amount equal to the hornblende. Typically, however, it is much subordinate in amount. The accessories titanite, apatite, and magnetite are plentiful. Some aplite dykes were noted intruding the volcanics near the granite contact along the northeast shore of lake Eau Jaune. These are higher in microcline than the typical rock. However, the plagioclase in the sections examined gave the percentage composition Ab85+An15.

BIOTITE-HORNBLENDE GRANITE, PRESQU'ILE LAKE

The granite outcropping in the vicinity of lake Presqu'ile is a grey to flesh-coloured, medium-grained, massive appearing rock composed essentially of feldspar, quartz showing a slight tendency to be opalescent, and appreciable amounts of both biotite and hornblende. Typical thin sections show about 20 per cent quartz, 65 per cent feldspar, and 15 per cent femic minerals including both biotite and hornblende, with the usual accessory minerals apatite, magnetite, titanite, and zircon. Common alteration products are epidote and sericite. The quartz shows marked strained extinction. Microcline and oligoclase (Ab80+An20) constitute the feldspar. Oligoclase is masked by secondary mica and some slightly pleochroic epidote has been developed. Microcline is much less altered than the oligoclase. Thin sections indicate that the proportion of microline to oligoclase varies greatly from place to place. West and north of lake Presqu'ile the microcline appears equal in amount or slightly in excess of the oligoclase, whereas to the west of lake Presqu'ile oligoclase preponderates greatly over the microcline. Both biotite and hornblende appear to be present throughout, but their relative proportions vary between wide limits. There appeared to be no definite relation between the relative amounts of the biotite and hornblende and the relative amounts of oligoclase and microcline in the rock. The hornblende is fresh and is a variety brilliantly pleochroic in green and yellowish brown tints. The biotite is fresh except for some minor bleaching in places.

On Obatogamau river about 1½ miles below lake Presqu'ile this granite has well-defined intrusive relations with the old volcanics.

BIOTITE GRANITE, LAKE DICKSON

Granites in the region of lake Dickson, including some outcrops on Obatogamau river to the north and east, are in the main light flesh coloured, but phases are present ranging from a grey to a light pink. They are typically equigranular, medium-grained, and in many places show a definite but not strongly developed gneissic structure. Microscopically the typical granite is markedly rich in albite (Ab92+An8) constituting about 40 per cent of the rock with the other feldspar, microcline, not in excess of

10 per cent. Quartz makes up about 40 per cent and a moderate amount of biotite, commonly associated with a few shreds of muscovite, is characteristic. Titanite, apatite, magnetite, and zircon were noted as accessories. Some zircons in the biotite and chlorite are surrounded by pleochroic haloes. In addition to chlorite, epidote, in particles showing great variation in size, and sericite are common secondary products. The microcline, relative to the plagioclase, is remarkably fresh. In many outcrops the typical, light flesh-coloured or grey rock contains segregations of pinkish material usually poor in dark mineral and in some places of pegmatitic aspect. The feldspar of these is predominately microcline, uniformly unaltered. Where albite does occur it commonly contains perthitically intergrown microcline. The proportion of muscovite is normally greater than in the typical rock.

The Lake Dickson biotite granite intrudes the volcanics. Its relation to the other granitic intrusions of the area is not known, but the slightly developed gneissic structure suggests that it may be older.

HORNBLENDE-AUGITE SYENITE, LAKE DUROCHER

This rock outcrops along the shores of lake Durocher and on Obatogamau river both directly above and below the lake. Splendid outcrops of this rock are shown in a prominent ridge half a mile long, strike 80 degrees magnetic, located three-quarters of a mile southeast of the east end of lake Durocher. Usually the rock is medium-grained, fresh appearing, and composed essentially of light salmon-coloured feldspar and a variable amount of dark mineral. Normally oligoclase (Ab85+An15) comprises about 60 per cent of the rock. Potassium feldspar in the form of microcline makes up about 10 per cent. The plagioclase in places shows a tendency to enclose smaller amounts of microcline in perthitic intergrowth. In a few places there is some variation in the relative amounts of oligoclase and microcline, but the oligoclase is always much in excess. Ferromagnesian minerals usually constitute between 20 and 30 per cent of the rock and are represented by hornblende, augite, and biotite. Hornblende is present throughout, and in places it is the dominant dark mineral. This is the case in the outcrops on Obatogamau river just above and below lake Durocher and in the prominent ridge to the southeast. In the ridge just mentioned the range in the variation in relative proportions of dark mineral and feldspar is increased by the presence of random segregations of hornblende with little else and of similar ones consisting almost wholly of reddish feldspar, both ranging up to 4 square yards in area. In the outcrops on the south shore of lake Durocher a pale green, slightly pleochroic augite is the dominant ferromagnesian mineral and only a very little hornblende is present. Almost all sections show a few shreds of biotite usually closely associated with the augite and hornblende. The rocks rich in hornblende and those rich in augite appear alike in all respects other than kind, and relative amounts, of dark mineral. Titanite is a prominent accessory mineral. Magnetite, apatite, and zircon are also present. The magnetite in some instances at least appears to be titaniferous, or the mineral may be ilmenite, for it is commonly surrounded by titanite

which has the appearance of having altered from it. A little epidote is normally present and secondary mica in the feldspars is general. On the ridge to the southeast of lake Durocher there are some peculiar roundish masses about one foot in diameter which consist almost entirely of epidote and a few scattered blotches of chlorite. On the whole, however, the rock is relatively little altered.

OLIGOCLASE GRANITE, OLIGOCLASE ANORTHOSITE, ALBITE-OLIGOCLASE GRANITE

The northern part of the map-area adjoins the Lake David area, mapped by Mawdsley in 1927[1], and includes a narrow southern extension of the belt of the granitic rocks outcropping from lake Doré westward through the region of lakes David and Simon to lake Asinitchibastat. These rocks were designated by Mawdsley as albite-oligoclase granite, oligoclase anorthosite, and oligoclase granite and syenite. Near the southern shore of lakes David, Simon, and Asinitchibastat they are in intrusive contact with the old volcanic flows, a considerable body of which lies to the south. This locality is flat and the outcrops in general are sparse.

