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CASTAGNIER MAP-AREA, ABITIBI-EAST COUNTY

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BUREAU OF GEOLOGICAL SURVEYS
I. W. JONES, *Chief*

GEOLOGICAL REPORT 26

# CASTAGNIER MAP-AREA

## ABITIBI-EAST COUNTY

by

W. Warren Longley.

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1946

# CASTAGNIER MAP-AREA

## ABITIBI-EAST COUNTY

By W. Warren Longley

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## INTRODUCTION

### Location of Area and Means of Access

The Castagnier map-area lies northeast of Amos, Abitibi-East county, its southwest corner being twelve miles north-northeast of that town. Amos itself is on the eastern bank of Harricana river at the point where it is crossed by the Canadian National railway, about sixty-five miles east of the boundary between Quebec and Ontario.

The area examined extends from longitude 77°30' to 78°00', a distance of about twenty-three miles, and from the 49th parallel southward for about nineteen miles, to a little more than two miles south of latitude 48°45'. It includes the whole of Coigny, Bernetz, Castagnier, and Vassal townships and also, on the east, a strip about two miles wide of Hurault and Despinassy townships, and on the west a strip about half a mile wide of Miniac and Béarn.

A large part of the area is readily accessible from the town of Barraute, on the Canadian National railway. A good road extends northward from Barraute for seventeen miles to the village of Champcoeur and thence west and north for about seven miles to the southeast corner of Castagnier lake, midway along the southern boundary of the area. The road continues around the southern end of the lake and extends both to the east and to the west from the lake for about five miles. Castagnier river, flowing northeastward from Castagnier lake, together with a large tributary, Vassal river, which flows northward through the eastern part of Vassal township and the southeastern part of Bernetz, provides a good canoe route to the south-central, central, east-central, and part of the northeast sections of the area.

The southwestern part of the area may be reached most readily from the town of Amos. Harricana river flows northward from Amos and widens to form Obalski lake, which is in the southwest corner of the area. Due to rapids in the river north of Amos, however, it is not advisable to travel all the way by canoe. There is a good road leading from Amos northeast to Saint-Maurice-de-Dalquier, a distance of about twelve miles. From this village one can drive a truck to the bank of Harricana river, and from this point on to Obalski lake the canoe route is good, there being no rapids along this part of the river. From Obalski lake and Obalski river, the southwestern section of the area is readily accessible.

The west-central and northwestern sections can be reached by way of a chain of small lakes with intervening portages that extend northward from Obalski lake. The first of these portages, however, is five miles long.

Although Coigny river, a tributary of the Harricana, extends into the northwestern part of the area, and Bernetz river, a tributary of the Laflamme, into the northeastern part, the sections of these rivers which lie within the map-area present considerable difficulty to canoe travel. The most convenient starting point for travel in this part of the area is Coigny lake, which may be reached by aeroplane. The lake is about five miles south of the centre of the northern boundary, and from it there extends westward and eastward the centre-line of the two northern townships, Coigny and Bernetz. This line was cut only recently, and it has been kept clear by trappers. Alternatively, this line may be reached by following Castagnier river, or the series of lakes and portages that extend north of Obalski lake.

## Field-Work and Acknowledgments

The writer spent the field season of 1941 making a geological survey of the area described in this report. Land traverses were run by pace-and-compass at intervals of approximately half a mile, but modified as necessary to include all hills indicated by the stereoscopic study of aerial photographs.

The base-map upon which the geology was plotted was compiled by the Quebec Department of Mines from maps supplied by the Bureau of Geology and Topography, Ottawa, and from stream and line surveys of the Department of Lands and Forests, Quebec. Vertical aerial photographs, taken by the Royal Canadian Air Force for the preparation of the Ottawa maps, were used extensively in the field-work and in the preparation of this report and the map accompanying it.

The field party consisted of Gaetan Michaud and Blaise Brochu, assistants; P.E. Gonthier, cook; and Paul Blondin, Aimé Imbeault, and George Boudreault, canoemen. All discharged their duties in a satisfactory manner.

## Description of Area

### Topography and Drainage

Topographically, the area is a flat plain, relieved here and there by low, very gently rounded, knolls or hills, these being most abundant in the central and north-central parts. The general elevation is about one thousand feet above sea level. None of the hills rise as much as three hundred feet above their surroundings, and the highest is probably less than fifteen hundred feet above sea level. One of the more prominent hills, in the northwestern part of Castagnier township, is shown in plate I-A, another is shown in plate I-B. A persistent esker with a north-south trend extends through the western part of the area and in places forms a prominent ridge. It lies from a quarter of a mile to three miles east of Obalski lake and along or near the portage and chain of lakes northward from there to the northwest corner of the map-area.

A pronounced northeast trend is exhibited by the drainage pattern, with the water flowing northward. The eastern half of the area is drained by tributaries of Laflamme river, which in turn flows into Bell river, and the western half by Harricana river and its tributaries. Obalski river, in the southwest, is the only important exception to the general northward drainage; it flows south and west, into Obalski lake. Small muskegs are scattered throughout the area, which, however, is for the most part well drained.

Lakes are fairly numerous, but they are all relatively small. Obalski lake, in the southwest corner, is about five miles long and has a maximum width of a mile and a half; Castagnier lake, straddling, and about midway along, the southern boundary, is rudely circular, with a maximum width of less than three miles; Vassal lake, a mile and a quarter north of Castagnier lake, has a length of about one mile; and Coigny lake, in the north-central part of the area, is somewhat larger, being about a mile and a quarter in length. In addition to these there is a chain of more than thirty small lakes extending through the western part of the area in a general north-south direction. These are definitely related to the glacial ridge or esker previously mentioned.

## Colonization and Agriculture

A settlement has been established recently in the southern part of the area, in the vicinity of Castagnier lake. Both westward and eastward from the lake, a good road has been constructed following range-line I-II of Castagnier and Vassal townships, and in both townships other roads were under construction, branching northward from range-line I-II to range-line III-IV, a distance of two miles. The settlement along the east-west roads already embraces lots 35 to 57 of Castagnier and lots 11 to 38 of Vassal, and at the time of the writer's visit there were two schools and forty-one houses west of the lake, and two schools and forty-nine houses east of the lake. Most of the houses were occupied. Lac Castagnier post-office is immediately southeast of the lake, south of the boundary of the map-area.

