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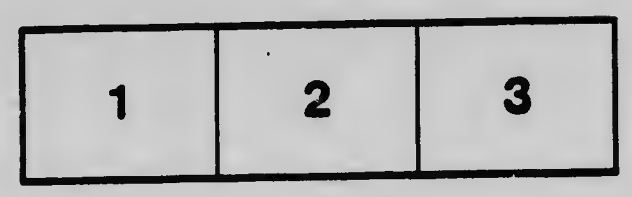
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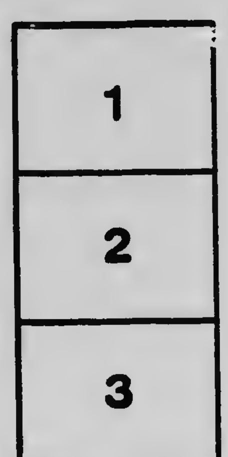
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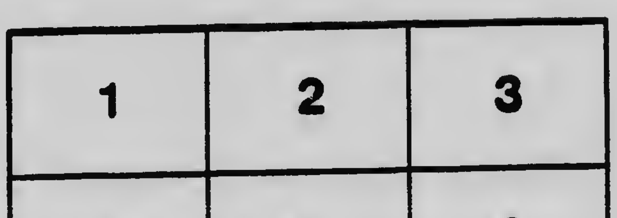
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HON. MARTIN BURRELL, MINISTER; R. G. MCCONNELL, DEPUTY MINISTER.

GEOLOGICAL SURVEY
WILLIAM MCINNES, DIRECTING GEOLOGIST.

MEMOIR 109

No. 94, GEOLOGICAL SERIES

The Harricanaw-Turgeon Basin, Northern Quebec

BY
T. L. Tanton

OTTAWA
J. DE LABROQUERIE TACHÉ,
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1919

No. 1735

PLATE I.

View to northwest from village of Amos, Que., showing bridge of the National Transcontinental railway over Harricanaw river and site of the earliest settlement, on left bank. (Page 2.)

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CHAPTER I.

INTRODUCTION.

GENERAL STATEMENT AND ACKNOWLEDGMENTS.

The district described in the following report is that part of northwestern Quebec which lies between the Harricanaw and Turgeon rivers northeast of lake Abitibi. Very little was known about this area until recently on account of the difficulties of access; but with the coming of the National Transcontinental railway, an active interest has arisen in the character of this new country which has been opened for development. It lies in the so-called clay belt and consequently is a promising field for agricultural development, and the occurrence of gold in the adjacent district to the south suggests the possibility of further deposits of that mineral.

Field work was carried on during the summers of 1914 and 1915. Practically all of the navigable streams of the district were traversed, and micrometer and track surveys were made of those not shown on the base map. Land traverses extending from 3 to 9 miles back from the waterways were run, by pace and compass, at intervals of 10 miles or less, into areas which could not be reached by canoe.

In 1914, the writer was assisted in the field by L. Clermont and L. I. Walker, and in 1915 by G. Hanson, C. B. Dawson, and R. K. Carnochan.

The resultant geological map, scale 4 miles to 1 inch, which accompanies this report, includes an area along the National Transcontinental railway which was examined by W. J. Wilson[1] and M. E. Wilson.[2]

The map of the Abitibi district, 1911, scale 4 miles to 1 inch, issued by the Department of Lands and Forests, Quebec, was used as a base map.

LOCATION AND AREA.

The map covers a rectangle 112 miles by 82 miles in the northwestern part of Quebec, in the county of Timiskaming, and the territory of Abitibi (Figure 1). Lake Abitibi is situated in its southwest corner. The principal stream in the district is Harricanaw river which flows across the eastern part.

MEANS OF COMMUNICATION.

Prior to the construction of the Transcontinental railway, the district was accessible by a canoe route from Ottawa river into the headwaters of

[1] "Geological reconnaissance along the line of the National Transcontinental railway in western Quebec"; Geol. Surv., Can., Mem. 4, 1910.
[2] "The Kewagama Lake map-area, Quebec"; Geol. Surv., Can., Mem. 39, 1913.

Harricanaw river, or by a canoe route from Matheson, Ont., on the Timiskaming and Northern Ontario railway, along Black river, Abitibi river, and Abitibi lake. Since the Transcontinental railway now runs completely across the southern part of the district, the stations Amos, Makamik,

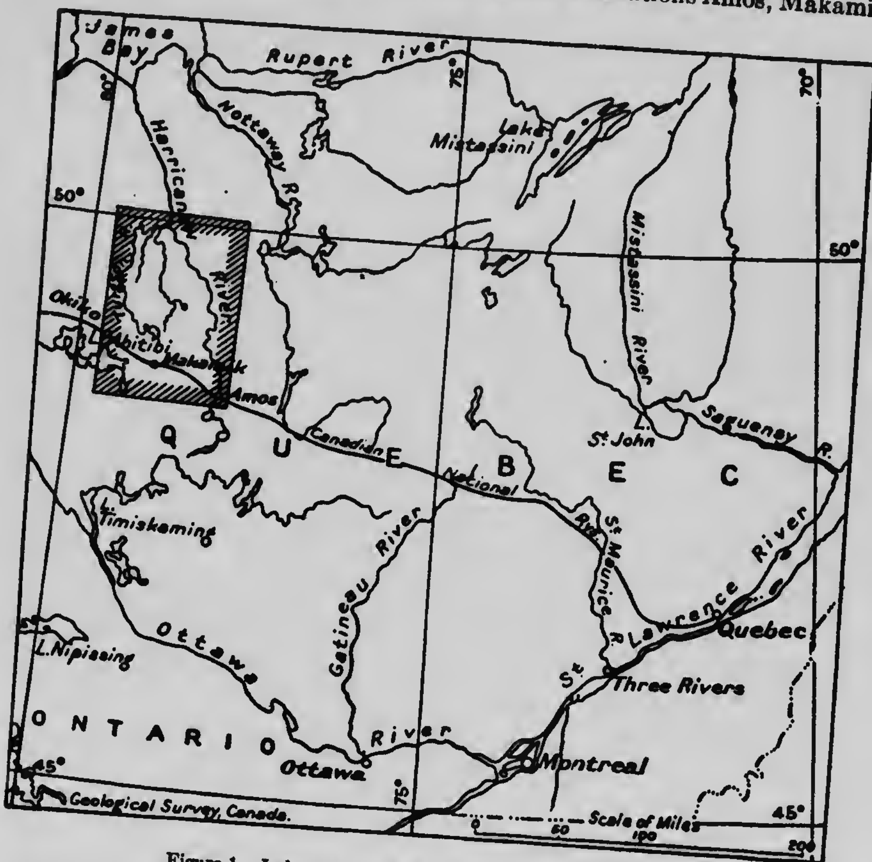

Figure 1. Index map showing position of explored area.

Wabakin, and Okiko may be considered the starting points on the main canoe routes leading north. The last three arc near streams which flow into lake Abitibi, but which connect by portage trails with the Harricanaw waters. Amos is a town with a population of about 300, suitable for outfitting purposes (Plate I). It is situated on Harricanaw river, which offers a good canoe route to the north.

HISTORY.

Except for the small southwestern portion of the map-area which lies in the Abitibi basin, very little was known of the district until recent years. Doubtless the Harricanaw-Turgeon basin has been used as a hunting ground by Indians for many years, but there is evidence that it was never well populated nor extensively travelled. An Indian cemetery is situated on Otter lake in which some of the crosses appear to be over thirty years old, but in parts of the district more remote from Abitibi post, only a few old winter camps give evidence of previous occupation. Harricanaw river is not considered a good canoe route to James bay on account of the numerous falls and rapids below Turgeon junction, and, until recent years, there was no trading post in the Harricanaw-Turgeon basin.

A reported discovery of gold on Patten river in 1912 caused a number of prospectors to investigate this section and signs of prospectors' camps are abundantly found along the whole course of this stream. No valuable deposit was found, however, and all workings have been abandoned.

At present, agricultural settlements are growing up along the railway, and several trappers have located in the district recently.

Very little intensive prospecting has been done as yet, and only one mineral deposit of economic interest has been found; this is a copper deposit carrying gold and silver values, 3 miles northeast from Amos.

PREVIOUS WORK.

The first important contribution to knowledge of the district was made by the Quebec Department of Lands and Forests, which issued a map in 1911, 4 miles to 1 inch, showing the course of all the larger waterways in the district, together with notes on the character of the adjoining land.

National Transcontinental Railway surveys were made across the southern part of the district in 1910, and since that time a considerable amount of accurate geographical information has been accumulated in the vicinity of the railway through the subdivision of townships.

It is of historical interest to note that an early mention of Harricanaw river is given in a report by R. Bell[1] whose assistant, A. S. Cochrane, was told by the Indians on Nottaway river that that stream emptied into Hannah bay. In 1895, Dr. Bell[2] mentioned that Harricanaw river (then called Hannah Bay river or Wash-a-how-sipi) was known to his Indian guides, but it was not known until the following year that Nottaway river belonged to a different river system. In 1900, T. B. Speight,[3] O.L.S., traversed Turgeon river (Hannah Bay river) from the confluence of Burntbush river up to Ninemile portage. In 1906, T. J. Patten, O.L.S., made a track survey of Patten (formerly Woman) river, from which circumstance it derived its name.[4] From a personal communication the writer learns that, in 1907, Mr. J. J. Sullivan made a winter trip from Rupert House on James bay to Abitibi post, crossing the Harricanaw basin. He noted the general scarcity of lakes in the district. The record of this trip was given to Mr. F. H. Clergue of Montreal. Other early geographical notes and surveys were made in connexion with the geological explorations listed below.

[1] Geol. Surv., Can., Ann. Rept., vol. III, pt. 1, new ser., 1887-8, p. 24A.
[2] Geol. Surv., Can., Ann. Rept., vol. VIII, new ser., 1895, p. 76A.
[3] Report on the survey and exploration of northern Ontario, 1900, p. 4.
[4] The Canada Gazette, Geographic Board decisions, May 18, 1918.

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McOuat, Walter.—"Report on an examination of the country between lakes Timiskaming and Abitibi": Geol. Surv., Can., Rept. of Prog., 1872-73, pp. 112-135.
This work included the survey and geological examination of lake Abitibi, the first recorded scientific work done in the area discussed in this report.

Johnston, J. F. E.—"Eastern part of the Abitibi region": Geol. Surv., Can., Sum. Rept., 1901, pp. 130-143.
A geological examination was made of the canoe route from lake Abitibi to lake Lois. Sketch map (G. S. C. No. 760) which accompanies this report shows the part of Turgeon river surveyed by T. B. Speight in 1900.

Wilson, W. J.—"On exploration along the proposed line of the Transcontinental railway from lake Abitibi eastward": Geol. Surv., Can., Sum. Rept., 1906, pp. 119-123.
A brief summary is given of the geology along the proposed line of the National Transcontinental railway and the adjacent waterways in the southern part of the map-area.

Obalski, J.—"Explorations to the north of the county of Pontiac": Mining operations in the province of Quebec, 1906 and 1907.
These reports describe certain rock outcrops and the general character of the country along the waterways near lake Abitibi and also the Upper Harricanaw river.

Baker, M. B.—"Lake Abitibi area": Ont. Bureau of Mines, Ann. Rept., vol. XVIII, pt. 1, 1909, pp. 263-283.
This report is accompanied by a geological map, 2 miles to 1 inch, and describes the geology adjacent to the shore of lake Abitibi in Ontario.

Wilson, M. E.—"Northwestern Quebec adjacent to the Interprovincial Boundary and the National Transcontinental railway": Geol. Surv., Can., Sum. Rept., 1910, pp. 203-207.
A brief account of field work performed in the Kewagama Lake map-area.

Wilson, W. J.—"Geological reconnaissance along the line of the National Transcontinental railway in western Quebec": Geol. Surv., Can., Mem. 4, 1910.
In this report is included a detailed account of geological observations taken in the district traversed by the railway east of the Interprovincial Boundary. On the accompanying map, 4 miles to 1 inch, the drift is mapped as well as the rock outcrops.

Wilson, M. E.—"Kewagama Lake map-area, Pontiac county, Quebec": Geol. Surv., Can., Sum. Rept., 1911, pp. 273-279.
A brief account of field work performed in 1911.

Bancroft, J. A.—"A report of the geology and natural resources of certain portions of the drainage basins of the Harricanaw and Nottaway rivers to the north of the National Transcontinental railway in northwestern Quebec": Report on mining operations in the province of Quebec, 1912, pp. 131-198.
This includes the results of a geological reconnaissance of Harricanaw river above the Allard portage and is accompanied by a geological map, 10 miles to 1 inch.

Wilson, M. E.—"Kewagama Lake map-area, Quebec": Geol. Surv., Can., Mem. 39, 1913. This report deals in a comprehensive manner with the results of field work performed in 1910 and 1911. The accompanying geological map, 4 miles to 1 inch, adjoins the Harricanaw-Turgeon map sheet on the south.

Tanton, T. L.—"The Harricanaw basin north of the Grand Trunk Pacific railway, Quebec": Geol. Surv., Can., Sum. Rept., 1914, pp. 96-98; Sum. Rept., 1915, pp. 168-170.
Brief accounts of field work performed in 1914 and 1915. The Summary Report for 1915 contains a geologically coloured diagram of Harricanaw-Turgeon basin, 20 miles to 1 inch, on which is marked the mineral occurrences in the district.

CHAPTER II.

SUMMARY AND CONCLUSIONS.

TOPOGRAPHY.

The Harricanaw-Turgeon basin forms parts of the great Pre-Cambrian peneplain of northern Canada. The country slopes gently northward to James bay, with a slight inclination toward the east, as shown by the greater number of tributary streams joining Harricanaw river from the west than from the east. In the 114 miles between the railway and Turgeon junction at the north end of the map-area, the fall on Harricanaw river is from 1,000 to 600 feet above sea-level. This descent is accomplished by a number of irregularly spaced falls and rapids with stretches of sluggish water between. All the large streams in the district make their descent in a similar way, but the small streams are characterized by swift currents and fairly evenly graded valleys, due to the fact that they run through unconsolidated materials and have not yet cut through to the irregularities of the rock floor. The northern half of the map-area is a great muskeg plain with a few widely scattered rocky or clay-covered hills rising above the general level. Numerous hills and ridges occur in the southern half of the district, the highest of the hills being Plamondon hill which rises 800 feet above the surrounding country. There are only a few lakes in the district and these are, for the most part, small. The majority of the lakes occur near the headwaters of small streams and are not arranged as a chain of river expansions, as is commonly the case in the rockier parts of the Laurentian plateau.