All the rocks have a characteristic in common in that they are greatly altered. The feldspars are eaten up by epidote, zoisite, chlorite, white mica, and carbonate, with a masking of the twinning. Biotite has gone to chlorite and the hornblende shows all stages in the alteration to chlorite. Further, plagioclase appears to be the only feldspar. Mawdsley determined the relative ages of these rock types to be oligoclase granite and syenite, oldest, then oligoclase anorthosite, and albite-oligoclase granite, youngest, and believed that, owing to the petrographic similarities and gradations of these types into one another, they are differentiates of the same magma and their successive intrusion occurred in the same general period of igneous activity.

The oligoclase granite extends southward beyond the boundaries of Lake David area and outcrops along the shores of lakes Buckell and Dulieux and the southwest shore of lake Simon. Normally this rock has in the outcrop the appearance of an altered quartz diorite or diorite and indeed it is questionable whether or not the latter names would be most appropriate for the rock. The plagioclase is usually so highly altered that it can only with difficulty be determined. Mawdsley referred to the plagioclase as acidic oligoclase. Some determinations as calcic as Ab70+ An30 were obtained in a section from an outcrop, within the area covered by this report, believed to be of this rock type. Both quartz and hornblende are very variable in amount. Either may, in different outcrops, comprise as much as 50 per cent of the rock or in others be practically absent. The quartz is markedly strained and megascopically in some places is opalescent. With the decrease in the amount of hornblende, types are formed which appear gradational between oligoclase granite and the albite-oligoclase granite. Such types appear to be present in outcrops on the small islands in the western part of lake Simon. Some sections show a few particles of chlorite obviously after biotite. Magnetite and apatite are the common accessories.

[1] Geol. Surv., Canada, Sum. Rept. 1927, pt. C., p. 1.

The oligoclase anorthosite extends south and west from Lake David area and outcrops sparsely along the north shore of lakes Merrill and Ledden, along the south shore of lake David, and in the region of lakes Buckell and Dulieux on the route between lake David and lake Simon. This rock has been well described by Mawdsley. In its characteristic development, within the area covered by this report, it is greyish white composed almost wholly of feldspar or its alteration products, and blotches of chlorite. The feldspar, the original particles of which were as much as 3 or 4 centimetres in length, has been in some cases shattered into smaller particles. The feldspar in places has a marked sieve texture caused by the development of much epidote, zoisite, and white mica within it. Elsewhere there are gradations to a condition whereby the growth of secondary minerals has become so pronounced as to totally obliterate the outline of the feldspar particles. The blotches of chlorite probably represent original ferromagnesian minerals. Little quartz and carbonate are present.

The albite-oligoclase granite which stretches for a considerable distance through the central part of Lake David area extends beyond to the southwest and outcrops on the shores of lake Asinitchibastat. Typically this is a light-coloured rock rich in quartz which is commonly opalescent. Phases of it with appreciable amounts of dark mineral closely resemble the oligoclase granite. The feldspar, normally an acid oligoclase or albite, has suffered great alteration in the same manner as has affected the feldspars of the other members. The quartz is strained. Minor amounts of hornblende and in places biotite occur, both in the process of altering to chlorite.

ECONOMIC GEOLOGY

Prospecting within Obatogamau area has been almost wholly confined to the vicinity of lakes Obatogamau, Eau Jaune, and Presqu'ile of the Obatogamau drainage and in the territory along the south shores of lakes David, Simon, and Asinitchibastat just south of Lake David area. Both districts have been gone over by a considerable number of prospectors, but with little or no success.

The territory along the south shore of lakes David, Simon, and Asinitchibastat, on account of its general flat and low-lying character with scarcity of outcrop, is not advantageous for prospecting, although geological conditions may be considered favourable, for this is along the contact of the east-west belt of intrusives of Lake David area with the volcanics lying to the south. The northern contact of this belt of intrusives is within Lake David area just north of the above-mentioned lakes. It is in a hilly region with good outcrops and here prospectors have met with considerable encouragement. The writer is not aware of any claims being held at present in the territory along the southern shore of lakes David, Simon, and Asinitchibastat. A mineralized zone on the shore of lake Dulieux on the outlet of lake David just above lake Simon has been exposed by a number of trenches and some shallow open-pits. Here a diorite-like rock, probably belonging to the oligoclase granite of Mawdsley, occurs with much associated greenstone material. The mineralization

consists of stringers of white quartz with considerable siderite and minor amounts of magnetite and pyrite. Pyrite is also disseminated in the country rock which is for the most part greenstone. This showing appeared to be abandoned.

A number of shear zones more or less mineralized with quartz and pyrite, not particularly promising, were noted in different parts of the area comprised in the Obatogamau drainage basin, particularly north of lake Eau Jaune, north of the river between lake Eau Jaune and lake Presqu'ile, southeast of lake Presqu'ile, and the south shore of lake Deux Orignaux. Some claims are held on the southeast shore of lake Presqu'ile where an open-pit exposed a 6-foot zone of silicified and sericitized rock mineralized by pyrite.

The different granitic intrusions of the area do not appear to contain commercial amounts of feldspar or of other minerals commonly associated with granite.

Wide areas of volcanics and sediments are intruded by a number of igneous masses of different sizes and character and economic mineral deposits may be found, but prospecting will be hampered by the extensive drift and moss cover. It is not believed that the area is as promising as some nearby areas of greenstone and sediments with more rugged topography.

None of the streams of the area affords natural waterpower sites of probable importance.

Most of the region is well forested with pulpwood. Conditions are not favourable for agriculture.