On each occupied lot the amount of land cleared ranged from five acres to about thirty-five acres, and many of the colonists were actively engaged in extending their homesteads. Some have cleared land for grazing as well as for tilling.

In general, the soil appears to be fertile. Despite an extended dry period in the early part of the summer of 1941, an excellent crop of hay was harvested from most of the farms. The land of the entire southwestern section of Vassal township and the southeastern part of Castagnier appears to be equally as food as that already cleared for cultivation. The abundance and quality of wild berries, such as strawberries, gooseberries, raspberries, and blueberries, suggests that these fruits might be cultivated to advantage.

## Timber

About one-half of the area has been burned over by forest fires in recent years and the re-growth is not yet large enough to be of any value (see Figure 1, p.7). However,

except for small patches where the trees are stunted because of poor drainage, the unburned sections of the area support a growth of good quality timber (see Plate II-A). The greater part of this is spruce, but there is some fir, and locally jackpine and birch are abundant. In the better stands, the spruce trees have butt diameters of eight to fourteen inches, with some as much as eighteen to twenty-four inches.

## Fish and Game

Neither fish nor game are abundant in the area. In general, the streams are too muddy for fish, although a few creeks in the central part of the area are clear, and in these some brook trout were observed. A few moose and fur-bearing animals, particularly beaver, were seen, but such animals are evidently kept well thinned out by trappers and hunters. Partridge, however, appear to be unusally abundant.

## Previous Work

Some prospecting and exploration work has been carried out in the area during the past few years. This was confined chiefly to the northeastern half of Castagnier township and the southwestern part of Vassal.

No geological work had been done within the area prior to the present study. However, adjoining areas on the northeast (1), east (2), south (3), west (4), and northwest (5) have been mapped in recent years by geologists of the Quebec Department of Mines and of the Geological Survey of Canada, and some of these investigations have included narrow strips along the boundaries of the present map-area. Reports on the areas referred to, and on related areas, are listed below.

## Bibliography

1.- AUGER, P.E., Lower Laflamme River Area, Abitibi District, Western Section; Que. Bur. Mines, Geol. Rept. No.2, 1939.

2.- FAESSLER, Carl, Geological Exploration along the Laflamme River, Abitibi County; Que. Bur. Mines, Ann. Rept., 1934, Part C, pp.35-44.

3.- WEEKS, L.J., Duverny Sheets, East and West Halves; Geol. Surv. Can., Maps Nos.529A and 530A, 1939.

4.- DENIS, F.T., Desboues Sheet, East Half; Geol. Surv. Can., Map No.353A, 1938.

5.- WILSON, J.T., Gale River Sheet; Geol. Surv. Can., Map No.554A, 1939.

6.- LONGLEY, W.W., Tonnancourt-Holmes Area, Abitibi County; Que. Bur. Mines, Geol. Rept. No.24, 1946.

7.- WEEKS, L.J., Amos Sheet; Geol. Surv. Can., Map No.327A, 1935.

8.- COOKE, H.C., JAMES, W.F., and MAWDSLEY, J.B., Geology and Ore Deposits of Rouyn-Harricanaw Region, Quebec; Geol. Surv. Can., Mem. 166, 1931.

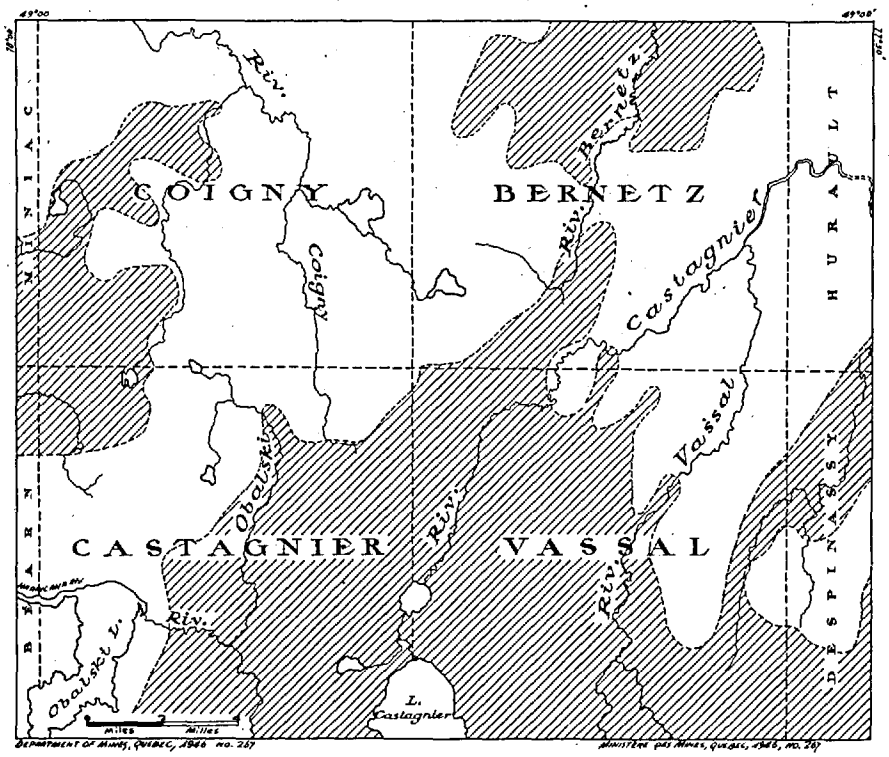


Figure 1.—Showing (by diagonal lines) areas which have been burned over in recent years. In these areas stands of good timber are small and scattered.

## GENERAL GEOLOGY

### General Statement

The area generally is blanketed by till and glacial clays. Exposures of bed-rock were seen only on the hills, on the shores and islands of the lakes, and occasionally along the banks of streams. The tops of the larger hills are practically bare rock, the glacial alluvium having been almost entirely washed away, probably by wave action when the hills existed as islands in glacial lake Barlow-Ojibway.

As is well shown on the accompanying map, regions of abundant outcrop are definitely localized, practically all observed outcrops lying within a strip about ten miles in width which extends through the central part of the area in a southwesterly direction and terminated abruptly about three miles northeast of Obalski lake. The general trend of the streams, and of a prominent dyke, is also in this direction. On the other hand, the general structural trend of the area is northwest. The assumption, therefore, seems warranted that this pronounced southwest trend is due to faulting, the belt of abundant outcrop representing an up-faulted block.