GENERAL GEOLOGY.

All the solid rocks observed in the Harricanaw-Turgeon basin are Pre-Cambrian.

The oldest rocks, hereafter referred to as the Abitibi group, include a complex series of lava flows, which range in composition from basalts to rhyolites, water-lain tuffs of varying acidity, and a banded iron formation. Many of these types present evidence of widely differing metamorphic action, ranging from rather fresh-looking, massive varieties to steeply inclined schists.

A sedimentary series of rocks, the Harricanaw series, unconformably overlies the rocks of the Abitibi group. The sediments have been largely altered to schists, and are infolded with the older members of the basement complex.

Approximately one-half of the map-area is underlain by granites and gneisses. These rocks represent batholiths which intruded the Abitibi group and have been exposed by erosion since that time. The granitic rocks are by no means uniform in their lithological character, but no evidence was found for regarding one type as different in geologic age from any other.

A small minette dyke was observed cutting a schisted member of the Abitibi group. Since the dyke rock is not schisted, its age is given as post-batholithic.

Comparatively fresh-looking dykes of quartz diabase and olivine diabase cut the granites and older rocks. The dykes are not large but they are widely distributed through the district. The diabase intrusives are believed to be of Keweenawan age on account of their similarity to dykes which occur at numerous localities between this district and lake Superior and whose age has been determined in the latter locality.

A mantle of unconsolidated materials now covers the lowlands of the deeply eroded Pre-Cambrian rock-floor. These deposits of boulder clay, gravel and sand, and stratified clay and sand, were deposited by the continental glaciers which passed over the district in Pleistocene times, and by the waters from these melting ice-sheets as they retreated.

ECONOMIC GEOLOGY.

When the National Transcontinental railway was built, very little was known of the natural resources of the Harricanaw-Turgeon basin except that it lay in the clay belt. The best of this land along the railway was speedily taken up by agricultural pioneers.

Very little prospecting has been done in the region as yet, although approximately one-half of the basin is underlain by rocks of the schist complex. The only parts of the district altogether unsuitable for prospecting are the large interstream areas north of the Mistawak batholith, which are known to be almost entirely occupied by muskeg, and the interior parts of the batholithic masses of granite, which are characteristically barren.

Quartz veins are abundant in the rocks of the Abitibi group, especially in the vicinity of the granitic intrusives. Several such veins showed the presence of small amounts of gold when assayed. Some quartz stringers in the ferruginous dolomite on Harricanaw river, just north of the Mistawak batholith contact, showed a high gold contact upon assay.

Silver values have been found in pegmatitic quartz veins in the Abitibi greenstones near the granite contact, a few miles southeast of Okiko and on Chikobi lake.

Chalcopyrite has been found in considerable amount, near Amos, in a quartz vein cutting a schistose rhyolite tuff, and a small occurrence was found near the mouth of Patten river in a quartz vein cutting the Abitibi greenstone.

Small amounts of galena have been found in a pegmatitic quartz vein in the Abitibi greenstone near the granite contact and also in a quartz vein associated with a post-batholithic minette dyke.

Banded iron formation was observed about 10 miles northwest from Chikobi lake, and boulders of this rock and strong local magnetic deflexions testify to its presence in the Abitibi greenstone area in the northern part of the sheet.

A small amount of molybdenite was observed in a pegmatitic quartz vein in the Abitibi schist on Plamondon hill near the granite contact.

Considering the accessibility of the district, the numerous rock exposures between the railway and the Mistawak batholith and along the waterways to the north, and the fact that casual prospecting already has shown the presence of valuable minerals, it is evident that the district merits the attention of prospectors.

CHAPTER III.

GENERAL CHARACTER OF THE DISTRICT.

TOPOGRAPHY.

GENERAL ACCOUNT.

The Harricanaw-Turgeon basin forms part of the Pre-Cambrian plateau which occupies a wide, V-shaped area around Hudson bay. Throughout this physiographic province the surface is characteristically one of low relief and the old rock structures are truncated, indicating that the whole area was at one time reduced by erosion to a peneplain. Evidence that this peneplain was raised and subjected to erosion long before Glacial times is found in the old river channels which now appear as rock gorges where the present streams have followed the same course, and in the cliffs and minor topographic irregularities which are found in the higher parts of the area where the rock is exposed. The erosive action of the continental glaciers which passed over the area during the Glacial epoch is to be seen on the polished and grooved rock surfaces and the rounded character of the hills when viewed from a distance. Glacial rock flour and boulders have been deposited over the whole Pre-Cambrian plateau in an irregular manner, and in a large area in northern Quebec and Ontario, known as the clay belt, a depositional plain of considerable thickness has been formed by stratified lake clays and sands which were laid down in the waters derived from the melting glaciers.

The map-area lies within the clay belt and consequently its topography differs from the greater part of the Pre-Cambrian plateau. An abundance of drift materials, a large part of which were laid down in glacial lake waters, covers the lowlands of the district and hides the minor irregularities in the rock surface. The rivers are consequent on the drift plain and have cut V-shaped valleys in the unconsolidated materials. There are only a few lakes in the district and these are for the most part at the headwaters of small streams. Such a drainage system is in marked contrast to the mesh of rock-basin lakes which spill into one another by streams characterized by falls and rapids, as described in the Pre-Cambrian plateau outside the clay belt. The northern half of the Harricanaw-Turgeon basin, which lies between the Harricanaw, Wawagosik, Theo, and Turgeon rivers, is occupied by great muskeg plains in which the vegetation has prevented the development of the drainage system. The southern half of the map-area is of comparatively high relief. Muskeg areas of considerable extent occur between the hills and ridges, but the drainage system is much better developed than to the north (Plate II B).

RELIEF.

The Harricanaw-Turgeon basin has an average height of 700 to 1,100 feet above sea-level, this being somewhat lower than the general elevation of the Laurentian plateau. Hills and ridges are scattered through the southern part of the sheet an. these rise to heights of a few hundred feet above the surrounding country. The highest point in the district is Plamondon hill, with an approximate height above sea-level (aneroid determination) of 1,880 feet; the lowest point is on Harricanaw river at the extreme north end of the sheet, the elevation here being approximately 600 feet above sea-level, giving a vertical range for the district of approximately 1,280 feet.

Plamondon hill is situated 18 miles due north of lake Chikobi. It is the highest hill in a long irregular ridge which runs through this part of the sheet in a northeast-southwest direction. Plamondon hill and Hebert hills, which rise from the same ridge to the northeast, are composed of highly metamorphosed green schists near the granite contact, whereas southwest of Plamondon hill, the ridge terminating in the three Nissing hills and Oditan hill, is composed of granite near the greenstone contact. At Oditan hill this major ridge meets the divide between the Harricanaw and Abitibi waters, which runs west-northwest and east-southeast. The most prominent elevations on this divide are the Abitibi hills near the west side of the sheet. Other prominent hills occur in various isolated positions throughout the southern part of the district; practically all of these are near the contact between granite and greenstone. The only hills of any prominence in the northern half of the sheet are two diabase masses standing about 200 feet above the general level, west of Harricanaw river, 9 miles above its junction with the Turgeon.

The following elevations are taken from the "Altitudes in Canada" and from aneroid observations by the writer.

	Feet.	
Lake Abitibi highwater level	8[illegible]	
Makamik lake (low water)	917	
Robertson lake (low water)	1,001	
Height of land, east of Robertson lake	1,076	
Davy lake	1,003	
Beauchamp lake	1,036	
Harricanaw station	1,002	
Harricanaw river (highwater) at N.T.R. bridge	972	
Harricanaw river (low water) at N.T.R. bridge	966	
Lake Obalski	952	(aneroid)
Lake Chikobi	1,020	"
Otter lake	910	"
Lake Joe	1,040	"
Abitibi hills	1,300	"
Oditan hill	1,408	"
Tanginan hill	1,465	"
Plamondon hill	1,880	"
Rifted hill	1,350	"
Plug hill	820	"

DRAINAGE.

With the exception of a small part of the Ottawa River basin, in the southern part of the sheet, the district drains into James bay. The major part is in the Harricanaw-Turgeon basin, and the remainder drains into Abitibi lake, mainly through La Sarre and Okikodosik rivers.

The depressions in the rock surface are filled with glacial boulders, sand, and clay, so that the rivers are consequent on this depositional surface. Where a stream runs through sand and clay, the valleys are V-shaped and graded. Where belts of boulders too large for the streams to roll have been encountered, rapids occur. In many places also the streams have incised their channels down to the rock floor and have exposed irregularities which now show in falls and cascades. These irregularities, toward whose grading very little progress has been made, serve to give the stream courses a step-like character, that is long stretches of quietly flowing water alternate with falls and boulder dams. The headwaters of the large streams and the small tributaries are normally more swift and meandering than the main streams and are characterized by fewer falls. The scarcity of falls is doubtless due to the fact that the smaller amount of water in these streams has taken longer to cut through the upper sand and clay deposits; whereas the swiftness is due to the more even grade and the head of water found between the high lands and the main river channels. All the stream valleys are youthful. The main streams have valleys much larger than is warranted by the amount of discharge during the greater part of the year. In the spring after the breakup, however, there is an enormously augmented run-off, the floating ice leaving its record in chafe marks on the trees often 10 feet above river-level in July. The rivers when in flood erode actively and where their beds are in clay, they scour their bottoms in places deeper than their local base level. This is illustrated in the case of the La Sarre which has a depth of 25 to 30 feet; whereas lake Abitibi is 15 feet shallower. On Wawagosik river above the 18-foot falls the bed of the river has been scoured deeper than the lowest point on the brink of the falls and at several points on Piamondon river the clay has been washed away from above as well as below the boulder belts, leaving prominent boulder dams.

Unlike the Laurentian plateau in general, lakes are not numerous. Besides lake Abitibi there are only fourteen known lakes in the whole district, and the majority of these are comparatively small. All the larger lakes of the district occur in the southern half, which is more hilly than the northern half. The lakes owe their origin to the combined effect of irregularities in the rock floor and the [illegible] deposits. The dominant influence of the drift deposition in forming lake basins is seen in such lakes as Makamik and Newiska which are very shallow and have clay bottoms and few rock exposures along their shores. Lake Chikobi has been caused by the damming of a depression in the rock floor by a wide boulder and sand belt which is to be seen at the numerous rapids at the head of Octave river. In the case of Otter lake the hollow in the rock floor has been the dominant factor, though a small part of the lake's rim is defined by drift deposits. Other lakes show to a varying extent the influence of the old rocky irregularities and the uneven glacial accumulations.

The more important lakes in the region and their areal extent are given in the following table:

	Square miles.
Abitibi	335
Makamik	18
Otter	8
Newiska	4
Mistawak	9
Wawagosik	4
Chikobi	10
Robertson	2½
Obalski	9

In the main southern part of lake Chikobi through a distance of about 5 miles, the shores of the lake roughly parallel the schistosity strike of the Pre-Cambrian rock-floor. In looking for evidence of the old preglacial drainage system it was noted that practically all of the rock gorges in the district trend north-northwest, south-southeast.

Linear valleys which are so characteristic of the district to the south and southwest are lacking. There is, however, a general parallelism to be observed in the major directions of the main streams, and the more or less sinuous course of one stream often finds its counterparts in the adjoining streams. A general survey of the map reveals two major directions to the main channels, one being due north and south, the other north of northwest. The northerly direction is normal, due to the slope of the plain toward James bay, the northwesterly direction corresponds closely with the direction from which the main ice-sheet advanced and its directional influence is due to the linear arrangement of its morainic deposits along its course, and possibly, in part, to the influence of preglacial channels as seen in gorges. The southern half of the district is characterized by rock hills, and rolling sand and clay land. The drainage is on the whole much better developed than in the northern half of the district which is so nearly flat that the vegetation does not permit the incision of channels by small streams. Moss has accumulated to a depth of from 6 to 10 feet and in wet seasons this forms a saturated spongy mass from which the seepage into the streams is very slow. Numerous ponds with no defined stream leading from them are encountered in the muskeg areas and many of these dry up during the late summer months. The streams which run through the great northern muskeg belt are entirely consequent on the glacial deposits, there being no sign of influence from the preglacial topography. Following the general slope of the plain the streams maintain a very constant main direction of flow. Theo and Wawagosik rivers are brought to the Harricanaw by the abrupt turn to the east of the lower Turgeon river. The sudden change of direction of the Turgeon, which up to the Grand Bend has been north for over 28 miles, is due to a great boulder sand belt which stretches across the north end of the district in a direction slightly north of east.

CLIMATE.

The climate of the Harricanaw-Turgeon basin is the chief drawback to what would otherwise be a splendid agricultural district. Although the area explored extends over a distance of 114 miles north of the railway, the altitude diminishes going north, so that there is sufficient uniformity to allow for the consideration of the most northerly part of the area along with the most southerly. On an average, it might be said that the opening of the waterways in the spring occurs at the latter end of April, and that the freeze-up comes near the beginning of November. Frosts are liable to occur during all of the summer months. Annual precipitation is about 28 inches. The Harricanaw valley is annually visited by cyclones of varying intensity, during the summer months. These appear to sweep down from the north or northwest following hot, dry spells. Their approach is signalized by a strong wind which increases to a gale, often destroying trees, and by a sudden drop in temperature, then follows heavy rain and hail sometimes accompanied by thunder and lightning. The high wind and precipitation usually last for a period of twenty-four hours, though during September of 1915 a storm of this character lasted for five days. The close of the storm is marked by a north wind and breaks in the low scudding clouds, after which the normal westerly winds prevail and blue sky appears.

Eight violent storms travelled up the Harricanaw-Turgeon valley during the summer of 1915. The precipitation from the storm of June 19-20 was sufficient to raise the water 8 inches in 24 hours in Turgeon river just below the confluence of Burntbush river. The most violent storm of the season and the one of longest duration lasted from September 14 to September 19.