DEEP BORINGS IN ONTARIO, QUEBEC, AND THE MARITIME PROVINCES

By D. C. Maddox

The Borings Division of the Geological Survey is organized for the purpose of collecting samples and records from wells drilled for oil and gas, water, and non-metallic minerals. The organization of the information received and the storage of samples also form part of its work. A laboratory specially equipped for the purpose of sample examination is available and a limited amount of research work, more especially with reference to the heavy mineral content of the sediments and the mechanical analysis of sediments, is being done.

The drilled well often provides the field geologist with information as to the extent and structure of formations largely or wholly concealed. In drift-covered areas the well may be the only source of information for conditions at depth. As regards water conditions the well provides information as to the porosity and water contents of rock formations as also the height of the water-table and the nature of the water. For oil and gas exploration work the log of the well made as a result of the examination of samples forms a section which is available for the study of structural conditions. In this work the identification of stratigraphic horizons is often very difficult or impossible. The samples taken from the well are in general too finely crushed to permit of the recognition of any fossils except microscopic ones. The identification of formations, therefore, resolves itself into an attempt to evolve methods which are independent of the use of larger fossils and which are adaptable to the small fragments generally found in well samples. The microfossils especially, foraminifera and the ostracods, and the heavy minerals contained in the sediments, are the two chief methods employed to date, but others may be developed later as further advances are made in the study of sedimentation. The value of the collection and storage of samples is thus increased as they provide material to which new methods may be applied when these become available.

It is hoped that well drillers and owners as well as Government officials will not fail to co-operate in the collection of data that must be made as the well is being put down. Many drillers in the eastern provinces cordially co-operated with the Borings Division during 1929, as did many Government officials and thanks are herewith extended to them. Four thousand and ninety-six samples from wells drilled in the provinces of Ontario and Quebec were examined and reported on.

In Nova Scotia the only drilling in 1929 for oil and gas, as far as known, was the sinking of a few test-holes by the Imperial Oil Company in Minudie district, Cumberland county. The Imperial Oil Company appears to be

continuing its policy of exploring undrilled areas for oil and gas, a policy that has resulted in the accumulation of much valuable data as to subsurface conditions in many parts of Canada, and the company through Mr. John Ness has extended cordial co-operation to the Borings Division during 1929.

Since the abandonment of the deep well put down by the H. L. Doherty interests on Governor island, P.E.I., no drilling for oil and gas has been undertaken in the province.

In New Brunswick in 1929 drilling for oil and gas was confined to the operations of the New Brunswick Gas and Oil fields, Limited, in Moncton area. Thanks are due to Dr. Henderson of this company for continued co-operation with the Borings Division in the matter of samples and records. The point of special interest in this area was the obtaining of salt in two wells drilled in Gautreau district on the east side of Petitcodiac river.

In Quebec considerable interest appears to be taken in the oil and gas possibilities of the area on the north side of the St. Lawrence between Quebec and Montreal, especially in Portneuf, Laval, L'Assomption, and Berthier districts, but no results of drilling had come to hand during 1929.

A rather interesting well, the log of which is given, is that put down for the Dominion Experimental Farm at L'Assomption. The log shows that the well passed through two igneous bodies apparently dykes. The thickness of the Utica formation in this well is also a matter of interest. In this area the Utica is generally considered to be about 300 feet thick. The geological map shows the well position to be in about the centre of the northeasterly trending band of Utica which indicates that the formation at this point is about 150 feet thick. The log shows this thickness was passed through before the igneous mass was encountered and an approximately equal thickness below the same igneous material. Thrust faulting might possibly explain the situation.

Log of Well on the Dominion Experimental Farm about 1 Mile South of L'Assomption and near Bank of L'Assomption River

Depth (in feet)		Rate of effervescence with acid Cold	Hot	Notes
25	Clay, dark grey	0	0	
35— 110	Clay, medium grey	3	4	A little coarse sand
120	Shale, dark grey	2	1	Much coarse sand
125— 275	Shale, dark grey	0		
285— 375	Igneous, medium grey	1	1	
385— 425	Shale, dark grey	0	1	
435— 515	Shale, very dark grey	1	2	
525— 535	Shale, very dark grey	2	3	
590	Shale, dark grey	3	4	Sandy, calcareous
600	Shale, dark grey	2	5	Sandy, dolomitic, probably contains some igneous rock
610— 620	Igneous, dark brown-grey	1	2	
630	Limestone, shaly dark grey	4	5	Residue insoluble in acid 30 p.c.
640	" "	4	5	" " 30 "
650	" "	4	5	" " 35 "
660	" "	4	5	
670	" "	4	5	" " 40 "
680	" "	4	5	" " 22 "
690	" "	5	6	" " 30 "
700	" "	5	6	" " 30 "
710	Limestone, dark grey	5	6	" " 35 "
720	" "	5	6	" " 20 "
730	" "	5	6	" " 20 "
740	" "	5	6	" " 30 "
750—1,030	Limestone, dark brown-grey	5	6	Considerable shale
1,040—1,080	Limestone, brown-grey	6	7	Residue small
				Samples missing 535–590 feet

Summary:

	Depth Feet	Thickness Feet
Surface deposits	0— 120	120
Utica shale	120— 285	165
Igneous rock	285— 385	100
Utica shale	385— 600	215
Igneous rock	600— 630	30
Trenton limestone	630—1,250	620

Samples from the well put down some years ago at the Experimental Farm at Cap Rouge, Portneuf county, Quebec province, were examined. This well is of interest as it is located slightly to the north of the mapped line of the Champlain fault. The condensed log of the well is given.