The consolidated rocks of the area are all of Precambrian age. The distribution of such outcrops as were found indicates that well more than one-half of the area is underlain by intrusive igneous rocks, which form a wide belt

extending northwest through the central part. Keewatin-type rocks, mainly typical 'greenstones', occur as a belt ranging from four to ten miles wide across the southern part of the area, and also in lesser amount in the central part and the northeast corner, occupying in all about one-third of the map-area. The youngest rocks, probably Keweenawan in age, are certain gabbro dykes, the largest and most persistent of which may be traced in a northeasterly direction across the area from a point about three miles northeast of Obalski lake.

Table of Formations

| | | |
|---|---|---|
| Quaternary | Pleistocene and Recent | Till, glacial-lake silts, eskers |
| Great unconformity | | |
| Precambrian | Post-Keewatin intrusives | Gabbro dykes (Keweenawan ?) |
| | | Aplite, pegmatite, and related dykes |
| | | Cóloron Granite: Biotite granite |
| | | Hornblende-biotite granite |
| | | Bernetz Gneiss: Biotite-quartz diorite gneiss |
| | Keewatin | Interbedded amphibolite, conglomerate and other sedimentary (?) rocks |
| | | Massive, ellipsoidal, and fragmental flows, and tuffs |

## Keewatin (?)

The 'greenstones' of the area include massive, ellipsoidal, and fragmental lavas of the type customarily referred to the Keewatin and, in addition, a series of well banded quartz-hornblende schists, amphibolites, and some narrow conglomerate bands. The writer is of opinion that the latter also are of Keewatin age although younger than the main body of flows. Weeks (1) has suggested that similar schists and conglomerate occurring in the Duverny map-area to the south may belong to the Keewatin.

The distribution of the outcrops observed indicates that about one-third of the map-area is underlain by greenstones. The principal belt of these rocks crosses the southern part of the area with a width ranging from about four

(1) WEEKS, L.J., Duverny Sheet, East Half; Geol. Surv. Can., Map No.529A, 1939.

miles at the eastern boundary to ten miles at the western side. This belt is known to continue far to the east (1), south (2), and west (3) of the present map-area.

Another, smaller belt of greenstones, one to two miles wide, extends from the southwest corner of Coigny township, through the northeast corner of Castagnier, and for about four miles into the northwestern part of Vassal. Just east of the centre-line of Castagnier township this belt probably connects with the main southern belt already referred to. To the east, as far as the boundary of the map-area, the intrusive rocks along the line of strike of this belt contain inclusions of greenstone which no doubt represent remnants of roof pendants from the former eastward prolongation of the belt. The continuation of this belt to the west, beyond the present map-area, has been described by Denis (4), who considers it is composed there of rocks that are possibly of sedimentary origin and post-Keewatin age.

The extreme northeastern corner of Bernetz township is occupied by greenstone. This is a portion of a belt which extends for many miles to east and west. It has been described by Auger (5).

Exposures of the Keewatin-type rocks are not abundant in the area. Along the shores and on the islands in the southern half of Obalski lake, however, there are many excellent exposures of ellipsoidal and massive lavas, with some interbedded fragmental material. Practically every outcrop seen on the lake includes some ellipsoidal lava. Individual flows appear to be of the order of five to ten feet in thickness. The fragmental lavas are not abundant.

Equally striking ellipsoidal lavas, with associated massive flows and minor amounts of interbedded fragmental material, were observed in the middle part of range VII, Castagnier township, around the southern end of Amélion lake, and also in the central part of ranges I and II of Vassal township.

Massive, amygdaloidal, and fragmental lavas are exposed in a series of ridges about two miles northwest of Vassal lake, in the east-central part of Castagnier township, and massive andesite, with a small amount of interbedded fragmental material, was seen along the shore in the southwestern part of Castagnier lake.

At one point on the southeastern shore of Obalski lake, a sharp contact between two fine-grained andesitic flows is exposed. Ellipsoidal lavas in the immediate vicinity indicate

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(1) FAESSLER, Carl, Geological Exploration along the Laflamme River, Abitibi County; Que. Bur. Mines, Ann. Rept., 1934, Pt.C, pp.35-44.

(2) WEEKS, L.J., Duverny Sheet, East and West Halves; Geol. Surv. Can., Maps Nos.529A and 530A, 1939.

(3) DENIS, F.T., Desboues Sheet, East Half; Geol. Surv. Can., Map No.353A, 1938.

(4) DENIS, F.T., Loc. cit.

(5) AUGER, P.E., Que. Bur. Mines, Geol. Rept. No.2, 1939.

that the tops of the flows are to the north. Extending down from the contact is a small, irregular dyke, about three inches wide (see Plate II-B). The dyke rock appears to be continuous with the rock of the overlying flow, indicating that the dyke is either a pendant from or a feeder to it. The writer favours the latter interpretation.

The only greenstone in the northern half of the map-area which is definitely of igneous origin is an occurrence of small extent in the southeast corner of Coigny lake. However, Auger (1) has described extensive outcrops of pillow lava immediately north of the northeastern corner of the present map-area.

On the southeast shore of Castagnier lake, just south of the map-area, there are a few small exposures of hornblende schist, some narrow bands of which contain obvious pebbles (see Plate III-A). The pebbles are not abundant and are small, the maximum size observed being less than two inches by about three quarters of an inch. They are considerably elongated parallel to the schistosity. Many of the smaller pebbles appear to be of the same material as the matrix, but the larger and better preserved pebbles are light grey in colour and almost flint-like in appearance. Microscopic examination of a thin section of one of these revealed that it was composed entirely of minute grains of quartz.