Frost occurred during the summer months on the following days in 1915: June 10, July 10, July 15, August 3, August 18, August 31, September 21, and September 22. Snow fell in flurries on June 8, July 23, and August 30. The only hailstorm of sufficient severity to affect vegetation occurred on July 8. This was observed while on the Corset river in the west central part of the district. No record could be obtained of its having passed over any agricultural region to the south.

The greatest amount of rain falls during late September and early October.

In summer, the nights are always cool, the days are normally very hot except when the severe cyclonic storms are passing.

AGRICULTURE.

Agriculture in the Harricanaw-Turgeon basin is still in the experimental stage. The large areas of post-glacial lake clays and loams when drained support a heavy growth of native vegetation, and leave no doubt as to the excellence of the land for farming purposes. It only remains to determine the limitations imposed by the erratic weather conditions. The growing season is short, but the days are so long and the heat so great that growth is very rapid. The worst feature is the frosts which occur occasionally during the summer months, following the heavy cyclonic storms which sweep along the Harricanaw basin from the north and northwest.

Farming has been carried on for some time on lake Abitibi and recently along the railway at Okiko, La Sarre, Makamik, and Amos. Very satisfactory results have been obtained with root crops and hay. Very promising crops of barley and oats have been raised at Amos, but harvest-time is a period of great anxiety. The crops survived the frost of August 31, 1915, but were badly affected by the heavy rains in September.

A large farm was cleared by the prisoners at the Spirit Lake detention camp. The location is just north of Beauchamp lake. In 1913 this was a muskeg and rock area heavily covered with medium-sized spruce and a considerable depth of moss. The clearing of land in all the unburnt sections in this district requires a considerable amount of work over a long period of time. The only income which settlers can realize from the outset is by the sale of pulpwood and the growing of garden produce in small patches. When the valuable timber has been cut off, the moss and stumps are piled and fired. When this has been cleared, the land has to be drained and boulders removed before ploughing. Locations near waterways by which pulpwood and timber can be sent to mills are being most actively developed by settlers. This gives especial importance to the areas adjoining the streams flowing into lake Abitibi and Harricanaw river near the railway.

An interesting experiment in gardening has been carried on by Mr. J. J. Sullivan on lake DeMontigny. Potatoes, beets, parsnips, radish, lettuce, cabbage, and other market garden produce have been raised with success and also a great variety of garden flowers, but the proximity to the large expanse of water has been undoubtedly a moderating influence on the climate.

FLORA AND FAUNA.

The principal trees and shrubs occurring in the district are: black, spruce, white spruce, jack pine or banksian pine, white birch or canoe birch, poplar, balsam, balm of Gilead, tamarack, white cedar (Upper Harricanaw, Otter lake, and Abitibi lake), red pine (Abitibi only), yellow birch, black ash, mountain ash, maple, wild red cherry, alder, willow, moosewood or mountain maple, blueberry, high bush cranberry, low bush cranberry, meadowsweet, red osier dogwood, saskatoon berry or sugar plum, hazel, moosewood or leatherwood.

Black spurce is commercially the most important tree in the district. It occurs in all the clay areas and reaches a diameter of 2 feet or more in the well-drained strips along stream channels and the prominences of the rolling southern part of the district. This wood was extensively used for ties on the Transcontinental railway and is now the chief tree cut for pulpwood. The only red pine observed in the district was on some rocky islands in lake Abitibi; this appears to be the northward limit of pine in this part of the country. The northward limit of maple occurs in the upper Harricanaw basin a few miles south of the map-area. The farthest point north at which cedar was observed was in Otter lake. The northern half of the district is largely muskeg. Practically all of the timber in the district, which is of sufficient size for commercial purpose, is found along narrow strips bordering the streams and in the hilly southern part of the sheet; but this timber cannot be utilized under present conditions because the streams flow north away from the railway and the settlements. The timber in Abitibi basin at the southwest part, however, is not under this disadavantage and considerable quantities of pulpwood and lumber are being cut around Makamik lake, La Sarre river, and the Okikodosik. The lumber trade of Amos draws its supply from the forests on the banks of upper Harricanaw river.

Land traverses through the district frequently show a strikingly sharp boundary between different types of forest, due to the peculiarities of their habitat. In well-drained clay areas the predominating trees are white and black spruce, and balsam; on sandy clay, poplar and birch; on sand areas, jackpine. On rocky hills a mixed forest of these trees and various large shrubs is found. On old burnt areas poplar and birch saplings dominate in the clay areas, jack pine on the sand areas, and in the muskeg stunted black spruce and tamarack are sparsely scattered.

The largest animal in the Harricanaw-Turgeon basin is the moose. The great numbers of these have attracted such attention that the district is becoming a favourite resort for hunters. Red deer are locally abundant in the vicinity of Plamondon hill and around the Turgeon-Harricanaw junction. Caribou are said to be present in the region, though none were seen by the writer's party.

On account of the remoteness of the district from Hudson Bay posts and the difficulties of access the animals of the region have been hunted and trapped very little until recent years, so that the fur-bearing animals are still present in their normal abundance. The dams and houses of the beaver are more numerous at the headwaters of the streams than in any other part of the north country that the writer has visited. The other fur-bearing animals of the region include: otter, mink, fox, marten, fisher, lynx, wolf, black bear, muskrat, skunk, rabbit, chipmunk, red squirrel, and flying squirrel.

Wild ducks frequent the lakes and streams in large numbers, especially in the central part of the district.

The fish in the larger streams of the district include pike, maskinonge, pickerel, whitefish, herring, chub, and sucker.

Clay is so abundant in the district that the spring floods and the periodic downpours of rain in the summer keep the water constantly muddy, hence, no bass or trout inhabit the main streams. Trolling and bait fishing are of little value for catching fish except in the deeper lakes of the district, i.e. Otter, Mistawak, and Chikobi. Practically all the fishing in the district is done with gill nets. Upper Makamik river and a clear stream flowing across Ninemile portage contain brook trout. Lake Abitibi is the only place in the district where fishing is carried on extensively and fish from there are shipped from La Sarre (Wabikin) station to southern markets.

WATER-POWERS.

The Abitibi streams, on account of their proximity to the railway and centres of population, offer means for the development of power. La Sarre river falls 120 feet between Lois lake and lake Abitibi. The greatest single drop in its course is at a 25-foot cascade in La Sarre township, range IX, lot 43. The high banks on either side at this point would permit of the construction of a dam without flooding any farm lands. Another falls of about 18 feet occurs about 4 miles below this, only 3 miles from the town of La Sarre on the railway. Lois lake and lake Makamik on the upper parts of this stream ensure a considerable flow of water throughout the year.

The branch of the Okikodosik river which has its source in the Abitibi hills, has a series of falls stretching over 2 miles at a distance of about 9 miles north from the town of Okiko; the drop probably totals 100 feet. The supply of water is probably less constant than on the La Sarre river, as the source is in a muskeg area and not from lakes.

On the Harricanaw waters there are several large falls which are indicated on the map; most of these are too remote from settlements to be of any economic value in the near future. A series of cascades and rapids about 5 miles in length, which appear very favourable for power development (Plate IIIA), occurs on Harricanaw river between 21 and 26 miles below Harricanaw village. The total drop is over 75 feet. A dam could be built in the granite gorge which would not cause the flooding of any farm land. The three rapids on Harricanaw river between the railway and lake Obalski deserve immediate attention before the lands along the banks become of too much value. The total drop is approximately 14 feet, divided as follows: 4 feet, 2½ feet, and 7½ feet. A dam at the foot of the third rapid, with a lock, would add 20 miles to the 60 miles of the upper Harricanaw waters which are already navigable for power boats. Power might be developed from the drop, which would reduce the cost of transportation north of the track and make the land around Obalski lake more desirable for settlement.

CHAPTER IV.

GENERAL GEOLOGY.

GENERAL STATEMENT.

The solid rocks of the Harricanaw-Turgeon basin are all Pre-Cambrian and are classified under the following headings: (1) Abitibi group, (2) Harricanaw series, (3) granite batholiths, and (4) post-batholithic intrusi. ?s.

The Abitibi group embraces the oldest rocks in the district. It consists of basic, intermediate, and acidic lavas and tuffs, also hornblende, chlorite, and mica schists, which are regarded as the metamorphosed equivalent of the volcanic and pyroclastic members, together with ferruginous dolomite, and banded iron formation. Certain banded mica schists, the ferruginous dolomite, and the banded iron formation may be sediments; but, considered as a whole, the Abitibi group is one in which the volcanic and pyroclastic members predominate.

Within a very restricted area, field evidence is found which indicates that, after the deposition of the banded iron formation, uplift and subaerial erosion of a part of the district took place. During this period a conformable series of sediments was laid down consisting of a thin bed of quartzite and arkose followed by thicker beds of conglomerate and greywacke. These rocks have been designated the Harricanaw series. Among the pebbles found in the conglomerate are representatives of a great variety of rock types found in the Abitibi group and in addition there are granite pebbles. The granite, which is a plutonic rock, must have been exposed at the surface by erosion at the time of the deposition of the Harricanaw sediments.

The classification of the Harricanaw series as a distinct entity rather than as a member of the Abitibi group is based on the following considerations: (1) these definitely recognizable normal sediments are the oldest rocks of this type found among the pre-batholithic rocks, (2) they record a period of unknown but possibly great duration when the normal processes of erosion, transportation, and sedimentation were not masked by volcanic activity (which masking may have taken place in earlier times). The period is probably much more important than might be inferred from the limited distribution of these rocks in the Harricanaw basin, because they occupied a stratigraphic position which exposed them in a particular manner to the erosive agencies which have since planated the district. (3) By distinguishing from the Abitibi group any series whose stratigraphic position can be ascertained, the remaining group becomes less of a " complex " and progress is made toward the orderly classification of the whole pre-batholithic assemblage.

It is not known to what extent the rocks of the Abitibi group were folded previous to formation of the Harricanaw series, but it is evident that f lding took place on a large scale at some later date and probably contemporaneously with the great batholithic intrusion. The Harricanaw sediments are infolded with members of the Abitibi group and in many of the stratified members of the Abitibi group also folds can be observed. There has been a striking development of schists. It is inferred that the whole pre-batholithic group was thrown into folds of huge dimensions and that numerous minor folds were superimposed upon these.

This great folding or mountain-building process was accompanied or followed by the intrusion of huge batholiths of granite. There are also within the areas underlain by the Abitibi group a number of granite bosses and dykes together with pegmatite veins; and since the rocks in these smaller intrusives are lithologically identical with those in the batholithics they are regarded as being of the same age and origin. Field evidence indicates that mineralization is a much more prominent feature in the numerous veins which occur in the vicinity of these smaller granite bodies than in those near the contact of the large batholiths. This fact is of significance in directing prospectors to promising fields.

The next event following the great granite intrusions appears to have been the intrusion of minette dykes. These dykes are quite small and the few occurrences that are known appear to be disposed along a line running south from Rest lake.

Other post-batholithic intrusives, whose age relation to the minette and to each other is unknown, are diabase, quartz diabase, and olivine diabase. These rocks as now exposed are massive and unaltered. Small dykes of these rocks were observed at scattered localities throughout the district, and at Plug hills the quartz diabase masses may be the erosion remnants of volcanic necks. No diabase sills occur in the Harricanaw-Turgeon basin.

The quartz diabase of this district is lithologically identical with the quartz diabase which occurs in the form of dykes and sill remnants in the vicinity of Cobalt and Gowganda. There, rich deposits of silver, etc., are found associated with the diabase sills; but no mineralization of this type is to be found in connexion with the smaller dykes. In the light of this experience it appears that mineral deposits of the Cobalt type are scarcely to be expected in connexion with the diabase intrusives of the Harricanaw-Turgeon basin.

The region was exposed to erosive agencies for a period of great duration between the time of the mountain-building of the Abitibi and Harricanaw formations and the deposition of the Pleistocene drift. A planated surface resulted, in which was exposed the truncated structures of all the solid Pre-Cambrian rocks of the district. No sediments of Huronian or Palæozoic age occur in the map-area. But the study, in neighbouring regions, of the field relations of the Huronian and the distribution of the Palæozoic sediments indicates that the Huronian rocks were deposited on an old erosion surface of low relief, and that there was a cessation of erosion during a period of marine submergence in Silurian time.

In Pleistocene time, continental glaciers passed over the district scouring bare the rocky uplands and depositing till in an irregular manner. These deposits were evidently of greater volume than in that part of the Pre-Cambrian shield which lies outside of the so-called clay belt, and it appears that much of the debris was subjected to the assorting action of lake waters which covered a large part of the district during the time of glacial recession.

TABLE OF FORMATIONS.

The geological formations in the following table are arranged in descending order with respect to age, except in the subdivision of the Abitibi group where no age classification is attempted.

Quaternary	Pleistocene	Stratified lacustrine clay and sand. Boulder clay, gravel, and sand.
	Unconformity	
Pre-Cambrian	Post-batholithic intrusives Keweenawan (?)	Olivine diabase, quartz diabase. Minette.
	Igneous contact	
	Batholithic intrusives Laurentian (?)	Granite and granite-gneiss.
	Igneous contact	
	Harricanaw series	Arkose, conglomerate, greywacke.
	Unconformity	
	Abitibi group	Ferruginous dolomite and carbonaceous volcanic slate. Acid pyroclastics (chert) iron formation. Rhyolite and quartz porphyry. Intermediate pryoclastics and banded mica schists. Diorite, andesite, dacite, and hornblende and chlorite schists. Gabbro, diabase, basalt, and schists.

ABITIBI GROUP.

GENERAL CHARACTER AND SUBDIVISIONS.

Until recently the rocks composing the basement complex of the Pre-Cambrian have been described under two headings, the Laurentian and Keewatin: the former embracing all granite and gneiss plutonics; the latter, the surficial rocks consisting chiefly of lava flows. The work of recent years indicates that both of these subdivisions include rocks which differ greatly in age, so that the use of these terms, as defined by the international geological committee for the Lake Superior region, is not warranted in this district. In the Harricanaw-Turgeon basin dykes of slightly altered andesite and quartz porphyry intrude highly metamorphosed older lavas and schists. In certain places the foliation in schists has been folded and faulted, indicating that these rocks have been twice bjected to dynamic metamorphism. Granite fragments have been found in the tuffs of the greenstone complex and these are intruded by later granitic batholiths.