Condensed Log of Well on Dominion Experimental Farm, Cap Rouge, Quebec

Depth (in feet)		Rate of effervescence with acid Cold	Hot	
300— 490	Shale, grey	2	3	Slightly calcareous, white calcite at 300–320 feet, 375–380 feet, and 400–405 feet, probably vein filling
495— 570	Shale, dark grey	1	2	Less calcareous than the above
575— 600	Shale, dark grey	1	2	With a large proportion of greenish grey shale

In Ontario the collection of samples and records falls within the duties of the Gas Commissioner of the province, Col. R. B. Harkness. Co-operation with the Borings Division, however, is established by the forwarding to the Borings Division of data of interest and the writer has pleasure in acknowledging the receipt of much useful information from Col. Harkness. The logs of wells drilled are published in the Ontario Department of Mines reports and it is only samples from wells put down at points of unusual interest that are examined by the Borings Division. Samples received in past years from a few wells drilled in Ontario were examined during 1929. Of these a well in Puslinch township traversed 770 feet of Precambrian rocks before the well was abandoned. The log of the Suburban Gas Company's well, given below, is of interest as indicating a passage directly from Palæozoic limestone to an underlying Precambrian dolomite.

Log of No. 1 Well, Suburban Gas Company, Lot 30, Con. VIII, Nassagaweya Tp., Halton Co., Ont.

Depth (in feet)		Effervescence with acid Cold	Hot	Notes
40— 60	Dolomite, brown.....	1	6	
95	Shale, medium grey.....	1	3	
105	" red.....	1	4	
133	" medium grey.....	1	4	
140— 160	Dolomite, medium grey.....	1	6	
230— 260	Shale, red.....	1	4	
270— 280	" "	2	4	
290— 380	" "	2	3	
390— 560	" "	4	4	
570— 580	" "	3	4	
590— 610	" "	2	3	
620— 630	" "	1	3	
640—1,000	" green-grey.....	1	3	
1,010—1,050	" medium grey.....	2	3	
1,060—1,350	" medium grey.....	1	2	
1,360—1,420	" dark grey.....	1	2	
1,450—1,460	Limestone, brown-grey.....	5	6	
1,470—1,480	" dark grey.....	5	6	
1,490—2,080	" brown-grey.....	6	7	Considerable shale at 1,800, 1,840, and 1,900 feet
2,090—2,150	Dolomite, light grey.....	2	6	
2,160	" "	4	4	
2,170—2,290	" "	2	6	
2,300	" "	4	6	
2,310—2,330	" "	1	5	
2,340—2,360	" "	3	4	
2,370	" "	1	5	
2,380—2,410	" brown-grey.....	1	4	
2,420—2,440	Igneous, dark grey.....	1	3	Contains much mica and hornblende

Summary:

	Depth Feet	Thickness Feet
Lockport.....	40— 95	55
Cabot Head.....	95— 140	45
Manitoulin.....	140— 230	90
Queenston.....	230— 640	410
Richmond-Lorraine.....	640—1,360	720
Utica.....	1,360—1,450	90
Trenton-Black River (?).....	1,450—2,090	640
Precambrian, dolomite.....	2,090—2,420	330
Precambrian, igneous.....	2,420—2,440	20

The Colborne well, of which the log is here given, also seemed to pass from the Basal Palæozoic into a thick Precambrian limestone.

Log of Colborne Well, Lot 28, Con. I., Cramahe Tp., Northumberland Co., Ont.

Depth (in feet)		Effervescence with acid Cold	Hot	Notes
63— 635	Limestone, medium grey....	5	7	
644	Dolomite, light grey.....	2	7	
656	Limestone, light grey.....	5	7	
668	Dolomite, light grey.....	3	6	Contains green shale, and purple stained fragments
674	Shale, purple.....	1	4	Calcareous
689	Dolomite, purple.....	1	6	
694	Arkose, purple.....	2	2	
700	" "	4	5	Very calcareous
708	" "	4	5	"
712— 918	Limestone, light grey.....	6	7	
922	" "	5	6	
925	" "	2	3	Very impure
929	" "	2	5	Dolomitic
930— 937	" "	5	7	
940	" "	2	4	Very impure
942— 945	" "	3	4	Impure
948	" "	4	5	Rather impure
950	" "	3	3	Very impure
960—1,000	" "	5	5	
1,004—1,020	" "	5	7	

Summary:	Depth Feet	Thickness Feet
Trenton-Black River (?).....	63— 694	631
Basal Palæozoic.....	694— 712	18
Precambrian.....	712—1,020	308

Another well of interest, the log of which is also provided, is that put down by the Kincardine Salt Company at their plant at Kincardine, Bruce county. Thanks are due to the company for permission to publish this log, also to Mr. William Welsh of Kincardine for interest taken in collecting data *re* this well.

Log of Kincardine Salt Company Well, Kincardine, Bruce Co., Ont.

Depth (in feet)	——	Effervescence with acid Cold	Hot	Notes
140— 190	Dolomite, brown.....	2	6	
190— 220	Dolomite, brown-grey.....	3	6	
220— 230	Dolomitic limestone, brown-grey.....	4	6	
230— 280	Limestone, brown-grey.....	5	6	
280— 380	Dolomite brown-grey.....	3	6	
380— 400	" "	2	4	Considerable chert
400— 410	" "	2	6	
410— 420	" "	2	4	" "
420— 430	" "	2	6	
460	" grey.....	2	6	
520	" brown-grey.....	2	6	
530	" brown-grey.....	0	4	
540	" grey.....	0	2	Very compact and impure
545— 560	" grey.....	0	6	
570	" brown-grey.....	0	6	
580— 600	" grey.....	0	6	
610— 620	" brown-grey.....	0	5	
630— 650	" slate grey.....	0	6	
660— 700	" grey.....	1	5	
710— 790	" brown-grey.....	1	6	
800— 810	Shale, medium grey.....	1	4	Calcareous
820	" pink.....	1	4	"
830— 850	" medium grey.....	1	4	"
860	" reddish grey.....	1	4	"
870— 880	" medium grey.....	1	4	"
890— 900	Dolomite, medium grey....	1	5	
910— 920	Salt, white.....	0	1	
930	Gypsum, light grey.....	1	4	With dolomite
940	Shale, medium grey.....	1	2	
950	Gypsum, light grey.....	1	3	With dolomite
960—1,115	Salt, white.....	0	0	
1,125	Dolomite, brown-grey.....	2	7	
				Sulphates reported by chemical tests at 890, 900, 940, and 976 feet

Summary:	Depth Feet	Thickness Feet
Detroit River.....	140— 790	650
Salina.....	790—1,125	335

The contact between the above formations is difficult to locate definitely, it is here placed at first shale occurrence.