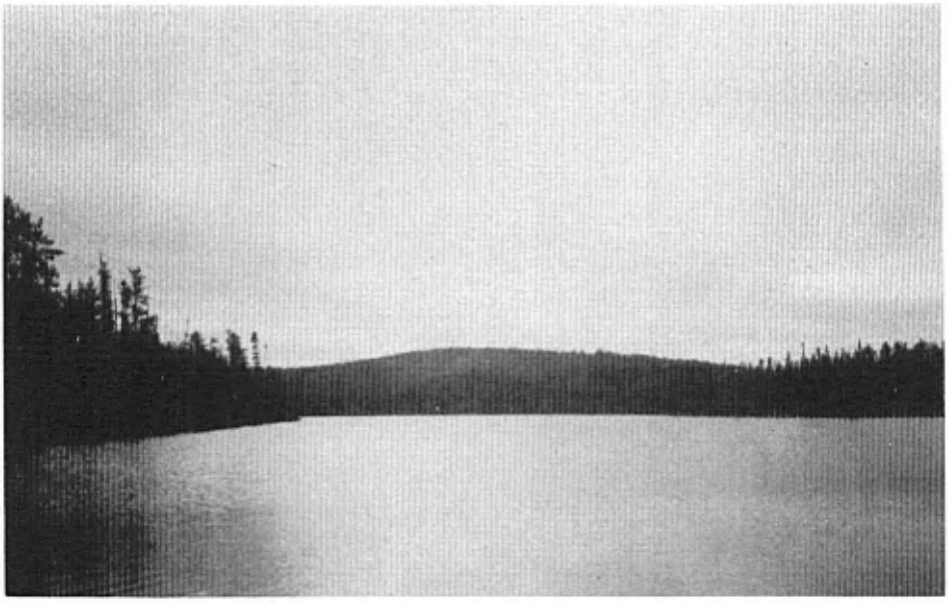
The fine grained, dark grey schist with which the conglomerate is interbedded, consists essentially of a felted mass of chlorite, sericite, and minute grains of quartz, with an occasional grain of plagioclase. The schistosity is rendered more pronounced by minute black streaks which may be graphite.

A bare rock hill, about two and a half miles east of Castagnier lake, in the middle of range I, Vassal township, is composed essentially of a finely banded schist consisting largely of fine grained hornblende and quartz, the banding being due to alternate concentrations of these two minerals. Near the eastern end of this hill, the rock is much altered, the ferromagnesian constituents of the schist being replaced by magnetite and hematite. The zone affected is about twenty feet in width, and is exposed for four hundred feet or so along the strike, which trends in a northwesterly direction, nearly parallel to the strike of the banding. In thin section, the rock in this altered zone is seen to be composed essentially of small, irregular grains of magnetite and hematite (about 40 per cent) and similarly small quartz grains. The iron minerals are strongly zoned along irregular bands related to micro-fractures.

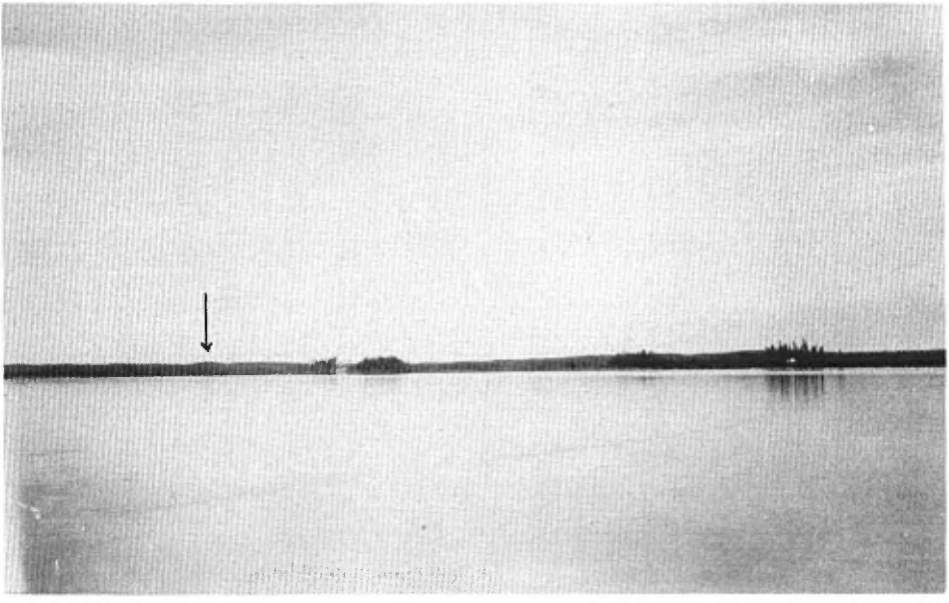
Banded rock similar to the above was also observed on an island near the south end of Castagnier lake, on the southern boundary of the map-area (see Plate III-B).

The writer is of the opinion that the rocks described above are unquestionably of sedimentary origin. However, there are other schists - amphibolites or quartz-hornblende schists - within the area whose origin is open to some doubt. The most characteristic feature of these rocks is their well defined and persistent banding, due to the alternation of hornblende-rich and quartz-rich layers. A belt of such rock, about two miles in width, extends northwestward from the

(1) AUGER, P.E., Que. Bur. Mines, Geol. Rept. No.2, 1939.



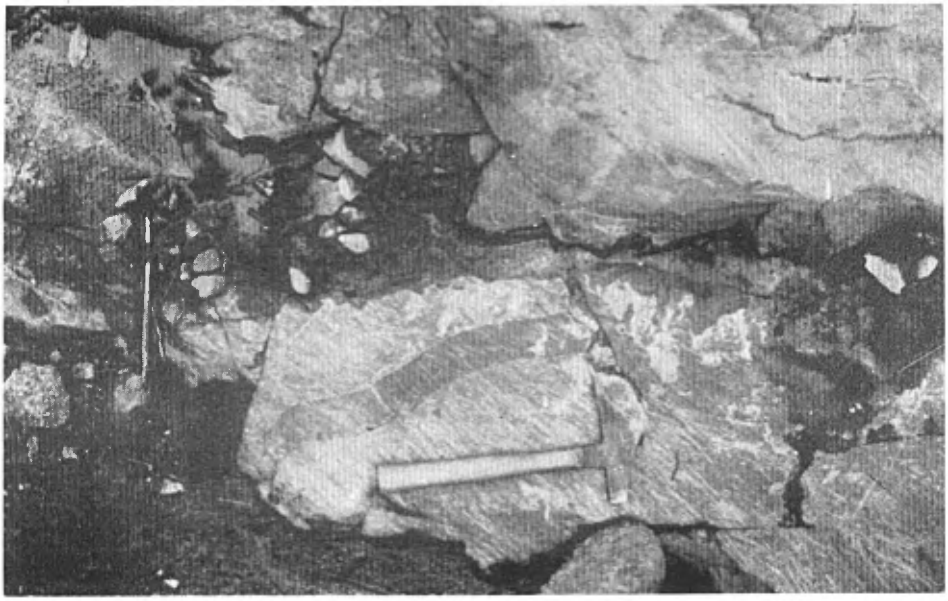
A.—A knoll, near the southwestern margin of the Céloron stock, which is one of the larger hills of the area. From the northern end of a small lake south of Céloron lake.