In the Lake Superior region, where detailed geological work has been done, volcanic rocks are found in every Pre-Cambrian series of that region. Hence, in this region it is possible that the surficial igneous rocks belong to more than one geologic age and it is evident that there are, or have been, granites of two distinctly different ages. Consequently, the name Abitibi group will be applied to the lavas and related surficial rocks of the basement complex instead of the term Keewatin, thereby avoiding a name which bears a definite age significance, and the plutonic granite and gneiss (Laurentian?) will be referred to by special local names given to each batholith.

The Abitibi group includes a great variety of lava flows, pyroclastics, and dykes, surficial rocks for the most part, which make up a large part of the basement complex of the Pre-Cambrian. The stratigraphic and structural relations of these rocks have not been wholly determined, but in accordance with the more pronounced lithological distinctions recognized in the field, the complex may be divided, for the purposes of description, into: (1) basic and intermediate volcanics, (2) intermediate pyroclastics, and banded mica schists, (3) rhyolite and quartz porphyry, (4) acid pyroclastics, chert, and iron formation, (5) ferruginous dolomite and carbonaceous volcanic slate.

BASIC AND INTERMEDIATE VOLCANICS.

The basic and intermediate volcanics occupy large areas in the north and south parts of the sheet, but the irregularity of their distribution renders it impracticable to define their boundaries in detail. They comprise the greater part of the area which is coloured green on the accompanying map.

Gabbro, Diabase, and Basalt.

Character and Distribution. These basic volcanics occur in various small areas. They are represented by schists for the most part, but occasionally dark green, massive phases are found. Those with an allotriomorphic texture are classed as gabbro, those with an ophitic texture, diabase, and the fine-grained or glassy-textured members are called basalts. Secondary minerals have developed to such an extent that these names are not in accord with the present essential mineral constituents of the rocks. In some of the outcrops examined, these rocks are found to pass gradationally one into the other, and in some cases the diabase is a phase of a basaltic lava. Flow structures were noticed in some of the basalt outcrops.

Lithological Character. Microscopic examination of the gabbro and diabase shows that the original feldspars have been replaced almost entirely by sericite, epidote, zoisite, and calcite; and the original augite is only seen in the central part of hornblende crystals, entire alteration into hornblende being most common. Chlorite, actinolite, tremolite, calcite, ilmenite, and magnetite form the interstitial material between the original feldspar and augite crystals.

Thin sections of basalt show a dense, fine-grained mass of minerals which are mostly alteration products. No phenocrysts were observed, although rods of secondary hornblende sometimes give a porphyritic appearance to the rock in the field. The plagioclase of the basalt is almost entirely replaced by calcite, zoisite, epidote, and sericite, though some tiny grains still show the characteristic twinning lamellæ. The ferromagnesian minerals are represented by actinolite and chlorite in small, irregular patches. Iron oxide is locally abundant in the thin sections.

Hornblende schists and amphibolites are the chief contact metamorphic products of the Abitibi volcanics at the borders of the granitic batholiths (see page 43).

Certain outcrops of the basic members of the Abitibi complex show the effects of dynamic metamorphism. From the general continuity and parallelism of foliation in the various schists in the district it is believed that the presence of schists among massive rocks (in some cases at a considerable distance from any known batholith) is not due to local rock movements, but rather the result of a great general compressive force which sheared only the weaker members in the series. The weaker rocks yielded sufficiently to relieve the strain, whereas the massive rocks were stronger than the force applied. In various parts of the region there are evidences of local deformational movements. The basic rocks which have been sheared have altered to greenish grey, calcite-chlorite schists.

Origin. The basic rocks of the Harricanaw-Turgeon basin are for the most part ancient lava flows. The only exceptions to this were: the gabbro which occurs on Turgeon river 17 miles below Corset island and is probably either a laccolith or a stock; and a hornblende-chlorite schist which occurs as a dyke on the left bank of Turgeon river 4 miles above the confluence of Theo river.

Diorite, Andesite, and Dacite.

Distribution. The greater part of the Abitibi complex is composed of rocks of these types. Outcrops were observed in all the greenstone areas from the extreme south end of the sheet to the farthest point north.

Lithological Character. The diorite is a grey or green rock with a fine, granitic texture in most cases, but that which is exposed on Theo river 5 miles above its mouth is rather coarse. The andesite, the fine-grained equivalent of diorite, is a greenish-grey or grey rock in which the individual crystals can seldom be seen with the naked eye, though in a few localities a porphyritic development of feldspar crystals can be observed. The andesite frequently has an ellipsoidal structure, in which case it presents many variations in composition and texture. Dacite, a fine-grained equivalent of quartz diorite, resembles the andesite in the field. It is grey, greenish-grey, or pinkish grey in colour, and porphyritic phases of this rock were more commonly found than in the case of the andesite. Fine-grained rocks of this family are much more abundant in the district than their coarse-grained equivalents.

Any thin section of the diorite is almost entirely composed of secondary minerals, though a few remnants of primary minerals indicate that the fresh rock was essentially made up of hornblende, biotite, and plagioclase. In its present condition the rock consists of large, irregular crystals of hornblende with fibrous terminations, biotite and chlorite crystals, also with irregular boundaries; between these crystals the outlines of altered feldspars can be traced in a fine-grained mass of epidote, zoisite, chlorite, and kaolin. Rectangular masses of leucoxene with occasional cores of ilmenite are plentiful.

The andesites range from types carrying abundant hornblende and a little plagioclase to types composed almost entirely of plagioclase with a small amount of hornblende and some of the latter contain a little quartz. In texture they vary from fine-grained, holocrystalline types to porphyritic and glassy types.

The dacites show a similar variation in texture and composition, their only difference being the presence of small amounts of orthoclase and quartz. It was frequently found that dacite occupied the central part of andesite ellipsoids and elsewhere the connexion between these two rocks suggests that both were derived from a common magma.

Microscopic examination shows that both the andesite and dacite have been highly altered, decomposition products usually being in excess of the primary mineral constituents. The majority of the andesites examined are porphyritic, containing small phenocrysts of oligoclase and oligoclase-andesine in a fine-grained matrix of plagioclase laths and smaller amounts of hornblende. These minerals are largely replaced by calcite, chlorite, zoisite, and sericite. Pyrite in small cubes is abundant in several of these rocks. Parallel streaks rich in chlorite in which the crystals are not parallel show the direction of the original flow structure; broken fragments of plagioclase phenocrysts were observed in one section strung out in the same direction. Magnetite and tiny needles of apatite occur as accessory minerals.

A spherulitic andesite outcrops on the portage on Turgeon river just above where Patten river enters. It is composed of a recrystallized glass full of small, stout crystals of hornblende. The spherules consist of radiating microlites of feldspars. Similar spherulitic andesite occurs on Turgeon river at Corset island.

A massive, 8-foot dyke of porphyritic dacite cuts the slightly schisted ellipsoidal andesite on the right bank of Woman river 3 miles above its mouth. No other rock of exactly the same type was observed in the region. In the field, the dyke material appears quite fresh; rectangular white feldspars ranging from the size of pin heads up to one-third of an inch, stand out clearly in a dense, greenish-grey matrix. Pyrite, in tiny cubes, and a speck of gold were observed in a hand specimen. Under the microscope, phenocrysts of badly altered plagioclase were seen, together with hornblende and a feldspar which is not twinned. The matrix consists of fine-grained quartz, feldspar, calcite, sericite, and zoisite.

A small dyke of biotite andesite was found on the east side of a small bay on the south shore of Chikobi lake. This appears to be closely associated with other andesites of the locality, but microscopic examination shows that it is of a distinctly different type from any of the andesite observed elsewhere. It is a porphyritic, dark, greyish-green rock slightly schisted, carrying small phenocrysts of a dark micaceous mineral. Microscopic examination shows abundant green biotite phenocrysts embedded in a fine-grained matrix composed of tiny rods and grains of biotite, chlorite, plagioclase, and zoisite. The materials of the matrix show a distinct parallelism. The biotite is regarded as partly primary and partly secondary, as some crystals have a drawn out appearance conforming to the schistosity, whereas other crystals with irregular boundaries have developed with haphazard orientation, and, in some cases merge into chlorite patches which include particles of the matrix.

Metamorphism. The andesites and related rocks are greatly katamorphosed. Sufficient evidence is not at hand to decide whether these changes took place soon after consolidation, through the agency of heated waters emanating from the lava and possibly mixed with the sea water under which they were extruded, or by protracted weathering. Both processes are believed to have been operative, but the former was probably the more effective. Extreme alteration is found throughout the whole rock material. The evidence that this alteration was carried on largely through the agency of sulphur-bearing solutions is found in the abundant development of pyrite in certain of the andesites, particularly on Harricanaw river at Tanbell rapids, and on the south shore of lake Chikobi; and in the interstitial filling of quartz and calcite containing pyrite, which is best seen at the Tanbell Rapids outcrop.

Dynamic metamorphism of the andesites gave rise to calc-chlorite schists, in some of which sericite is an important constituent. These rocks are best seen on Harricanaw river between Plamondon and Turgeon junctions and on that part of the Wawagosik river which lies to the west of this section. Shearing of ellipsoidal andesite gives rise to light and dark grey, banded rock, the light-coloured bands representing the flattened ellipsoids, the dark bands, the squeezed interstitial material. Petrographically, the main difference between the light and dark-coloured rock lies in the greater abundance of chlorite in the dark part. Examples of such rock outcrop at the first rapids below Obalski lake, on the left bank of Harricanaw river; and also on the same stream 50 chains above the confluence of Octave river. In the ellipsoidal andesite on the east shore of Obalski lake fibrous hornblende, or stiff-fibred asbestos, has been developed along local shear zones.

Amygdaloidal Structure. In a few localities amygdules are found near the borders of ellipses in the ellipsoidal andesites. These vary in size from one-quarter inch to an inch in diameter, the filling material usually being quartz, though occasionally quartz with a central mass of calcite was observed. An amygdaloidal structure is of remarkably rare occurrence in the lavas of the district.

Ellipsoidal Structure. A majority of the outcrops of andesitic lava exhibit an ellipsoidal or pillow structure (Plate IVB). In some places the interstitial material is weathered away and the pillow stands out distinctly, but, as a rule, glaciation has smoothed the outcrops and prominence of the structure depends on differences in colour or texture between the pillows and the interstitial filling. The ellipsoids are elliptical, circular, or irregular in section and vary from 3 inches up to 6 feet in maximum diameter, though in any one outcrop the range in size is not so great. Sometimes the ellipsoids are composite, that is, the interstitial material does not completely close around an ellipsoidal mass, but allows two or more pillows to join. In some outcrops a bun structure was observed, the pillows being flattened on one side and convex on the other. It is supposed that the flattening is due to gravity, while the material was still molten, the flattened sides thus representing the bottom of the ellipsoids at the time of their formation. At present, the angle which the flattened surfaces make with the horizontal gives a clue to the structural relations of the flow.

As has been previously stated, the rock material forming the ellipsoids is usually a grey or greenish-grey andesite, sometimes having an irregular kernel of pale grey dacite or rhyolite representing an acid differentiate from the andesite. The rock is always fine-grained, even when porphyritic. A spherulitic development of radiating microlites of feldspar is characteristic of the ellipsoidal andesite on Turgeon river near Corset island. Amygdules, when present, occur around the periphery of the ellipsoids. The material which occupies the gore-like interstices between the ellipsoids and which follows around their borders varies in different outcrops. At Tanbell rapids at the northern limit of the mapped area, it is quartz and calcite. On Theo river 9 miles above its mouth it is calcite and chlorite, and elsewhere it is a dense, dark, fine-grained material which, when schisted, resembles slate. The original character of the dark filling material is not known, though it probably represents fragmental igneous material.

Origin. A concise summary of some of the various hypotheses which have been advanced in explanation of ellipsoidal structure is given by M. E. Wilson.[1] He concludes that "the ellipsoidal structure in extrusive rocks is always subaqueous in origin and is dependent on two factors: (1) the flowage of the lava, and (2) the rapid cooling effected by contact with water. Owing to this rapid cooling, and to the pressure of the lava from within, innumerable fractures are formed in the surface of the lava flows from which the fluid lava of the interior is ejected. This molten material is immediately cooled by the water, however, to a viscous mass, which by movement is later drawn out into ellipsoidal form. By repetition of this process, great thicknesses of ellipsoidal lavas could be accumulated just as they are known to occur in various parts of the world."

This conclusion appears to be in accord with the writer's field evidence, except in so far as lava movements are suggested as responsible for the ellipsoidal shape. Though this may be true in some cases, there are some occurrences where it is evident that the ellipsoid has merely sagged under its own weight, and there is also the case of interlocking ellipsoids, which show that there has been very little, if any, flowage since their formation.

Composite ellipsoids, which have been previously mentioned, indicate that these globular ejections may be forced out from similar masses. This would explain a considerable thickness of ellipsoidal lava without the necessity of several sheet flows, though in all cases there would have to be a lava connexion between the volcanic neck and the ejecting ellipsoid in order to supply the necessary pressure and ejection material.

The volcanic vents through which the extrusions of andesite occurred were probably located in numerous localities in this region. Dykes of andesite cutting similar andesite were observed on Harricanaw river at Tanbell rapids, at the gorge 6 miles above the confluence of Turgeon river, and also near the middle of the south shore of lake Chikobi.

[1]Geol. Surv., Can., Mem. 39, pp. 51-54.

INTERMEDIATE PYROCLASTICS AND BANDED MICA SCHISTS.

The pyroclastics of this group are agglomerates and banded, fine-grained tuffs associated with andesitic lavas. Certain among them closely resemble arkose, argillite, and slate. The banded mica schists are medium to fine-grained, grey, glistening rocks, composed chiefly of biotite and quartz. These rocks outcrop along Turgeon river in the north and western parts of the sheet, on the lower Wawagosik river, on the upper Okikodosik river, and along an east-west belt passing a short distance south of Chikobi and Rest lakes.