The log of the Coste No. 7 well, Dover East township, is given as representing an unusually complete section of the Palæozoic formation in southwestern Ontario.

Log of Coste No. 7 Well, Lot 17, Con. VII, Dover East Tp., Kent Co., Ont.

Depth (in feet)	——	Effervescence with acid Cold	Hot	Notes
5	Sand, light grey.....	2	3	
10— 70	Clay, light grey.....	2	3	Slightly calcareous
75	Clay, light grey.....	2	3	Same coarse, well-rounded sand
80— 90	Shale, dark grey.....	0	0	Sand and gravel present; oil by distillation.
100— 110	Limestone, brown-grey.....	3	5	A little dark grey shale
120	Dolomite, brown-grey.....	1	5	" "
130	Limestone, brown-grey.....	4	5	
140	Shale, dark grey.....	0	0	
150— 300	Shale, light grey.....	3	4	Calcareous
310— 320	Limestone, medium grey....	4	5	
330— 440	Limestone, light grey.....	4	5	
450— 610	Dolomite, light brown.....	3	6	
620— 850	" "	2	5	
860—1,010	" "	1	5	
1,020—1,065	" brown-grey.....	1	5	
1,070	" medium grey....	1	5	
1,080—1,150	" brown-grey.....	1	6	
1,160—1,265	" light brown.....	1	6	
1,275—1,290	" brown-grey.....	1	4	A little shale
1,300	" "			
1,310—1,360	Dolomite and dark grey shale.....	1	4	
1,370	Salt, white.....	0	0	
1,380	" "	0	0	
1,445	" "	0	0	
1,495	" "	0	1	
1,530—1,560	Dolomite, brown-grey.....	0	4	
1,570—1,670	" dark brown-grey	1	4	
1,680—1,740	" brown-grey.....	1	5	
1,750—1,790	" light brown.....	1	5	
1*800	" medium brown...	1	5	
1,810—1,890	" light brown.....	1	6	
1,900—1,920	" light grey.....	1	6	
1,930—1,950	" light brown.....	1	7	
1,960	" light grey.....	1	7	
1,970	" dark grey.....	1	7	
1,980	" "	1	6	Considerable shale
1,990	" medium grey....	1	6	"
2,000	" "	1	7	
2,010—2,035	Shale and dolomite, red and grey.....	0	5	
2,050—2,120	Shale and dolomite, medium grey.....	0	5	
2,130—2,140	Dolomite, brown-grey.....	1	5	
2,150—2,170	Shale and dolomite, medium grey.....	1	5	
2,180—2,260	Shale, reddish brown.....	0	4	A little dolomite
2,270—2,390	" "	1	3	
2,400—2,440	" "	0	2	
2,440—2,740	" medium grey.....	1	3	
2,750—2,880	" dark grey.....	1	2	
2,890	" "	2	4	A little limestone
2,900—3,240	Limestone, brown-grey.....	5	7	
3,250—3,320	" dark brown-grey	5	6	
3,330—3,730	" brown grey.....	5	7	
3,740—3,770	" brown grey.....	4	6	
3,780	" light brown-grey	4	6	
3,790	" brown grey.....	4	6	A little sandstone
3,800	Sandstone, medium grey....	2	4	A few green-grey fragments
3,813	Precambrian rock, pink.....	1	2	

Log of Coste No. 7 Well, Lot 17, Con. VII, Dover East Tp., Kent Co., Ont.—Continued

Summary:	Depth Feet	Thickness Feet
Surface deposits	5— 75	75 A
Huron shale	75— 90	15 A
Hamilton	90— 300	210 A
Onondaga	300— 420	120 A
Sylvania	420— 440	20 A
Lower Monroe	440— 790	350 A
Salina	790—1,660	970 A
Guelph-Niagara	1,660—1,970	310 A
Rochester-Clinton	1,970—2,000	30 A
Medina-Cataract	2,000—2,170	170 A
Queenston	2,170—2,440	270 A
Richmond-Lorraine	2,440—2,740	300 A
Utica	2,740—2,890	150 A
Trenton and Lower Palæozoic	2,890—3,790	900 A
Arkose	3,790—3,800	10 A
Precambrian	3,800—3,813	13 A

The thickness of the Trenton and Black River, 900 feet, is unusual, these formations generally being from 600 to 700 feet in thickness. The presence of fossils towards the base of the limestone series at 3,780 feet precludes the possibility of the well having passed into the Precambrian limestone, however.

As regards the bentonite occurrence reported in the Geological Survey Summary Report 1928, as occurring in the Robert Cherry well at Collingwood, it should be noted that the final results of drilling indicate that the bentonite horizon is much lower stratigraphically than was expected, the top of the basal sandstone being obtained 35 feet below the base of the bentonite bed. This would seem to place the occurrence in the Black River formation, although it is impossible in well samples to distinguish between the Black River and the overlying Trenton formation. It is hoped that further work may result in the identification of this horizon in other wells drilled in Ontario, for several soft streaks have been recorded by drillers near the base of the "Trenton" some of which may be this bentonite horizon. A brine high in calcium and magnesium chloride was reported from the basal sandstone in this well, but this is not an unusual occurrence in southern Ontario.

The samples from a well drilled, many years ago, in Ottawa at Bay and Somerset streets, were re-examined; the results obtained are given in the following log.