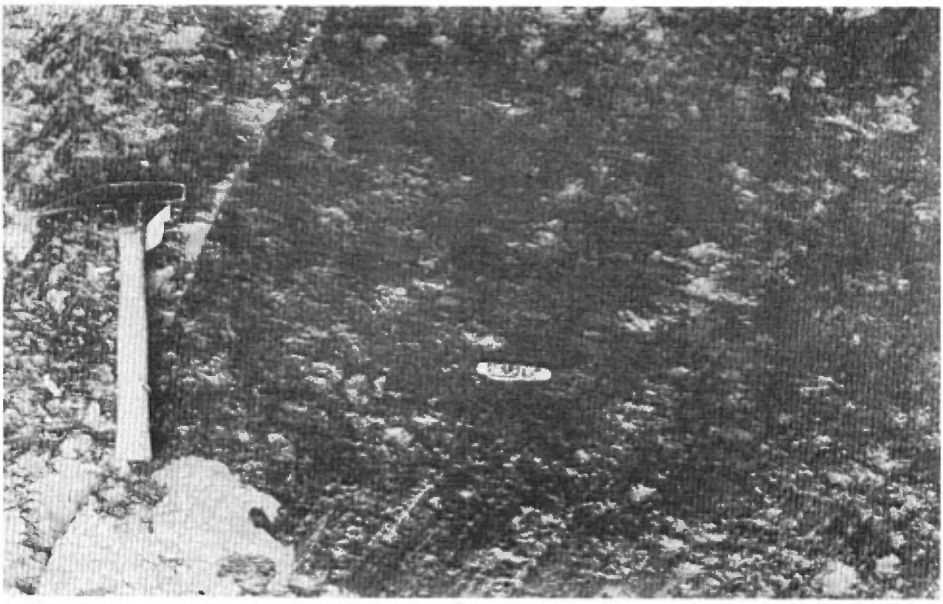
B.—Looking north from Castagnier lake; arrow indicates knoll formed of Céloron granite in eastern part of Castagnier township.

PLATE II

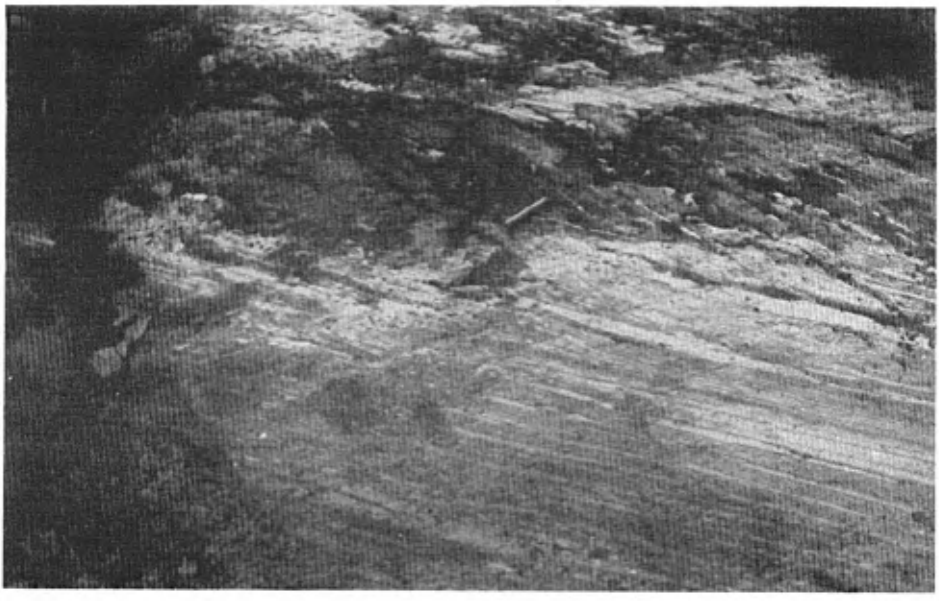
A.—Portaging through good stand of jackpine south of Céloron lake.



B.—A dyke that may be a feeder to the overlying flow. (Point of hammer is toward the north and the top of the flow). Southeast shore of Obalski lake.



A.—Small elongated pebbles in a narrow conglomerate band Southeast shore of Castagnier lake.



B.—Finely banded sediments, cut by an irregular dyke. The dyke and contact zone of the intruded rock have been extensively replaced by carbonate. Island near the south end of Castagnier lake.

central part of the south boundary of Vassal township through Castagnier lake, and passes south of Vassal lake. It could not be followed farther to the west because of lack of outcrops. Another belt, one mile to two miles in width, extends from the northwestern part of Vassal township across northern Castagnier and southwestern Coigny; and still another belt occupies the northeast corner of Bernetz township. There is a north-south ridge of similar rock, about a mile and a half in length, in Bernetz township, some two miles southeast of its central point, and an exposure of the same type of rock was observed about two and a half miles south-southeast of the northwest corner of this township.

The rock in these occurrences has been completely recrystallized, and all original features other than the pronounced banding, thought by the writer to represent bedding, have been obliterated. Individual bands in the schist maintain remarkable uniformity in width, but from band to band there is a range in width from one-thirtieth of an inch to several inches. Some bands or layers contain as much as ninety-five per cent hornblende; others are almost entirely quartz. As stated previously, the banding is due primarily to variations in the relative amounts of these minerals. In the opinion of the writer, the uniformity and thinness of the individual bands preclude the possibility of the rock representing successive lava flows. Also, the thickness of the series, which must be at least a thousand feet in each belt in which it is exposed, together with the chemical and mineral composition of the rock, rules out the possibility of its having been originally a tuff. Thus the evidence, negative though it be, favours the view that the original rock was a clastic sediment.

In the southern part of the area, the structural relationship of the hornblende schist to the lavas is evident. In outcrops around the southern shore of Obalski lake, the shape and attitude of the pillows of the ellipsoidal lavas indicate that the tops of the flows face to the north. In the central part of range VII, Castagnier, and the central part of range I, Vassal township, observations of a similar kind indicate that the tops face to the south. Thus the belt of obvious sediments and quartz-hornblende schists that crosses the southern part of the area rests in a syncline and represents the upper part of the 'greenstone' section of the area. It is assumed that the other occurrences of quartz-hornblende schist in the area occupy a similar structural position in relation to the lavas.