Agglomerates.

Lava Agglomerates. Flow agglomerates outcrop on the south shore of lake Chikobi at points whose bearings on the tip of the main peninsula are north 27 degrees east and north 56 degrees east respectively; on a small island in Turgeon river just above where the Burntbush enters; and on Burntbush river 3 and 6 miles above its mouth; also at the rapids on Harricanaw river one-quarter mile north of the railway. These rocks are composed of angular and rounded fragments of light-coloured, acidic lava in a matrix of light or dark green andesitic lava which often shows a distinct flow structure. The outcrop on the right bank of Burntbush river 3 miles above the mouth is the largest, and here the fragments show most variety, including pink and pale green rhyolite, and light green porphyritic andesite. The fragments vary in size from 3 feet down to one-quarter inch, the larger ones being rounded, the smaller ones angular. There is a rough parallelism among the fragments conforming to the flow structure. The matrix is a dark green, massive andesite.

Microscopic examination shows that all the rocks found in the agglomerate have their counterparts in the lavas which have been previously described. Secondary minerals predominate in both cases.

These rocks originated through a lava breaking through and carrying along fragments of pre-existing lava. A rock of similar appearance might be formed by movements in the previously described ellipsoidal andesite in which an acid differentiate had formed in the central part of the ellipsoids.

A peculiar pyroclastic rock occurs on the left bank of Turgeon river 4 miles below the junction with Garneau river. It has the general appearance of a massive andesite; it is pale green in colour and its texture, although fine, is coarse enough to show the constituent green and white minerals to the naked eye. The remarkable feature about this rock is that it contains widely separated, rounded fragments of coarse-grained granite, from 1 inch to 2 inches in diameter with distinct though not perfectly sharp boundaries. It is believed to be a lava agglomerate in which the andesite flow has intruded a pre-existing granite and carried away and partly assimilated a few fragments.

Tuff Agglomerate. A slightly sheared tuff agglomerate occurs on the Wawagosik river 6½ miles below the Mistawak junction. Subangular fragments of white and grey rhyolite and dacite up to a foot in diameter are embedded in a tuff composed of andesite and dacite fragments ranging from one-quarter inch in diameter down to tiny grains, intermixed with a chloritic material which probably is altered volcanic dust. The matrix of this rock is not essentially different from the rest since the whole is fragmental, but it is distinctly darker than the larger fragments.

The agglomerate is a rock formed of volcanic ejecta thrown out by a volcano of the explosive type. Since there is no evidence of transportation of the materials, the position of this outcrop marks the approximate site of the ancient volcano.

Stratified Tuffs.

Lithological Character. Stratified tuffs corresponding to andesites and dacites occur 4 miles east of the Harricanaw-Turgeon junction, on Turgeon river 2 and 7 miles above the Harricanaw junction, 3½ miles below the Détour River junction, and at several points between 2½ to 4 miles below Corset island.

They are best seen on Turgeon river 3½ miles below the confluence of Détour river. They vary from pale grey to black, depending largely on the texture, the finer-grained varieties being the darker. The beds vary in thickness from several feet to one foot as a rule, but occasionally a much finer banding within the major beds is observable on the weathered surface. The light grey, coarser tuff has the texture and general appearance of a fine-grained arkose and the quartz grains can be seen with the naked eye; subangular fragments of an intermediate glass were found at rather wide intervals in certain layers. The finest black layers are dense and homogeneous, break with conchoidal fracture, have all the characteristics of a normal argillite, and when schisted are distinctly slate-like. A thin section of the coarser tuff examined under the microscope was found to consist of quartz grains characterized by incurving edges, calcite, and other obscure secondary minerals probably derived from feldspars.

In this outcrop, the tuff is intimately associated with an andesite lava which in places shows the characteristic darker lava bands marking off irregular ellipsoids. The chilled edge of the lava indicates its intrusive relations.

Metamorphism. In the southern part of this outcrop the finely bedded tuffs are tightly folded and schisted, and resemble closely folded, banded rocks occurring elsewhere in the region, which would certainly have been classed as clastic sediments in the absence of other evidence as to their origin. A transition due to intense metamorphism can be followed in the outcrops on Turgeon river from 2½ to 4 miles below Corset island. The exposures to the south are like the banded tuffs just described, whereas those to the north are banded mica schists which show numerous tight folds. One of the tuff exposures on the left bank of Turgeon river, 3½ miles below Corset island, is cut by a rectangular network of quartz stringers, a tiny fissure being observed in the middle of each stringer. These stringers and the rock on either side stand out as ridges. The rock adjoining the stringers has been recrystallized with the development of prisms of green hornblende in a finely granular mass of chlorite quartz and feldspar. A small outcrop of intrusive granite occurs a short distance south.

Origin. The rocks are believed to be volcanic ash deposited under water, the bedding being due to different rates of settling of the fine and coarse material, and their repetition corresponding to the successive periods of explosive activity.

Banded Mica Schist.

Distribution. Banded micaceous schists were found in the following localities· on the right bank of Harricanaw river just below the 48-foot chute; on Wawagosik river 4½ miles above its mouth; on Turgeon river 4 miles below Corset island, and 3½ miles above its junction with Theo river; on Okikodosik river 4 miles below the 6-mile portage; on the northeast shore of lake Abitibi on the point which projects toward Kenosha island; 2 miles southeast of Rest lake; in the northeastern part of Languedoc township at the 10-foot cascades on Makamik river and the hill in the eastern part of range IX; on the high hill 2 miles southwest of lake Chikobi; and at several points which seem to form irregular, east-west bands 1 mile and 3 miles respectively south of lake Chikobi.

Lithological Character. The rocks in these outcrops are by no means identical, but all are characterized by highly developed fissility, an essential composition of mica, quartz, and feldspar, and a more or less distinct colour-banding depending on the abundance of mica. The bands vary from dark grey and green to buff and light grey. The texture is usually fine-grained, but may vary slightly in the different bands of the same outcrop. Lenticular quartz veins and rectangularly intersecting veinlets of quartz are common in these schists (Plate VA).

Microscopic examination shows that the biotite schists are composed of a mosaic of quartz and feldspar with marked parallel elongation, and abundant brown or green biotite crystals whose longer axes also conform to the direction of schistosity (Plate VB). The feldspar is chiefly orthoclase and albite. The biotite frequently shows pleochroic haloes. Minor quantities of chlorite, carbonate, pyrite, magnetite, sericite, epidote, zircon, and apatite were observed.

An outcrop of biotite schist from lot 58, range IX, Languedoc township, contains large secondary orthorhombic crystals which are believed to have been andalusite, but the schist is now composed of a dense felt of colourless mica and other obscure materials. Since the schistosity bends slightly around these crystals it is concluded that the schist was compressed after the development of this mineral.

Structure. The mica schists have been tightly folded and the minor plications are well shown on the upper Okikodosik river. Here, the folds, as seen on a vertical surface, have an amplitude of about 2 feet and are so tight that the anticline of any particular bed corresponding to a syncline seen in the outcrop, could not be found, though the bed was visible for 7 feet. The axes of the minor folds appear to be vertical and apparently have only a low pitch, since, when viewed on the horizontal surface, no sign of folding can be seen in the banded schists. The tightness of the folds in these rocks explains the fact that the bedding coincides so nearly with the schistosity that it is rarely possible to distinguish them in exposures which show the truncated folds. It is evident that in this locality the strike and dip of the observed bedding gives the trend but not the inclination or dip of the major formation.

The apparent thickness of the banded schists, as measured on horizontal outcrops in the field, is probably enormously greater than that of the original deposit.

Origin. The origin of the banded micaceous schists is not definitely known, nor is it certain that they are all of the same origin. Recrystallization has destroyed nearly all trace of original diagnostic structures and textures. Since the schists are definitely stratified, it is evident that they are waterlain deposits, but whether these deposits were normal sediments of the shale-arkose type, or volcanic tuffs, is an open question. Similar rocks, which are classed among the Pontiac schists in the Kewagama region to the south, are regarded by M. E. Wilson[1] as being derived from arkose and greywacke, on account of apparent conformity with and transition into sedimentary rocks of this character. The field evidence collected in the Harricanaw basin, however, leads the writer to favour the view that the banded micaceous schists are altered waterlain tuffs. In the outcrop on Turgeon river [illegible]½ miles below its junction with Détour river, undoubted banded volcanic tuffs are intimately associated with andesitic lavas. A local intense folding of these rocks has changed them to banded mica schists. On Turgeon river 3 to 4 miles below Corset island a complete gradation is found between banded tuffs and the typical banded mica schist; in fact, scattered subangular fragments of volcanic rock can still be seen in the coarser bands of the schisted tuff. The ellipsoidal andesitic lava flows which compose a great part of the Abitibi complex are believed to have been given off by submarine volcanoes; the tuffaceous rocks produced during the explosive periods of these volcanoes would naturally be stratified since they were deposited under water. The high content of ferromagnesian mineral and of plagioclase which characterizes the schists is in accord with the view that thay are recrystallized tuffs; although these minerals would also be expected in case of recrystallized shales and arkoses, they would not be produced from sandstone, and in a medium and fine-grained siliceous sedimentary series of such prominence, some sandstone at least would be expected.

A sedimentary series strongly resembling the rocks to the south of Kewagama lake which are said to show a gradation into the banded schists, also occurs in the Harricanaw-Turgeon basin, but in this region does not appear to be related to the banded mica schists. The irregularity of distribution and the lack of continuity over long distances, of the banded mica schists in the Harricanaw-Turgeon basin, suggests that they are folded pyroclastics developed most strongly at irregularly spaced centres of volcanic activity, rather than that they are folded sediments which should show regularity and continuity of outcrop.

RHYOLITE AND QUARTZ PORPHYRY.

In addition to the acidic differentiates of the ellipsoidal andesite, other fine-grained, acidic rocks in the district occur in distinct masses, and these are classed according to their texture, as rhyolite and quartz porphyry.

Rhyolite.

Rhyolite outcrops were observed in the following localities: near the right bank of Harricanaw river 3 miles below Amos; half a mile east of a point on Wawagosik river, 7 miles above its mouth; on the left bank of

[1] Geol. Surv., Can., Mem. 39, p. 73

Angle river, 10 miles above its mouth; and on Twining creek, 2 miles above its mouth.

The rhyolite is a dense, fine-grained rock with a resinous lustre and conchoidal fracture; the colour varies from pale grey to black. The masses observed are believed to be parts of folded lava flows. All of the outcrops are comparatively large, but drift obscures their contact with the adjacent rock in all cases except that near Amos, where the schisted rhyolite can be seen in contact with a schisted, banded rhyolite tuff which stands on edge.

The outcrops on Harricanaw river and Twining creek have suffered intense dynamic metamorphism and have been altered in large part to a calcite-sericite schist.

Quartz Porphyry.

Quartz porphyry occurs at the following localities: on the left bank of Harricanaw river 3 and 5 miles respectively above the junction with Turgeon river; also on its left bank 14 and 19 miles respectively below Allard portage; on Burntbush river 1 and 7 miles above its mouth; the southern half of the east shore of Rest lake; 60 chains east of the north end of Rest lake; and 2 miles south of the east end of Chikobi lake.

Thin sections of the quartz porphyry consist of abundant small phenocrysts of colourless quartz, some of which have sharp crystallographic boundaries; others embayments and irregular outlines; and phenocrysts of badly altered feldspar, a few of which show albite twinning. The groundmass is exceedingly fine-grained, probably composed of feldspathic material and quartz. No ferromagnesian minerals were observed.

The outcrops along the southern half of Rest lake are locally schisted. In the hand specimen, the rock appears to be made up of rounded or subangular granules of quartz and feldspar, averaging about 1 mm. in diameter, embedded in a sericitic matrix. This gives the rock a decidedly tuffaceous appearance, but microscopic examination does not reveal any pyroclastic characteristics. Small specks of free gold were observed in the feldspathic matrix of the quartz porphyry which occurs 14 miles below Allard portage on Harricanaw river; the gold appears to be an original constituent of this rock.

The quartz porphyry on the left bank of Harricanaw river 18 miles below Allard portage is a dark, greenish-grey porphyry in which the phenocrysts of quartz and green feldspar make up the greater part of the rock. Pyrite is finely disseminated throughout. Under the microscope, the groundmass appears to be composed of fine-grained feldspar, quartz, pyrite, and a black material resembling graphite, together with an abundance of secondary ankerite whose borders and fissures are marked by limonite.

No evidence of intense dynamic metamorphism was observed in any of the outcrops of quartz porphyry. In the slightly sheared material on the east shore of Rest lake, the rock still retains its identity and the phenocrysts have not been deformed, though the matrix has yielded to pressure; recrystallization and the development of sericite are the resultant features.

Acidic Agglomerate.

One small outcrop of a peculiar acidic agglomerate was found on the upper part of Leslie creek, 3¾ miles west of Chobodis house on Turgeon river. A boulder composed of red chert fragments embedded in green schist was observed on the upper end of the 20-chain portage on Turgeon river.

The material found in the outcrop is a dark, greenish-grey rock, which at first sight might be mistaken for one of the andesites so abundant throughout the district. Close examination, however, reveals the presence of rounded fragments of dark grey, chert-like material embedded in a fine-grained, but not glassy, dark, greenish-grey material which is highly siliceous.

Under the microscope the chert-like fragments are found to be rhyolite. The smaller fragments are distinctly elongated in the same direction, probably due to flowage in the lava, there being no indication of strain or shearing. The matrix of the rock was probably a quartz porphyry; it now consists of phenocrysts of quartz in a fine-grained groundmass of quartz, carbonate, chlorite, and epidote. Although fine-grained, it is much coarser than the rhyolitic fragments. Small pyrite cubes occur in both the fragments and enclosing material.

Banded Acidic Tuffs.

Distribution. Banded acidic tuffs were observed at the following localities: on a hill a few chains west of the forks of Authier river; on the islands and numerous points on the main peninsula and north shore of lake Chikobi; on the left bank of Octave river one mile below the upper 10-chain portage; and on a ridge to the east of Harricanaw river 3 miles below the village of Amos.

Lithological Character. These rocks vary in general appearance from types re[illegible] the intermediate banded pyroclastics to a cherty type.