Log of Well, Bay and Somerset Streets, Ottawa, Ontario

Depth (in feet)	——	Effervescence with acid Cold	Hot	Notes
20— 673	Limestone, medium grey.....	5	6	
673— 690	" green-grey.....	3	5	
690— 710	" "	3	4	
710— 860	Sandstone, green-grey.....	2	3	
860— 875	Shale, brown grey.....	2	3	
875—1,010	Dolomite, medium grey.....	2	6	
1,010—1,033	" brown-grey.....	2	6	
1,033—1,078	" dark grey.....	2	6	
1,078—1,086	" medium grey.....	2	6	
1,086—1,088	Sandstone, light grey.....	2	4	Coarse grained, well rounded
1,088—1,096	Dolomite, medium grey.....	2	6	
1,096—1,105	Sandstone, light grey.....	2	3	
1,109	" "	3	5	
1,114—1,141	" "	2	2	
1,145—1,168	" "	1	1	
1,168—1,376	" "	0	0	
1,376—1,380	Granite, light grey.....	0	0	

Summary:	Depth Feet	Thickness Feet
Trenton-Black River.....	20— 655	635
Age doubtful.....	655— 685	30
Chazy.....	685— 875	190
Beekmantown.....	875—1,086	211
Age doubtful.....	1,086—1,119	33
Potsdam.....	1,119—1,376	257
Precambrian.....	1,376—1,380	4

To assist in delimiting the Black River, the Chazy, and the Beekmantown formations, the amount of material insoluble in hot dilute hydrochloric acid was determined in the case of all samples representing depths within which the boundaries were considered to occur. The tabulation below gives the results of this work.

Depth	Insoluble residue	Description of insoluble residue
655	35	Brown, sandy shale
661	50	Fine, brown sandstone
667	25	" "
670	49	Brown and green, sandy shale
675	32	Fine, brown sandstone
680	35	" "
685	41	Green-grey sandy shale, Chazy type
690	65	Green-grey, sandy shale, Chazy type, considerable dark grey shale
695	60	Green-grey and brown sandy shale
700	60	Green-grey and brown sandy shale; coarse sand present
705	65	Green-grey shale and fine, white sandstone. Chazy type
710	68	" " " " "
715	70	" " " " "
720	68	" " " " "
725	68	" " " " "
1,067	25	Fine, brown sandstone
1,078	35	Brown shale and fine, white sandstone
1,086	63	Medium-grained, white sandstone. Potsdam type
1,096	87	White, medium-grained sandstone. Some grains well rounded
1,105	97	White, medium-grained sandstone. Some grains well rounded
1,119	65	Coarse-grained sandstone. Some grains well rounded
1,129	90	" " " "
1,141	95	Medium-grained sandstone
1,149	93	" "
1,158	92	" "
1,168	98	Medium to coarse-grained sandstone
1,175	99	" " "
1,179	98	" "

In Ottawa district the Chazy limestone lying above the Chazy sandstone and shale is, so far as known, thin. The thin Chazy limestone is succeeded by a group of strata mainly limestone, but including shaly and sandy members; this group corresponds to the Pamelia which may be considered as belonging to the Black River. If the Chazy limestone and Pamelia are represented in this well section, they would be expected to occur in the interval 655 to 685 feet. In the absence of fossil evidence, unobtainable in this case owing to the small size of the well cutting, it is impossible to delimit the contacts of these formations.

In places in Ottawa River valley the Beekmantown limestone is underlain by sandy measures with dolomitic beds. These may correspond with the Theresa formation and are underlain by the Potsdam. If they are represented in the well section, they probably occur within the interval 1,086 to 1,119 feet.

Records Received from Eastern Canada, 1929

Shallow Wells

Location					Description				Remarks	
Lot	Concession	Township	County	At or near	Elevation above sea-level Feet	Depth in feet covered by records	Depth in feet to first rock	Depth from surface to water Feet	Owner	Driller
					ONTARIO					
—	—	Carrick	Bruce	Mildmay		186	120	184	N. Bender	F. L. Davidson
—	—	Kinross	"	Lucknow	10 below railway	142	115	142	School section No. 7	"
6	5	S. Gower	Grenville	Kemptville		52	30	25	Cemetery	Ivan Simzer
—	—	Oxford	"	"		79	28	79	J. L. P. Saunders	"
3	6	"	"	"		38	23	35	E. McGovern	"
—	A	Keppel	Grey	Owen Sound		260	11	260	G. Hewitson	M. S. Bellerby
N. ½ 29	2	Sydenham	"	Annan	100 above bay	138	90	120	T. Farquaharson	"
—	—	Harwich	Kent	Blenheim	672	241	180	180	Public Utilities Commission	J. D. Longstreet
—	—	Romney	"	Wheatley		80	80	—	Wheatley town	Layne-Bowler Co.
—	—	"	"	"		68	68	—	"	"
—	—	"	"	"		90	90	—	"	"
—	—	"	"	"		73	73	—	"	"
—	—	"	"	"		63	63	—	"	"
—	—	"	"	"		90	90	—	"	"
—	—	"	"	"		68	68	—	"	"
—	—	"	"	"		92	92	—	"	"
—	—	"	"	"		93	93	—	"	"
—	—	"	"	"		93	93	—	"	"
—	—	"	"	"		31	31	—	"	"
—	10	Beckwith	Lanark	Carleton Place		127	10	127	B. Douglas	A. Arbuckle
2	11	Lanark	"	"		50	10	50	Boyd's Cheese Factory	"
28	2	Bosanquet	Lambton	Thedford	20 above lake	172	—	163	F. Moloy	A. A. Heal
24	9	Moore	"	Mooretown	40 above river	148	142	142	P. McKellar	"
11	3	Sarnia	"	Sarnia	4 below railway	125	120	119	Wm. Moore	"
19	3	Warwick	"	Watford	10 above railway	82	80	80	W. W. Edward	"
3	3	"	"	Forest	10 " "	125	111	125	O. Elleker	"
17	2	"	"	Watford	5 " "	83	79	79	C. Joynt	"
3	1	"	"	Forest	15 " "	134	102	No water	H. McKay	"
—	—	Caistor	Lincoln	Caistorville		67	65	67	A. Schooler	W. Lofts
12	2	Ekfrid	Middlesex	Appin	5 above railway	174	173	170	J. M. McCallum	A. A. Heal
—	1	S. Marysburg	Prince Edw'd.	Picton	4 above lake	65	1	No water	H. McConnell	
N. ½ 8	3	Bucke	Timiskaming dist.	Haileybury		73	Surface	68	N. Oslund	C. R. Plaunt
S. ½ 10	5	"	" "	"	40 above railway	65	5	60	W. Robb	"
25	1	Wainfleet	Welland	Wainfleet		100	70	100	B. F. Canby	
45	2	Ancaster	Wentworth	Ancaster	850	57	27	52	F. Roser	J. A. Pegg
8	5	Beverly	"	Sheffield	800	50	All rock	40	R. Cronan	"
5	6	"	"	"	800	95	2	90	H. Hartley	"
—	—	Glanford	"	Hannon		240	104	238	W. G. Smith	W. Lofts
3	3	Binbrook	"	Flanford Sta.		50	14	48	Ed. Woods	"
3	3	Flamborough E.	"	Waterdown	750	75	15	70	R. Cairns	J. A. Pegg
8	8	"	"	Carlisle	800	52	36	50	J. Eaton	"
—	—		"	Mount Hope		85	—	83	Mr. Hawkins	W. Lofts
—	—	Saltfleet	"	Hannon		64	—	64	J. Black	"