Inclusions of quartz-hornblende schist from a few feet to a hundred feet long are present in the few outcrops of gneiss seen in the northern half of Vassal township and the southeast corner of Coigny. Such inclusions also occupy well over half of the surface area of the rock exposed in a lobe, about five miles long, in the northeast corner of Castagnier and the northwest part of Vassal township. The lobe has been mapped as predominantly 'greenstone', though it also contains considerable gneiss.

## Post-Keewatin Intrusives

It is generally believed that, in western Quebec, the major intrusive bodies of the Canadian Shield are all of post-Keewatin age. The writer, accordingly, makes this assumption as regards the intrusive rocks of the present area.

Intrusive rocks underlie about two-thirds of the map-area. With minor exceptions, noted below, they all belong to one gneissic series, which shows little variation from place to place throughout the area. The rock is similar to that which, in the adjoining Tonnancourt-Holmes area (1), the writer has designated the 'Holmes Gneiss', and it is quite possible that the occurrences in the two areas are genetically related. However, since the earlier work has shown that the bodies are not continuous from one area to the other, those in the present map-area will be referred to as the 'Bernetz Gneiss'.

The other intrusive rocks of the area include what is here named the 'Céloron' granite, occurring as three separate bodies, the largest of which is in the northwest quarter of Castagnier township; and a small body of hornblende-biotite granite south of Bernetz lake, in the southwest corner of Bernetz township.

It is believed that the Bernetz gneiss is the oldest of these intrusives and that it was followed successively by the hornblende-biotite granite and the Céloron granite.

Acidic dykes are numerous in the area, particularly cutting the gneiss. The principal types represented are pegmatite, aplite, granite, quartz monzonite, and quartz diorite.

## Bernetz Gneiss

The Bernetz gneiss occupies a large part of the area. It underlies most of Coigny and Bernetz townships and, in Vassal, it occupies most of the ground in ranges V to X. It occupies only a small part of Castagnier, however, some outcrops of it having been found in the eastern part of the township, in ranges VII and VIII. Characteristically, the gneiss is light grey in colour, but in some places it has a pinkish tint. The rock is medium grained and strongly gneissic, with biotite the predominant dark mineral.

The general appearance of the gneiss is uniform throughout the area. However, as is usual, the degree of deformation differs from place to place and, with it, the degree of alteration of the constituent minerals. There has been considerable hydrothermal alteration of the rock in the immediate vicinity of the gabbro dyke which crosses it, but the numerous pegmatite, aplite, and other acidic dykes have affected it little or not at all.

Six thin sections of the gneiss were examined. Some variation in the relative proportions of the constituent minerals, and also in the mineral composition, was observed, but in essential details the several sections are similar. The average composition is approximately : quartz, 20 per cent; plagioclase (calcic oligoclase), 50 to 60 per cent; biotite, 10 per cent; with some microcline and orthoclase. Common accessory minerals are apatite, zircon, and titanite. The feldspar and mica are in part altered to epidote, sericite, and chlorite. A certain amount of crushing and shearing is

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(1) LONGLEY, W.W., Tonnancourt-Holmes Area; Que. Bur. Mines, Geol. Rept. No.24, 1946.

evidenced by granulation along the margins of the larger mineral grains, but in none of the sections examined was this severe. The rock is classified as a biotite-quartz-diorite gneiss.

Hornblende-Biotite Granite

Only one knoll of this rock was observed, in the southwest corner of Bernetz township, immediately south of the southwestern bay of Bernetz lake. The rock is pink, medium to coarse grained, with phenocrysts of feldspar up to an inch in length.

The mineral composition, as determined in a thin section of the rock, is : sodic plagioclase, 25 per cent; microcline, 25 per cent; quartz, 15 per cent; biotite and hornblende each 10 to 15 per cent. The microcline is fresh and is probably secondary. The plagioclase is but slightly altered, but the rock contains some secondary epidote and chlorite derived from partial alteration of the hornblende and biotite. Titanite and zircon are common accessories.

The rock is similar both in appearance and composition to that which the writer named 'Strangway Granite', in an area bordering Bell river in Laas and Tonnancourt townships, 18 miles east of the present map-area (1).

Céloron Granite

Three separate bodies of granite that occur along the southern margin of the Bernetz gneiss are included in this group. The largest of these, the 'Céloron stock', in the northwestern part of Castagnier township, is one to two and a half miles wide and at least four miles long. It may be more than twice that length and extend beyond the west boundary of the map-area. The westernmost exposure of this rock is a bare rocky knoll, one of the highest hills in the map-area (see Plate I-A). That the eastern boundary of the stock is probably about a mile east of the north-south centre-line of Castagnier township is suggested by the curving of the banding of the greenstones as if around such a body, and by the configuration of the northern part of Obalski creek.

The rock of the Céloron stock is coarse grained, grey, biotite granite. It is characterized by large, bluish, opalescent quartz grains. The mineral composition is : quartz, 25 per cent; albite, 50 to 60 per cent; orthoclase, 15 per cent; biotite, 5 to 10 per cent; with titanite, zircon, and apatite as common accessories. Secondary epidote and carbonate are present in small amount. Seen in thin section, the feldspar is for the most part fresh-looking, but many of the grains are more or less filled with blades of secondary muscovite or sericite, oriented parallel to the feldspar cleavages. Zircon inclusions in the biotite, with pleochroic haloes, are quite conspicuous. Where the main gabbro dyke (described below) crosses the eastern part of the stock, the granite is much altered and is red, rather than the usual grey, in colour.

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(1) LONGLEY, W.W., Tonnancourt-Holmes Area; Que. Bur. Mines, Geol. Rept. No.24, 1946.

A rock, similar to and very probably of the same age as the Céloron stock, but more altered and sheared, forms a narrow band along and near the northern margin of the greenstone belt about a mile north of Vassal lake.