The [illegible] tuff on lake Chikobi is made up of thin beds of fine-grained grey mat[illegible]ich alternate with beds of pale grey ash showing small fragments [illegible] quartz porphyry and rhyolite in a fine-grained, siliceous matrix. Under the microscope, the pale grey rock is seen to consist of indistinct fragments of rock composed of quartz, albite, and orthoclase, some uniformly fine-grained, but the majority porphyritic; these fragments are embedded in a matrix of broken and irregular crystals of quartz, albite, and a little orthoclase. The darker grey beds in this rock are much finer in texture, but otherwise similar.

The occurrence near Authier river and on Octave river are similar to the Chikobi tuff, except that the former is finer-textured throughout and the latter [illegible] coarser in texture.

The [illegible]litic tuff, near Amos, is a banded, pale grey and white, schisted rock in which small fragments of quartz porphyry and rhyolite can be determined. The matrix of the rock has been largely altered to sericite an[illegible] quartz. The less schisted parts of this rock have a cherty appearanc[illegible]

Metamorphism. The acidic pyroclastics have not been uniformly influenced by the dynamic activity which appears to have operated throughout the whole district in which they occur. The tuffs which appear to belong to the same series on lake Chikobi, present all gradations between massive varieties and fissile sericite schists. In all the outcrops which show the effect of dynamic metamorphism the tendency has been to produce sericite schists.

Field Relations. All the acid pyroclastics appear to be steeply folded, the strike in each locality being approximately east and west and the dip vertical, with the exception of the outcrop on Octave river. There the strike is north 5 degrees west, and the dip 85 degrees to the east. The outcrops on Chikobi lake are intimately associated with a dacite lava and ellipsoidal andesite. The occurrence on Octave river shows a gradational change in texture, passing across the strike from a coarse-grained tuff to a fine-grained tuff. The latter is characterized by bands of black, carbonaceous, slaty material. The outcrop near Amos shows the following change in passing from north to south across the strike; a schisted, white and green chert rock grades into a schisted, banded, light and dark grey rhyolite tuff, which is followed by rhyolite. The latter is cut by a small greenstone dyke composed largely of chlorite and ferruginous carbonate. The rock beyond the rhyolite to the south is a dacite, the contact being drift-covered. In each case, the pyroclastics appear to be in conformable relation with the adjacent rocks.

Carbonaceous Slate.

Lithological Character. A black, carbonaceous, slate-like rock occurs on Octave river one mile below the upper 10-chain portage, and also on the northeast shore of Rest Lake. This rock has the general appearance of a black slate, though locally, shearing has not produced the characteristic platy foliation. Abundant radiating, spherical nodules of pyrite occur through it, and from the sides of these, fibrous quartz or chalcedony has grown out in the direction of the schistosity, producing an augen-like shape (Plate VI). When the nodules are close together they frequently join, forming small lenticular veins of quartz with the crystals elongated parallel to the vein direction, and the pyrite spheres filling the vein expansions.

Under the microscope, the rock is found to be composed of a mossy mesh of tiny, irregular, carbonaceous particles in quartz. A microscopic banding is produced by the relatively greater abundance of carbon in certain layers. A few small grains of rutile, zoisite, and sericite can be seen, and pyrite is present in varying amount through the whole rock. The radiating pyrite nodules appear to have pushed back the carbonaceous material during their growth, and the fibrous quartz when present, appears to have grown out at the sides of these resistant nodules during compression at a later date.

In the Rest Lake occurrence an appearance of stratification is imparted by narrow bands of ankerite crystals. A specimen of the slate rock when heated became white, due to the burning of the carbonaceous material, so the carbon is evidently not in the form of graphite.

The slate rock has been rendered schistose by pressure. This action was accompanied by recrystallization of the ankerite content and by the introduction or recrystallization of quartz at the sides of the pyrite nodules. The pyrite is in process of weathering to limonite.

Field Relations. In the Octave River outcrop the slate rock occurs as lenses in an acidic tuff. The elongation of these masses conforms to an indistinct banding in the surrounding rocks, the strike of which is north 5 degrees west, and the dip 85 degrees to the east. On Rest lake the strike is west and the dip vertical, and in passing across the strike toward the north a fragmental phase is encountered, in which angular chunks of ferruginous dolomite up to 2 inches in diameter are enclosed in the black, slaty matrix. Beyond this, a slightly schisted, finely-granular ferruginous dolomite occurs. Across the lake, on the west shore, a sericite-carbonate schist occurs which in some measure resembles both the slate rock and the ferruginous dolomite. It contains abundant spherical concretions of pyrite, some of which are 10 inches in diameter. These are so closely packed that for a distance of 20 feet the pyrite makes up more than 50 per cent of the rock.

Origin. This rock is believed to be a volcanic mud, and since it occurs in intimate association with laminated tuffs and in one outcrop shows an apparent bedding, it is believed to have been deposited under water. The abundance of pyrite which was formed before schisting took place leads to the conclusion that the waters in which the mud was deposited were highly ferruginous, the whole deposit thereby acquiring a unique character somewhat analogous to that of the slaty, banded, iron formation, found on Michiwakenda lake in the West Shiningtree district,[1] in the Onaman iron range,[2] and elsewhere.

Carbonate Rock.

Distribution. A carbonate rock composed largely of ankerite or ferruginous carbonate occurs on the left bank of Harricanaw river 14 miles in a straight line below Allard portage; on the northeast shore of Rest lake; 15 miles east of this point; a short distance south of Authier river; and on the west shore of McKenzie lake. Two large boulders of this rock were observed on the south shore of Chikobi lake 20 chains west of its extreme east end.

Rest Lake Occurrence. The ferruginous dolomite is a pale grey, finely-crystalline, schisted rock containing disseminated pyrite cubes. Carbonate forms the greater part of it, but sericite is abundantly seen on the cleavage surfaces. Green chrome mica was not observed in this rock.[3] It consists of carbonate in small rhombohedrons and irregular grains, mosaic quartz, and abundant tiny sericite scales in parallel orientation. Pyrite cubes measuring sometimes as much as 6 mm. on edge, are scattered through the rock.

The glaciated surface of the outcrop is rusty and minutely pitted, and narrow veins of quartz and carbonate enclose irregular, ellipsoidal areas, giving the rock an appearance similar to the ellipsoidal andesite.

The rocks exposed along this shore are all schistose and the schistosity dip is vertical or nearly so.

[1]Collins, W. H., Geol. Surv., Can., Mem. 95, p. 39.
[2]Moore, E. S., Ont. Bureau of Mines, Ann. Rept., vol. XVIII, pt. 1, 1919, p. 234.
[3]Chrome mica is commonly found in the ferruginous dolomite of the Kewagama district: Geol. Surv., Can., Mem. 39, p. 64.

The rocks encountered in following along the shore from northwest to southeast are shown in the following table, together with their width of outcrop and schistosity strike.

	Width of outcrop in feet.	Schistosity strike.
Schistose dolomite	70	S. 80° W. N. 85° W.
Contact observed striking		N. 70° W.
Black slaty rock containing fragments of dolomite		N. 65° W.
Drift	2	N. 65° W.
Schistose dolomite	130	
Drift	40	N. 68° W.
Black slaty rock with cherty layer	80	
Drift	150	N. 70° W.
Schistose dolomite	20	
Drift	20	N. 70° W.
Black slaty rock containing fragments of dolomite rock	25	
Drift	6	N. 85° W.
Black slaty rock	150	
Drift	10	N. 20° W.
Schistose dolomite	25	
Drift	50	N. 20° W.
Black slaty rock showing bedding	155	
	15	N. 67° W.

The next outcrop to the south, half a mile distant, is a schisted quartz porphyry.

The slaty rock is bedded. Its contact with the ferruginous dolomite was observed at one point, as indicated. The black, slaty rock, for about a foot wide bordering the contact, contains many subangular fragments of the dolomite up to 2 inches in diameter. No indication of bedding is to be seen in the slaty rock at this point. The included fragments appear as parallel schistose plates in it. It is not certain whether this rock is a conglomerate or an autoclastic. The schistosity in the ferruginous dolomite changes from south 80 degrees west to north 65 degrees west in passing across the outcrop from northwest to southeast. The strike of the contact appears to be the same as the schistosity at this point, i.e., north 65 degrees west. The plane of contact is vertical and the schistosity dips 80 degrees toward the northeast.

In the most southerly exposure of the slaty rock bedding is visible, striking north 70 degrees west, and dipping 85 degrees toward the southwest; this differs only slightly from the schistosity, which strikes north 67 degrees west and dips vertically.

Since the slate is a bedded deposit the dip and strike of the plane of its contact with ferruginous dolomite represents its true dip and strike at this point. The relation of the schistosity to the contact plane shows that the slaty member stratigraphically overlies the dolomite. The fragments of dolomite in the slaty member are of the same character as the adjoining dolomite mass and if they are chunks which have been broken off this would be additional evidence that the slaty member overlay the dolomite. If, however, the fragments represent thin beds of dolomite which were interlayered with the slaty member and have been dismembered during the schisting of the slate, then the chief significance to be attached to these fragments is that they show that a rock of dolomitic composition was present in the slate before it was schisted to its present extent.

The repetition of slate and dolomite in the outcrops might equally well be interpreted as an interlayered series which now stands on edge, or as a truncated series of small folds composed of only two beds, one of slate and one of dolomite. The latter view is favoured, since these rocks were not encountered on land traverses or elsewhere in this vicinity, except along the projection of their strike. If they represent a monoclinal series it is highly probable that the other limb of the fold would have been found either to the north or south.

Harricanaw River Occurrence. The ferruginous dolomite is a massive, pale grey, fine-grained rock with dark mottlings and disseminated, tiny crystals of pyrite. The weathered surface is rust-coated. The rock is cut by a large number of quartz stringers. Some are tiny, irregular, and discontinuous, and contain carbonate, and others, later in age, cut the rock and the older stringers in two rectangularly intersecting sets and occasionally in other directions.

A thin section of the dolomite rock was found to consist of very small, interlocking, carbonate grains; small quartz grains and pyrite cubes occur irregularly through the section. A small, irregular stringer of quartz and carbonate was observed carrying small cubes of pyrite and one speck of gold. This stringer fades into the rock material at its end by an increase of carbonate. The quartz shows undulatory extinction, indicating that it has been strained.

The exposure extends for 68 feet along the bank of Harricanaw river and rises 6 feet or less above the water. At the northern end quartz porphyry was found. This rock is massive and consists of abundant quartz phenocrysts from 1 to 2 mm. in diameter, scattered through a dense, pale grey matrix which resembles chert in lustre and texture.

There appears to be a gradational contact between the quartz porphyry and the ferruginous dolomite, since the contact comes in a band approximately 2 inches wide which partakes of the character of both rocks, but is somewhat different from either. Freshly fractured material from this contact zone resembles pale grey chert and contains no quartz phenocrysts; it weathers rusty, but contains only a small amount of pyrite.

Since the material at the contact was not subjected to chemical or microscopical examination, it is not certain whether there is a true gradation of one rock into the other or whether the appearance of a gradation is due to a cherty phase of the ferruginous carbonate occurring at this point—this material bearing a close resemblance macroscopically to the matrix of the adjoining quartz porphyry. No quartz veins were observed in the quartz porphyry and no trace of quartz phenocrysts was observed in the ferruginous dolomite, even adjoining the contact.

The contact between the quartz porphyry and the ferruginous carbonate trends northwest; its dip was not determined. The outcrop in itself gives no clue to the attitude and geological structure of these rocks at this place.

About 5 miles farther down Harricanaw river in a northwesterly direction, an isolated exposure of quartz porphyry was observed. This rock resembles the rock in contact with the ferruginous dolomite and is mentioned in this connexion on account of the fact that under the microscope it is seen to contain tiny irregular quartz and carbonate stringers and also very small carbonate crystals within its matrix. The carbonate mineral weathers rusty. This rock has been slightly schisted, as evidenced by the manner in which it cleaves when struck with the hammer.

Authier River Occurrence. A small outcrop of ferruginous dolomite appears through the sandy drift a short distance south of Authier river, and about 500 feet west of this an outcrop of banded iron formation strikes east and west.

Chikobi Lake Boulder. A boulder of ferruginous dolomite was found which showed an apparent stratification. Thin beds of white chert alternate with buff-coloured carbonate. Pyrite is disseminated through the carbonate material.

Origin. M. E. Wilson, in connexion with his study of the Larder Lake district,[1] has analysed the evidence bearing on the origin of the ferruginous dolomite of that region. He points out that the occurrence of the ferruginous dolomite in bands which can be traced for 5 miles, associated with sedimentary rocks, is not necessarily a proof that they are also sedimentary; instead, these bands might be regarded equally well as metamorphosed dykes which had found in the sediments exceptionally favourable conditions for intrusion. He concludes, " . . . that the ferruginous dolomite, which is intersected by quartz veinlets and contains chrome mica, has probably in every case originated by thermal replacement of aplite, quartz porphyry, rhyolite, or other rocks, that the original rock which the dolomite replaced had suffered deformation as a result of compressive stresses, and that the fractures formed in this way afforded channels along which solutions containing carbon dioxide, silica, chromium, boron, iron, sulphur, and other elements percolated and thereby effected first the alteration and replacement of original rock by carbonate, sericite, chrome mica, and pyrite, and later developed quartz veinlets by the deposition of silica along the fractures."

Another hypothesis is that the ferruginous dolomite is a chemical precipitate genetically related to the banded iron formation. This conception presented itself to R. W. Brock when he studied the Larder Lake district in 1907. He states[2] that on Pancake creek the rusty weathering dolomite(?) occurs with a thinly banded chert, like the jasper bands in the iron ore formation.