Shallow Wells—Continued

Location					Description				Remarks	
Lot	Concession	Township	County	At or near	Elevation above sea-level Feet	Depth in feet covered by records	Depth in feet to first rock	Depth from surface to water Feet	Owner	Driller
					QUEBEC					
—	—	.....	Hochelaga....	Montreal.....	.....	500	—	314	Hotel Dieu hospital.....	Wallace Bell Co.
—	—	Ixworth.....	Kamouraska..	Holliday.....	20 above railway...	19	—	19	Can. Nat. railways.....	J. Labrecque
—	—	Woodbridge..	"	Lapointe Stn....	1 below railway..	30	—	30	" "	"
447	—	St. Sulpice....	L'Assomption	Assomption.....	50	—	135	835	Experimental Farm.....	A. Rioux
17	—	St. Francois de Sales	Laval.....	St. Francois de Sales	15 above river.....	98	164	164	A. Lachapelle.....	A. Dorveau
—	—	St. Foy.....	Quebec W....	Cap Rouge.....	290 above river.....	625	—	—	Dom. Exp. Station.....	Saluste Dube
—	—	St. Gabriel...	Quebec.....	Valcartier.....	20 above river.....	32	—	32	N. Tweedell.....	T. Adams
—	—	St. Johns.....	St. Johns.....	St. Johns.....	.....	28	—	20	Standard Clay Products, Ltd...	
—	—	Estcourt.....	Temiscouata .	Rivière-Bleue...	5 below railway...	192	30	192	Can. Nat. railways.....	J. Labrecque
—	—	———	" ..	Aubut.....	10 above railway..	31	—	31	" "	"
					NEW BRUNSWICK					
—	—	Wellington....	Kent.....	Cocagne.....	16 above bay.....	150	6	145	L. H. Higgins.....	T. R. Kent
—	—	Sussex.....	Kings.....	Sussex.....	10 above river.....	350	123	300	Sussex Beverage Co.....	W. H. Bluett
—	—	"	"	.....	.....	200	—	—	Sussex Mineral Springs.....	
—	—	Derby.....	Northumberland	Millerton.....	5 above track.....	157	30	157	Can. Nat. railways.....	J. Labrecque
—	—	Glenelg.....	"	Chatham.....	54	150	30	150	Can. International Paper Co.....	T. R. Kent
—	—	"	"	"	50	412	50	150	" "	"
—	—	"	"	"	56	300	—	300	" "	"
—	—	"	"	"	40	300	—	300	" "	"
—	—	"	"	"	50 above river.....	410	60	80	" "	"
—	—	St. Basil.....	Madawaska...	.....	50 above river.....	145	10	145	Can. Nat. railways.....	J. Labrecque
—	—	Balmoral.....	Restigouche..	Maltais.....	7 above track.....	150	19	150	" "	"
—	—	St. Quentin...	" ...	Five Fingers....	6 above track.....	181	12	181	" "	"
—	—	Douglas.....	York.....	Deersdale.....	Level with track....	138	62	138	" "	"
—	—	New Maryland	"	Fredericton.....	160	570	60	216	New Maryland Syndicate.....	G. J. Legassie
—	—	"	"	"	.....	180	—	75	Dom. Experimental Farm.....	Kent and Kennedy
—	—	"	"	"	.....	1000	500	—	" "	" "
					NOVA SCOTIA					
—	—	.....	Colchester....	Kemptown.....	.....	600	40	—	T. R. Kent (coal well).....	Wm. McNutt

OTHER FIELD WORK

Geological

T. L. TANTON. Mr. Tanton completed the geological and geographical survey of the Shebandowan one-mile quadrangle, Ontario (latitudes 48° 30′ to 48° 45′, longitudes 90° 00′ to 90° 30′). This area was selected as a key area for the study of the Precambrian geology of northwestern Ontario. It contains sulphide deposits bearing copper, platinum, and palladium, and a variety of other mineral occurrences.

H. M. BANNERMAN. Mr. Bannerman continued the geological and geographical survey of the Horwood one-mile quadrangle, Ontario (latitudes 47° 45′ to 48° 00′, longitudes 82° 00′ to 82° 30′). Horwood quadrangle is part of an extensive "Keewatin" area in which lead-zinc sulphides, gold-bearing quartz veins, and iron formations bearing sulphides, carbonate, and oxide of iron have been found.