A series of outcrops two miles northwest of Vassal lake, which form a crescent-shaped ridge about a mile in length, together with a low knoll to the northeast of the ridge, have the same mineral composition as the Céloron stock but are much finer textured and show some foliation. The crescentic ridge is definitely a sill or dyke, about five hundred feet thick, dipping 35° to 45° to the southwest. The lower contact was followed along the northeast and east ends of the body. The foliation is parallel to the attitude of the sill. The mode of intrusion would readily account for both the relatively fine texture and the foliation of this body. In many respects the rocks here grouped under the name of 'Céloron granite' are similar to those described by the writer as 'Tonnancourt quartz-monzonite' in his report on the Tonnancourt-Holmes area.

Aplite, Pegmatite, and Related Dykes

There are numerous pegmatite, aplite, and other acidic dykes in the area. The greater number of these cut the Bernetz gneiss, but some were observed in the greenstone. Many of the dykes in the Bernetz gneiss are granodiorite or quartz diorite. These usually parallel the gneissic structure of the rock and, together with the aplites and pegmatites, are believed to represent a late phase of the differentiation of the main gneissic body.

Several dykes of unusual character were observed on the islands in Castagnier lake. Many of them have such irregular and frayed margins that their contacts with the enclosing rock are very poorly defined (see Plate III-B). Weathered surfaces of the dykes, and of the country rock in their immediate vicinity, are strongly iron-stained, but the fresh dyke rock has a light greenish colour. The texture is coarse grained in the central portion of the dyke but very fine grained at the margins. In thin section, the rock is seen to be composed of carbonate (75 per cent), quartz (20 per cent), and a small amount of sericite and chlorite.

The rusty weathering indicates that the carbonate is ankerite. It would appear that the original minerals of the dyke, with the exception of quartz, have been completely replaced by carbonate through hydrothermal action. It is possible that some of the quartz, also, may be secondary.

A small dyke cutting greenstone three-quarters of a mile northeast of Castagnier lake was found to contain acid plagioclase (80 per cent), carbonate (10 per cent), with minor chlorite and sericite. It is quite possible that this dyke is related to those on the islands in the lake.

Gabbro Dykes (Keweenawan ?)

A persistent gabbro dyke extends across the area in a northeasterly direction, being exposed intermittently from lot 23, range VII of Castagnier township to the northern boundary of the map-area, two and a half miles east of the northwest corner of Bernetz township.

The presence of two other gabbro dykes is indicated. One of these is represented by two outcrops in the southern part of Obalski lake; it appears to be a northeastward extension of the dykes mapped by Weeks (1) in the area to the southwest. The other is exposed in a single outcrop, about half a mile long, in the southeastern part of the map-area, about three and a half miles north of the southern boundary and a quarter of a mile east of the line between Vassal and Despinassy townships.

These dykes are part of the system of gabbro dykes common in this part of the Canadian Shield and believed to be of Keweenawan age. In the present area, they vary in width, from fifty feet in some places to two hundred and fifty feet in others.

The gabbro has somewhat rusty weathering. At their margins, the dykes are very fine grained, but otherwise the rock is medium to fine grained, the largest plagioclase laths observed being less than half an inch in length. Only one thin section of the rock was examined, and this was found to contain fresh-looking labradorite and augite in about equal amount and to exhibit a pronounced ophitic or diabasic texture. Neither quartz nor olivine was seen in the section.

The main dyke was observed in contact with the Bernetz gneiss, the Céloron granite, and the greenstone. In each case, the gabbro is the younger rock. The granitic rocks show evidence of extensive hydrothermal alteration in the immediate vicinity of the dyke, and the greenstone has been considerably silicified in some places along the contact.

## Pleistocene and Recent

The map-area lies within the basin of glacial lake Barlow-Ojibway. As a consequence, the bed-rock throughout most of the area is buried beneath a blanket of glacial-lake silts with underlying glacial till. It is probable that all the hills were completely submerged at one time, during the higher stages of the lake, but in the later stages many of them evidently emerged as islands, and from the upper parts of these the finer material was washed away by wave action. However, ridges and terraces of rounded boulders were observed on or near the summits of even the highest of the hills. The glacial and glacial-lake deposits have also been removed at some places along the banks of the streams and from the shores and islands of the present lakes.

A conspicuous esker extends in a north-south direction completely across the map-area, some two and a half to four miles from its western boundary. It follows a course four to nine miles east of Harricana river and undoubtedly marks a late glacial channel of this river. Northward, the esker continues through the eastern part of Gale River map-area to its northern boundary at latitude 49°30' (2), and what is

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(1) WEEKS, L.J., Amos Sheet, Quebec; Geol. Surv. Can., Map No.327A, 1935.

(2) WILSON, J.T., Gale River; Geol. Surv. Can., Map No.554A, 1940.

probably the southward prolongation of the same esker extends through Duverny map-area, the southern boundary of which is at latitude 48°30' (1). This would give it a minimum length of seventy-five miles.

A second, smaller esker extends northward from the southern boundary of the map-area, along the western side and to the north of Castagnier lake. Other small ridges, probably of esker origin, were observed in the northeast corner of the area. There are extensive sand plains along the large esker first described, particularly between Obalski lake and the northern boundary of Castagnier township. These sand plains have probably developed largely as a result of wind action on the esker.

Glacial striae were observed on rock outcrops in many parts of the area. Almost everywhere, these indicate that the direction of ice movement was about 25° west of south. On some outcrops on the shore of Obalski lake there were seen, superimposed on the striae having this trend, a later set, indicating a movement of the ice toward the southeast.

## STRUCTURAL GEOLOGY

Throughout the greater part of the area, the trend of both banding and schistosity is about west-northwest, but locally there are marked deviations from this direction. Thus, in places, the strike of the Bernetz gneiss swings toward the north. Dips are predominantly steep to the southwest or vertical, but some as low as 35° to the southwest were observed, and in places the dip is to the northeast.

A close parallelism was noted between foliation and formation boundaries wherever the Keewatin-type rocks were seen in contact with, or in close proximity to, bodies of gneissoid intrusive rock. In view of this, it appeared safe to use foliation as a criterion in mapping formation boundaries in localities where actual contacts are not exposed. One instance of this was the mapping of the eastern end of the Céloron granite mass. Here, both in the most easterly exposures of the gneiss and in the adjacent greenstones and schists, there is a tendency to curvature in the strike of the foliation of schistosity of these rocks, such as might be expected around the nose of an intrusive body which was emplaced by the forcible thrusting aside of the adjacent rock.

About two miles southeast of the centre of Bernetz township, the strike of both the foliation of the gneiss and the banding of the greenstone is northward, with dip eastward at about 60°. A similar trend was observed in the rocks exposed east of Coigny lake. No logical explanation can be offered for the exceptional trend of the rocks in these localities.