A. G. Burrows in his report on the Porcupine district states that in the township of Deloro there are bands of carbonate closely associated with bands of iron formation, which can be traced for several miles in an east-west direction.[3]

R. C. Allen describes the iron formation in Woman River area as being composed in part of cherty iron carbonate.[4]

Sufficient has been written regarding the ferruginous dolomite in northern Ontario and Quebec to indicate that its origin presents one of

[1]Geol. Surv., Can., Mem. 39, pp. 65–70.
[2]Ont. Bureau of Mines, Ann. Rept., vol. XVI, pt. 1, 1907, p. 207.
[3]Ont. Bureau of Mines, Ann. Rept., vol. XX, pt. 2, 1911, p. 12.
[4]Ont. Bureau of Mines, Ann. Rept., vol. XVIII, pt. 1, 1901, pp. 255, 259.

the most interesting problems in a group of rocks replete with genetic problems. A full discussion of this subject would involve the consideration of the following possibilities: that it originated by the replacement of another rock either igneous or sedimentary; that it is an essentially unmetamorphosed rock and originated as a normal sediment or as a chemical precipitate; or that it is of the nature of a vein or pegmatitic dyke. Also, if more than one mode of origin is indicated, the relation between these should be investigated.

It is not the purpose of this report to discuss this matter comprehensively, but it may be pointed out that the conditions observed in northern Quebec and Ontario, accord with those found in the Harricanaw district. In the writer's opinion the larger masses of ferruginous dolomite in the Harricanaw district originated as a chemical sediment, genetically related to the iron formation, whereas the disseminations and dykelets (or veinlets) of the same material found in the associated acid igneous rocks are believed to be composed, for the most part, of primary minerals derived from the same magma as the acid igneous rocks, the dykelets (or veinlets) being of the nature of pegmatites. If the larger masses of ferruginous dolomite and the "dykelets" are of the same age, the material which formed as a chemical precipitate must have come from a magmatic residue of the associated igneous rocks, and been given off into an overlying body of water.

The stringers of ferruginous dolomite material in the quartz porphyry are dykelets or veinlets. Since the same materials are found in segregated patches and disseminations through the acid igneous rock in which the stringers occur, and since the composition of the quartz porphyry and related rocks precludes the possibility that this material was derived from these rocks by weathering, it is concluded that the ferruginous dolomite represents a differentiate from the magma which gave rise to the quartz porphyry. The chemical composition is not to be regarded as a criterion of origin, but it may be pointed out that a similar origin has been deduced for the carbonate material associated with the aplite in the quartz diabase of the Gowganda district.[1]

The evidence that the larger masses of ferruginous dolomite in the Harricanaw district are a chemical precipitate is briefly stated as follows: the phenomena observed at the contact of the ferruginous dolomite and the bedded slaty rock on Rest lake suggest that they are conformable, bedded deposits. The boulder of ferruginous dolomite, on Chikobi lake, shows stratification. This appears to be satisfactory evidence that the dolomite here is some kind of a sedimentary deposit.

That the ferruginous dolomite is not a normal sediment is indicated by its apparent genetic relationship with certain quartz carbonate "veinlets" which occur in it, and in the associated acidic igneous rocks. The dolomite of the Larder Lake district contains chrome mica and this mineral is not found in dolomites of the normal sedimentary type. The highly ferruginous composition of the dolomite distinguishes it from any dolomite known to have originated as a normal sediment.

The ferruginous dolomite is frequently, if not always, associated in the field with quartz porphyry, rhyolite, or related igneous rocks, and since these rocks contain a greater or less amount of the materials com-

[1] Collins, W. H., Geol. Surv., Can., Mem. 33, p. 67.

posing the ferruginous dolomite, in stringers and disseminations, it is believed that there is some genetic relationship between the igneous rocks and the ferruginous dolomite.

The ferruginous dolomite is in places associated in the field with banded iron formation. On the south side of Authier river ferruginous dolomite is found 500 feet east of banded iron formation which trends east and west drift intervenes. The intimate association of the iron formation and the ferruginous dolomite has been observed more clearly in the Porcupine and Woman River districts, and in the latter locality the dolomite is described as a phase of the iron formation.

Since the ferruginous dolomite is believed to be a sedimentary deposit, differing from the type generally known as normal sediment, and formed at a time when the conditions were present which favoured chemical sedimentation (as shown by the banded iron formation), and since this rock is associated and genetically related to igneous rocks, it appears probable that the ferruginous dolomite formed as a chemical sediment, in the same manner or in a related way, as the banded iron formation. Also, as the material which gave rise to the banded iron formation is believed to have been supplied to the waters of deposition by direct volcanic contribution,[1] the same method of supply might be expected in the case of the ferruginous dolomite, and it is possible that some of these very channels of supply are to be recognized in the vein-like, quartz-carbonate stringers found in the associated igneous rocks.

Chert Rock.

A rock resembling chert was observed on the right bank of Patten river, one-sixth of a mile above its mouth; 14 chains west of a point on Ninemile portage 1 mile and 50 chains from its north end; and on the right side of Harricanaw river about 3 miles below the village of Amos.

The occurrence on Patten river is the only massive one. The rock has the appearance of a dense, white chert, through which a few, rust-coloured streaks run in discontinuous lines.

A thin section was found to consist of an extremely fine-grained mass of quartz and feldspar and a considerable amount of carbonate distributed in irregular patches. Sparsely scattered through this fine-grained material are a few angular crystals of oligoclase-albite, which, though only about 0·5 mm. in diameter, are much larger than the other crystals. One of these crystals showed, under crossed nicols, a division into four quadrants which extinguished at different times, the result of combined twinning following the Manebach and Carlsbad laws. A carbonate mineral is developed through and around these larger feldspar crystals. The thin section when held to the light shows alternate white and colourless bands ranging in width from 1 mm. down to mere threads. This bedding cannot be detected in the hand specimen nor under the microscope unless low power and reflected light are used. This suggests that fine layers through the rock contain more feldspar than the alternate quartz-rich bands, and these stand out white on account of their less transparent alteration products.

The chert rock from Ninemile portage and from Harricanaw river contains a small amount of epidote which gives the rock a green tinge.

[1]Leith, C. K., "Iron ores of Canada": Econ. Geol., vol. III, pp. 276-291.

The schistose portions are characterized by an abundant development of sericite.

Outcrops of chert rock on Patten river and Ninemile portage are isolated. The outcrop on Harricanaw river near Amos is a member of a folded conformable series, consisting of chert rock which passes gradationally into a banded rhyolite tuff and is followed by a rhyolite.

Origin. The chert rock is believed to be a waterlain deposit formed through the agency of a rhyolitic volcano. The feldspathic nature of the rock and its field association with waterlain rhyolitic tuff suggests, on the one hand, its relation to a tuff, whereas its general resemblance to the leanest phases of the banded iron formation suggests a relationship to a chemical sediment.

Iron Formation.

Distribution. Lean banded iron formation was found on a small hill 20 chains south of Authier river, 10 miles northwest of lake Chikobi. Strong magnetic attraction, probably due to this rock, was noted on Harricanaw river, 3½ miles below the confluence of Plamondon river, and also on Wawagosik river 20 miles from this point in a direction south 72 degrees west; and boulders of iron formation occur in the glacial drift near the junction of Turgeon and Patten rivers.

Lithological Character. The iron formation is a dense, hard, cherty rock which shows alternate white and black bands. The white bands, which are commonly about one-third of an inch in width, are composed of an extremely fine-grained mosaic of quartz; the black bands, which range in width from half an inch up to an inch, are made up of a mosaic of quartz grains and numerous thin layers of magnetite crystals, the texture being even finer than that of the white bands. The smaller magnetite crystals are frequently seen in the quartz crystals as well as between them.

Structure. The outcrop, which is only a few yards square, shows two small open folds whose axes trend south 80 degrees west. The crests of the folds pitch 5 degrees down toward the east and the axial planes are approximately vertical. The crest of a certain band in the south fold is lower than the corresponding crest in the north fold, showing that the dip of the major structure is about 35 degrees toward the south. It is believed that the outcrop lies near the trough of a synclinorium.

Field Relations. The iron formation is underlain by green chloritic schist, a highly altered volcanic rock of the Abitibi complex. It is unconformably overlain by a schisted series of sedimentary rocks, the conglomerate member of which is largely composed of pebbles of iron formation.

Origin. The iron formation of the Harricanaw district probably originated in the same manner as the lithologically identical iron formation which is found so extensively through the Lake Superior district. Following the view of Dr. C. K. Leith, the banded chert magnetite rock is regarded as a metamorphosed chemical sediment, and some or all of the materials which formed the original deposit were contributed directly to the water of deposition by magmatic waters emanating from the same magma which gave rise to the associated volcanic rocks.

STRUCTURE OF THE ABITIBI GROUP.

The widespread occurrence of schists in the Abitibi group, and th variety of once flat-lying rocks now encountered in passing in a horizont plane across the schistosity strike supply the evidence for the broad gene alization that the Abitibi group as a whole has been subjected to foldin and that these folds have been eroded to the present peneplain surfac Small, tight folds can be actually observed in a small cliff composed o banded mica schist, and small open folds in an outcrop of the bande iron formation.

The study of the bun structure in certain very slightly schisted ellipsoidal andesite outcrops indicates that these lavas are now standin practically on edge and it is presumed that they folded into larger an more open folds than did the less competent, stratified rocks, which ar to be observed as banded mica schists thrown into small tight folds.

The banded iron formation immediately underlies the Harricanaw series and hence its stratigraphical position is presumed to be at or nea the top of the Abitibi group. This being the case, and supposing that the iron formation was at one time widely distributed, one would expect, now the whole group has been folded and planated, that the remnants of the iron formation would be found only in the troughs of the synclines, or, if erosion had proceeded far enough, the remnants would be confined to the main troughs of synclinoria (major folds on which are superimposed minor folds). This latter supposition finds application in the Harricanaw-Turgeon basin. Considering the chert rock and the banded iron formation occurrences and the points at which strong local magnetic attraction were observed as all indicative of the position of banded iron formation, we find that the distribution is very limited, and that upon joining these points two linear courses are traced which may be considered as the approximate position of the main troughs of two synclinoria. One occurs to the north of Mistawak batholith and trends north 70 degrees east from the mouth of Patten river, the other trends south 84 degrees east from a point near the north end of Ninemile portage. It may be noted that lines projected along these synclinorial troughs tend to meet toward the west and diverge toward the east implying that the pitch of the main folds was toward the west. The amplitude of the main folds as measured across the middle of the map-area at right angles to the main axis of the great fold is 51 miles.

The sharp re-entrants along the southern contact of the Mistawak batholith are in contrast to the more even course of its northern contact. This suggests that the plane of contact between the granite and the Abitibi group plunges more steeply beneath the older rocks on the south margin of the batholith than on the north.

Faulting has undoubtedly played a part in the deformation of the Abitibi group, and faults with small lateral displacement have been observed in a number of outcrops. No large faults have been recognized in the district; but, since the area has not been studied in detail, it would be unsafe to say that faulting has played an insignificant role in the regional deformation.

AGE.

The Abitibi group constitutes the oldest division of the Pre-Cambrian rocks in the Harricanaw-Turgeon basin. The rocks in all the other divisions viz., Harricanaw series, granite batholiths, and post-batholithic intrusives, are known to be younger than those members of the Abitibi group which have been found at their contacts.

The ages of all of the various rock types which make up the Abitibi group, relative to each other, are not known, nor is it certain that all rocks of the same type are of the same age. Nevertheless, a study of the general field relations of the Abitibi group suggests the following general inference as to the relative age of its members. The oldest rocks are the basic and intermediate volcanic rocks together with the pyroclastic rocks of intermediate composition. No attempt can be made, in the present state of knowledge, to resolve this complex and it is presumed that it represents a number of successive volcanic ejections and outpourings which were not separated by any great time interval. The basic volcanics and the pyroclastic rocks have been altered to a greater extent by dynamic metamorphism than have the intermediate lavas, but since all appear to have taken part in orogenic disturbances the degree of metamorphism appears to be less of a criterion of age than a clue to the original strength or competence of these rocks.

The rhyolite and quartz porphyry extrusives together with associated acidic pyroclastic rocks are regarded as being the products of a later period of volcanic activity than that which gave rise to the basic and intermediate lavas. This conjecture is based on the fact that rhyolitic material is found as a kernel within the ellipsoids of the ellipsoidal andesite at a number of localities and since this material is regarded as a residual differentiate of the andesite it might be inferred that a similar process went on in the parent magma and that the later ejections from it would be of the acidic type. The relative scarcity of these rocks and their general arrangement in the field between the great granite batholiths suggests that their stratigraphic position is above the more basic volcanic members. The bedded deposits, banded iron formation, ferruginous dolomite, carbonaceous slate and chert are regarded as the youngest members in the Abitibi group, and on account of inferred genetic affinities and their association in the field they are supposed to be of approximately the same age. In one locality it is known that the iron formation immediately underlies the Harricanaw series.

HARRICANAW SERIES.

General Character and Distribution.

The Harricanaw series consists of folded and highly metamorphosed sedimentary rocks, the dominant member being conglomerate and the accompanying beds arkose and greywacke schists. The rocks were found in place in only one locality, a small hill 16 chains south of Authier river and about 10 miles northwest of lake Chikobi. The previously described clastic chert rock which occurs near the northern end of Ninemile portage may be related to the Harricanaw conglomerate, but no decisive field evidence was found to prove such a correlation. A small exposur sedimentary rocks is reported by Mr. J. A. Bancroft on Harricanaw ri a short distance above Allard portage[1].

There are several exposures on the small hill near Authier river wl is, for the most part, soil-covered. Folding has been so intense; howe that the geological interpretation as to thickness of beds, structure, even the succession is subject to revision. The section at this point is gi as follows:

Rock.	Thickness in feet.
Banded light and dark grey greywacke	25+
Conglomerate	40+
Limy greywacke schist	8±
Arkose	5±
Unconformity	
Banded iron formation	?

Arkose. The arkose was not seen in actual contact with the ir formation, but was separated from it by only a few feet of drift coverir It is a light grey, medium-grained clastic which has been slightly schiste Microscopic examination shows that it consists of rounded and subangul fragments of quartz crystals, together with orthoclase and albite, the si of grain being uniform; around these is an interstitial filling of very fin grained quartz, sericite, and calcite which has been partly recrystallize

Limy Greywacke. The schisted, limy greywacke is a fine-graine light grey schist which effervesces when treated with hydrochloric aci No banding was observed nor any indication of original stratification; i contact with the adjacent arkose below and the conglomerate abov seems to be transitional. Microscopic examination reveals nothing of th original character of the rock, since it has been thoroughly recrystallize to a drawn-out mass of sericite, quartz, and calcite.