T. T. QUIRKE. Mr. Quirke continued the geological survey of a one-mile quadrangle (latitudes 45° 15′ to 45° 30′, longitudes 79° 30′ to 80° 00′), east of Parry Sound, Ontario. This is in continuation of an effort that is being made to correlate the Huronian and Grenville successions by examining and mapping in considerable detail a belt about 20 miles wide from the typical Huronian near Killarney southeastward into the typical Grenville region. This belt contains a variety of non-metallic deposits—feldspar, quartzite, etc.—within easy reach of transportation on the Great Lakes.

M. E. WILSON. Mr. Wilson completed the geological survey of the Westport one-mile quadrangle, Ontario (latitudes 44° 30′ to 44° 45′, longitudes 76° 00′ to 76° 30′) and commenced a geological survey of the Perth quadrangle, Ontario (latitudes 44° 45′ to 45° 00′, longitudes 76° 00′ to 76° 30′). These quadrangles afford good opportunities for the study of the Grenville sequence and contain a variety of mineral deposits.

ALICE E. WILSON. Miss Wilson completed the geological survey of the Cornwall one-mile quadrangle, Ontario (latitudes 45° 00′ to 45° 15′, longitudes 75° 00′ to 75° 30′) and of the southern part of the Thurso quadrangle, Ontario and Quebec (latitudes 45° 30′ to 45° 45′, longitudes 75° 00′ to 75° 30′). Interest in the geology of Cornwall quadrangle has been revived by the possible development of the St. Lawrence waterway. Thurso quadrangle is a typical Precambrian area that was opened up a few years ago by the branch railway of the Singer Manufacturing Company.

H. C. COOKE. Mr. Cooke revised the geological mapping of Kinojevis and Clericy one-mile quadrangles, Quebec (latitudes 48° 00′ to 48° 30′, longitudes 78° 30′ to 79° 00′) and of part of Opasatika quadrangle, Quebec (latitudes 48° 00′ to 48° 15′, longitudes 79° 00′ to 79° 30′). These quadrangles are part of Rouyn mineral area.

R. THOMSON. Mr. Thomson geologically and geographically surveyed the northern part of Thurso one-mile quadrangle, Quebec latitudes (45° 00′ to 45° 15′, longitudes 75° 00′ to 75° 30′).

H. W. MCGERRIGLE. Mr. McGerrigle under the supervision of T. H. Clark completed the geological survey of Lacolle one-mile quadrangle, Quebec (latitudes 45° 00′ to 45° 15′, longitudes 73° 00′ to 73° 30′). This is part of a detail study of the Palæozoic geology of southern Quebec by Dr. Clark.

G. W. CRICKMAY. Mr. Crickmay under the supervision of F. J. Alcock commenced a geological survey of Matapedia River valley, Quebec, within the limits of two one-mile quadrangles bounded by latitudes 48° 00′ to 48° 30′, and longitudes 67° 00′ to 67° 30′.

C. H. KINDLE. Mr. Kindle under the supervision of E. M. Kindle continued the geological and geographical survey of the districts bordering Chaleur bay, from the vicinity of Port Daniel east to Percé, Quebec.

F. J. ALCOCK. Mr. Alcock largely completed a geological survey of the districts bordering Chaleur bay from southeast of Campbellton to east of Bathurst, New Brunswick. The surveys by Mr. Alcock, Mr. Kindle, and Mr. Crickmay are all part of a rather detailed investigation and systematic mapping program of Chaleur Bay region.

E. R. FARIBAULT. Mr. Faribault continued the geological survey of Digby one-mile quadrangle (latitudes 44° 30′ to 44° 45′, longitudes 65° 30′ to 66° 00′) and commenced the geological survey of Sissiboo quadrangle (latitudes 44° 15′ to 44° 30,′ longitudes 65° 30′ to 66° 00′), Nova Scotia. This is in continuation of the systematic geological mapping of Nova Scotia in a series of one-mile sheets upon which Mr. Faribault has been engaged for many years. About four-fifths of the province has been covered.

W. A. BELL. Mr. Bell commenced a revision of the geology of the Sydney one-mile quadrangle, Nova Scotia (latitudes 46° 00′ to 46° 15′, longitudes 60° 00′ to 60° 30′). This is a re-study of the Sydney coal area and vicinity.

G. W. H. NORMAN. Mr. Norman completed the geological survey of Ainslie one-mile quadrangle, Nova Scotia (latitudes 46° 00′ to 46° 15′, longitudes 61° 00′ to 61° 30′). The Ainslie quadrangle contains the Port Hood and Inverness coal basins, gypsum, barite, and evidences of petroleum.

Topographical

A. G. HAULTAIN. Mr. Haultain completed the control surveys for the Chelmsford one-mile quadrangle, Ontario (latitudes 46° 30′ to 46° 45′, longitudes 81° 00′ to 81° 30′). This and the other, following positions are for the purpose of providing base maps for geological work and also are contributions to the systematic topographical mapping of Canada.

A. C. TUTTLE. Mr. Tuttle made geographical surveys in the Chibougamau one-mile quadrangle, Quebec (latitudes 49° 45′ to 50° 00′, longitudes 74° 00′ to 74° 30′).

H. N. SPENCE. Mr. Spence made additional control surveys in Opasatika quadrangle, Quebec (latitudes 48° 00′ to 48° 15′, longitudes 79° 00′ to 79° 30′). Mr. Spence also ran control surveys within three one-mile quadrangles including the south shore of Chaleur bay, New Brunswick, from longitudes 65° 30′ to 66° 30′.

J. W. SPENCE. Mr. Spence completed the topographical survey of the Moncton one-mile quadrangle, New Brunswick (latitudes 46° 00′ to 46° 15′, longitudes 64° 30′ to 65° 00′).

J. A. MACDONALD. Mr. Macdonald completed control surveys for Church Point one-mile quadrangle (latitudes 44° 15′ to 44° 30′, longitudes 66° 00′ to 66° 30′), and Port Mouton quadrangle (latitudes 43° 45′ to 44° 00′, longitudes 64° 30′ to 65° 00′), Nova Scotia.

INDEX