There is a suggestion of divergence from the general structural trend in the southwestern part of Castagnier lake, and this divergence becomes strongly marked farther west,

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(1) WEEKS, L.J., Duverny, West Half; Geol. Surv. Can., Map No.530A, 1939.

around Obalski lake when the strike of the lavas is about east-west in the central part of the lake and swings to southwest in the southern part. Ellipsoidal lavas, which are interbedded with massive volcanic flows, indicate that the tops of the flows are to the north and northwest. Hence it is believed that, where the change in strike takes place, the nose of a plunging anticline, or a large drag fold along the northern limb of an anticline, is indicated.

As previously stated, the attitude of ellipsoidal lavas in Vassal and Castagnier townships indicates a synclinal basin extending west-northwest through Castagnier lake. This basin is occupied, in part, by banded hornblende schist, and it is assumed that other belts of hornblende schist in the area also mark synclinal basins. If this is true, a second, parallel, synclinal axis extends through the southwest corner of Coigny township, the northeastern part of Castagnier, and the northwestern part of Vassal, and a third such axis passes through the northeast corner of Bernetz township.

There is a pronounced topographic trend in the area, in a direction about S.30°W. It is shown most conspicuously in the courses of the streams. As noted on an earlier page, this is also the direction of the belt, about ten miles wide, which included practically all the rock outcrops seen in the area, with the exception of those along the streams and around the lake-shores; and it is also the strike of the large gabbro dyke. This topographic trend is probably an expression of shearing and faulting, and the main belt of outcrops is interpreted as an up-faulted block.

As shown by glacial striae, the ice, in its first advance, moved over the area in almost the same direction, S.25°W. However, the writer is of opinion that the passage of this ice sheet did not initiate the topographic trend but merely accentuated the pre-existing trend.

In the northwest corner of the map-area, a southeast trend in the topography is evident. This is thought to owe its origin to the second, southeasterly, advance of the ice, evidence of which was seen in glacial striae on rocks along the shore of Obalski lake.

## ECONOMIC GEOLOGY

Little prospecting has been carried on in the area, doubtless because of the scarcity of outcrops of rocks which are generally regarded as favourable for mineralization. Some work has been done in Castagnier township and in the southwest corner of Vassal, where a number of small trenches and test pits were seen. A few prospectors were in the area for a short time during the summer of 1941.

The writer did not observe any features to encourage prospecting in the northern half of the area. Some zones of mineralization were observed in the northeast part of Castagnier township and the southwest corner of Vassal.

Chalcopyrite in small amount was seen in a quartz vein on the south shore of Obalski lake; in a quartz vein on the southeast shore of Vassal lake; and in a zone of sulphide replacement in the southern part of lot 49, range VI of

Castagnier township. Pyrite and pyrrhotite mineralization was observed in several localities, particularly along the granite-greenstone contact northwest of Vassal lake, where there has been considerable replacement of the greenstone by these sulphides.

Samples were taken from all zones and veins that looked particularly interesting. These were assayed in the laboratories of the Department of Mines, Quebec. The results, as shown below, are definitely discouraging.

Table of Assay Results

| Sample No. | Gold (oz./ton) | Sample No. | Gold (oz./ton) |
|---|---|---|---|
| 1 ..... | none | 7 ..... | 0.003 |
| 2 ..... | none | 8 ..... | none |
| 3 ..... | trace | 9 ..... | 0.002 |
| 4 ..... | trace | 10 ..... | 0.006 |
| 5 ..... | 0.004 | 11 ..... | 0.003 |
| 6 ..... | trace | 12 ..... | 0.002 |

Description of Samples

No.1.–From contact zone between granite and greenstone, one mile northwest of Vassal lake. The greenstone has been considerably altered and is locally mineralized by disseminations and veinlets of pyrite.

No.2.–From a small band of greenstone, approximately two and a quarter miles west-northwest of Vassal lake. The greenstone lies between a small body and a sill of granite and in some places is rather heavily mineralized by pyrite, pyrrhotite, and a small amount of chalcopyrite. Some years ago a few test pits were opened along the mineralized zone.

Nos.3, 4, and 5.–From a hill which lies astride the line between lots 22 and 23 of range II, Vassal township. Many small zones in the rock exposures on this hill are slightly mineralized. Sample No.3, from a zone of contorted chlorite schist containing crystals of pyrite; No.4 from a quartz-carbonate vein mineralized with pyrite; No.5 from a small stringer of fine grained pyrite.

No.6.–From an exposure of pillow lava in the northern part of lot 31, range I, Vassal township. The lava is highly carbonatized and slightly mineralized with pyrite.

No.7.–From a zone of schistose, carbonatized greenstone, slightly mineralized with pyrite; southern part of lot 47, range IV, Castagnier township.

No.8.–From a large, irregular, quartz vein, near the southern shore of Vassal lake. The vein contains chlorite, tourmaline, feldspar, and scattered pockets of chalcopyrite, one of which was included in the sample.

No.9.—From a zone of chlorite schist, containing scattered crystals of pyrite; about two hundred feet southwest of No.8.

No.10.—From hill near the middle of lot 56, range VIII, Castagnier township. The hornblende schist of the hill has been extensively injected, lit par lit, by a granitic intrusive. The general strike of the schistosity is northwest and there is a zone of slight shearing trending in the same direction. Locally, along this zone, the greenstone has been almost completely replaced by quartz and green mica, and, in places, the silicified zone has been well mineralized with pyrite.

No.11.—From a small pocket of chalcopyrite in a quartz lens which cuts greenstone on the southeastern shore of Obalski lake, in lot 8, range I, Castagnier township. Several such lenses occur here.

No.12.—Mineralized greenstone; lot 33, range IX, Castagnier township. The greenstone has been considerably silicified and slightly mineralized with disseminated pyrite at the point where the large gabbro dyke cuts across the contact between the greenstone and the Céloron granite stock.

The writer suggests that any prospecting in the map-area should be concentrated in Castagnier township and the southern half of Vassal. Particular attention should be given to the contact zones of the several bodies of Céloron granite, and to the area about Castagnier lake where extensive hydrothermal action is indicated by the many dykes which have been considerably altered to carbonate-rich rocks.

## ALPHABETICAL INDEX