Conglomerate. The conglomerate is a highly altered rock with sericitic schist matrix. The rounded and subangular pebbles range i size from 6 inches to one-eighth of an inch, and consist for the most part c chert and banded iron formation, other pebbles being of slightly schiste andesite, dacite, and quartz porphyry, and granite. The pebbles ar abundant but are not closely packed, except in a few small linear groups Their longer axes conform for the most part to the schistosity which i nearly the same as the indistinct bedding; but a few notable exception were found where the longer axis of the pebble stood at a considerable angl to the schistosity and the bedding. The stratification is suggested by the relatively closer packing of the pebbles along certain bands. The matrix consists of a fine-grained, schistose mass of mosaic quartz, sericite, calcite, and chlorite; pyrite in small amount occurs as a secondary mineral. The contact between the conglomerate and the banded argillite is sharp and apparently conformable. It strikes north 84 degrees west.

Banded Greywacke. The banded light and dark grey greywackes are highly folded, siliceous, limy rocks, in which the bedding appears to have the same strike as the schistosity; the dip could not be accurately determined but appears at the conglomerate contact to be approximately

[1]Personal communication.

vertical, whereas the schistosity dip is about 80 degrees to the south. In thin section, microscopic crenulations can be observed in the recrystallized, fine-grained material, which is largely composed of quartz and sericite, with a small amount of calcite and limonite.

Structure.

The Harricanaw sediments are believed to be a conformable series which overlies the iron formation of the Abitibi complex unconformably. They have been infolded with the rocks of the Abitibi complex, the whole showing minor folds superimposed on a major fold. From an analysis of the structural data obtained it appears that the rocks in the outcrop occur in a major synclinorium a short distance south of the main trough. The axes of the minor folds strike north 70 degrees west and pitch towards the west at a low angle. Faulting was observed in the outcrop, but the horizontal displacement was never greater than a foot.

Origin.

The Harricanaw sediments are believed to have been formed by the erosion of an adjacent land area of the Abitibi complex. The iron formation which is stratigraphically just below the sediments supplied a majority of the pebbles in the conglomerate. The pebbles are, for the most part, well rounded, as if they were waterworn through either wave or river action. The only feature noticeable in the conglomerate, which is not characteristic of normal waterlain conglomerate, is that the majority of the pebbles are not closely packed and contiguous but are separated by a fine-grained matrix. The sharp contact between the conglomerate and the overlying, fine-grained deposits shows that deposition of the conglomerate gave way suddenly to deeper water deposits, thus suggesting sudden subsidence. It might be mentioned that the banded sediments overlying the conglomerate have been intensely metamorphosed and resemble banded schists which occur elsewhere in the region and which have been previously described as altered stratified tuffs. The origin of these rocks has been given on the basis of their association and stratigraphic position in the field.

Age.

Harricanaw sediments are younger than the iron formation and other rocks of the Abitibi complex, which occur as pebbles in the conglomerate. These pebbles include greenstone volcanics and a granite which has not been recognized in place in the district. No members of the Abitibi complex are known to be younger than the Harricanaw sediments. Since the sediments are cut by large lenticular quartz veins such as are commonly found in intruded rocks near the granite contact and have been infolded with the Abitibi complex and since the folding is supposed to have taken place at or before the time of the great batholithic intrusions of granite, it is concluded that the sediments are older than the granitic batholiths. Thus their age is given as being between that of the Abitibi complex and the granitic batholiths.

GRANITE AND GNEISS.

Distribution.

Approximately one-half of the mapped area in the Harricanaw-Turge basin is underlain by granite and gneiss. A large area extends entir across the central part of the sheet in an east-west direction, with an avera width of about 20 miles. This, for convenience of reference, is called t Mistawak batholith. South of this are the Abitibi batholith, the Roberts Lake batholith, and the Davy River batholith of considerable dimensio and numerous small intrusions. To the north of the Mistawak batholi there are several small granitic outcrops, and one rather large mass on t lower Turgeon river at the junctions of the Theo and Wawagosik rive the northern boundary of which is not known.

Lithological Character.

The granitic rocks found in the batholiths of the district vary conside ably in texture and composition, especially at the margins of the batholit and in the smaller intrusions. The granite in the central parts of the larg batholith is typically coarse-grained with pink and white feldspars, bioti a little hornblende, and quartz. A gneissoid structure is rarely we developed except near the batholith margin. The typical granite is coarse-grained, even textured rock consisting of quartz, orthoclase, albit and biotite with small amounts of hornblende. The plagioclase is occ sionally zonally banded, the core being albite-oligoclase and the outer laye albite. The central part of such crystals is usually partly decomposed t a mass of sericite, calcite, and epidote; the other feldspars are not so muc altered. The biotite crystals sometimes contain fine needles of ruti regularly oriented in three directions parallel to the edges of the bas pinacoid; zircon inclusions surrounded by pleochroic haloes were als observed. Apatite and magnetite occur as accessory minerals.

Many of the granite outcrops show a complex of different rocks whic vary in texture composition, and foliation. Thus, on the hill to the eas of Pajegasque river, 8 miles above its mouth, a medium-grained, pin biotite gneiss is cut by a coarse, grey biotite gneiss of more basic compos tion, and also by pink aplite dykes.

Near the contact with the older rocks a great variety of granitic type is encountered. For example, the granite on Harricanaw river 5 mile above the confluence of Octave river is a dark biotite gneiss with a porphy ritic development of pink and white feldspar and allanite crystals. On th northwest shore of Otter lake a coarse, fresh-looking hornblende granit occurs near an acidic biotite granite which in places contains phenocryst of biotite and nearby becomes finer-grained but with phenocrysts of feld spar. In the biotite granite, rounded inclusions less than 2 feet in diamete were found, composed of a fine-grained biotite granite-porphyry with wel developed phenocrysts of bluish-quartz a half-inch in diameter. In th northeast corner of Languedoc township, pink hornblende syenite of variou textures occurs along with very coarse-grained pegmatites, in some of which the feldspar crystals have a diameter of over 1 foot.

A hornblende syenite-porphyry occurs at the headwaters of the north fork of Authier river, and abundant hornblende phenocrysts averaging one-quarter inch in diameter are embedded in a fine-grained matrix of hornblende and pink feldspar. The rock at the western contact of the batholith on lower Turgeon river is a very coarse-grained hornblende granite, whereas near the contact farther east there is a fine-grained biotite gneiss.

Microscopic examination of these granites which occur near the greenstone contact shows that they differ from the normal type in that microcline is the most abundant feldspar present. These rocks range from granites to granodiorites and syenites. There are other much more basic phases, but all these appeared to be partly assimilated blocks of greenstone which had been engulfed by the granite. In general, it might be pointed out that the granitic rocks which occur near the margins of the batholiths have a greater range in composition than those occupying the central parts, and that in the more basic varieties there is a tendency toward a porphyritic texture which occasionally becomes strongly developed. The phenocrysts may be either quartz, feldspar, hornblende, or biotite.

Structure.

The granite and gneiss areas are believed to be truncated batholiths, their upper parts and the overlying rocks having been removed by erosion. The size and abundance of the granite intrusions and the occurrence of granite and pegmatite dykes between these suggest that the whole region may be underlain by an enormous granite mass, of which the outcrops at the surface represent only the higher prominences.

The granitic rocks have not been foliated by metamorphic agencies. In places where a gneissoid structure is developed, this appears to be due to movements in the magma which arranged the minerals in lines, but these minerals do not show a parallel orientation of their longer axes.

The batholiths evidently intruded into their present position, at least partly, by a process of stoping; the overlying greenstones having been shattered by differential heating or other means and engulfed and assimilated by the magma. All stages in this process can be traced in the present contact zones.

That the granitic batholiths also forced their way through the older rocks and compressed them into folds is shown by the contact phenomena on the east shore of Wawagosik lake. Here, the strike of the schist is parallel to the line of contact with the granite; and dykes of granite are infolded with the hornblende schists and are cut by uncontorted dykes of similar granite arising from the same intrusive; i. e. there is an intimate relation in time between the intrusion of granite and folding of the Abitibi volcanics.

Contact Metamorphism.

At all points where the relationship could be studied, the granite or gneiss was found to be intrusive into the rocks of the Abitibi complex; the greenstones near the contact are intruded by abundant dykes of granite, aplite, and pegmatite and are characteristically altered to black, glistening amphibolites and hornblende schists and less frequently to sericite and chlorite schists. The schistosity, when present, usually parallels the line of contact. In some cases no definite line of contact can be drawn, since the granite permeates a shatter zone of greenstone blocks, which may be either polygonal or plate-like (Plates VII and VIII). Greenstone fragments in the granite mass are always hornblendic rocks; they decrease in number toward the interior of the granite. Usually the included basic fragments have sharp boundaries, but several cases were observed where the block was either drawn out or rounded and passed transitionally into the granite by an increase of quartz and feldspar; in fact there are sometimes bands and irregular areas of hornblende-rich granite in the more acid granite which may represent assimilated fragments. It is in such localities where evidences of greenstone assimilation are found, that the surrounding granitic rock is characterized by variations in composition and a tendency toward a porphyritic texture. In other places, as at the contact of the Mistawak batholith in the eastern part of the sheet, the granite shows few inclusions and is neither fine-grained nor porphyritic.

In some localities the greenstone schists have been intruded by numerous dykes of pegmatite, aplite, and granite, which either parallel the schistosity, or may cut across it at various angles. In these dykes and in the adjoining hornblende schists certain minerals are found which are not met under other conditions, and it is in such localities that mineral deposits of the Kienawisik type may be expected. The minerals referred to are molybdenite, garnet, vesuvianite, tourmaline, and allanite. The greenstones are sometimes only altered for a few inches away from the granite contact, but usually the metamorphic effects extend back a considerable distance and are especially pronounced in the neighbourhood of pegmatite veins. The alteration product of the greenstone is remarkably similar in nearly all cases, being a medium or fine-grained hornblende schist or amphibolite which has been silicified and mineralized with pyrite.

On the north slope of Oditan hill a "red rock" lens is enclosed by granite dykes. This rock is a fine-grained syenite porphyry composed almost entirely of pink orthoclase and microcline phenocrysts in a matrix of the same mineral with small crystals of green hornblende scattered through it; this rock is presumably the product of interaction of granite on greenstone.

Origin.

The granite and gneiss of the Harricanaw-Turgeon basin are believed to represent immense, deep-seated batholiths which intruded into the Abitibi complex after the deposition of the Harricanaw sediments, as an accompaniment of folding and faulting on a large scale. Differences in composition found in the main mass of the granites, certain gneisses, and the pegmatite, aplite, and granite dykes, are believed to have originated through a process of differentiation by crystallization, whereas certain other local variations near the contact, characterized by abundant ferromagnesian minerals and sometimes also by a porphyritic texture, originated by the recrystallization and partial assimilation of blocks of older rock which were broken loose and engulfed by the magma at the contact.

Age Relations.

The granite and gneiss of this region occur to the north and west of an immense complex of similar acid plutonics, which extends along the whole of the southern part of the Laurentian plateau from the gulf of St. Lawrence to Georgian bay. Since these rocks constitute the bulk of the Laurentide plateau the name Laurentian was given to them by Sir William Logan in 1853. But the recognition of two granites of different ages in the Lake Superior region suggests the possibility that elsewhere the granites may be a complex of batholiths of different ages, and consequently it is considered advisable to drop the term Laurentian in this district, since the granites are not known to be of the age to which this name has been assigned in recent classifications, i.e., younger than the volcanic greenstones and older than the pre-Huronian sediments. In the Harricanaw-Turgeon basin there is a granite older than the Abitibi pyroclastics and the Harricanaw conglomerate, pebbles of it being found in these rocks; but no masses of it being recognized in place. The large granitic batholiths of the region are younger than any of the rocks of the Abitibi complex with which they come in contact, and are probably also younger than the Harricanaw sediments, but they are older than the diabase which is believed to be Keweenawan in age. Their age relative to Huronian sediments is unknown since these rocks do not occur in the region.

POST-BATHOLITHIC INTRUSIVES.

LAMPROPHYRE.

On the east shore of Rest lake, 32 chains north of the outlet, an 8-foot dyke of biotite lamprophyre cuts the Abitibi quartz porphyry schist. The rock is black and massive with abundant small biotite crystals visible in a dull black matrix. Small quartz veins occur near the contact between the dyke and schist and cut both rocks. One of these veins carries small crystals of galena. Microscopic examination shows the dyke rock to be a minette. It is porphyritic, with dominant phenocrysts of brown biotite in a matrix of fine-grained biotite and mosaic quartz, together with small amounts of plagioclase, orthoclase, sericite, pyrite, and iron oxide. The biotite phenocrysts show numerous bands of secondary penninite parallel to the cleavage; and where this mineral has formed the crystals are slightly twisted and contorted. Alteration of the feldspar has given rise to calcite.

The minette has not suffered dynamic metamorphism as has the surrounding quartz porphyry; the biotite shows no trace of a parallel arrangement as in a schist and the deformation of the crystals is due to chemical alterations within the rock itself.

Age.

If the schisting of the rocks of this region occurred at the time of the granitic intrusions it is probable that this rock is younger than the granite batholiths.

Minette was found only in this one outcrop in the Harricanaw-Turgeon basin, but two other occurrences are recorded 33 and 41 miles, respectively, south from this occurrence, on lakes Dufresnoy and Dufault.[1] Mr. Wilson includes these dyke rocks in the Abitibi group.

[1] Geol. Surv., Can., Mem. 39, p. 49.

KEWEENAWAN (?) DIABASE.

Distribution.

The youngest consolidated rocks observed in the Harricanaw-Turgeon basin are diabase dykes. An outcrop on Rifted hill and the two exposures west of Beauchamp lake are of olivine diabase; the other seventeen observed outcrops are either normal diabase or quartz diabase. A majority of the dykes are less than 100 feet in width, though the one cutting Rifted hill is over 600 feet and the exposure on Plug hills is of even greater extent. The lengths of these dykes could not be determined on account of the abundant drift covering.

Lithological Character.

The diabase is always fresh-looking and massive. A considerable range in both texture and composition is found, due to the different conditions under which the rock solidified and to magmatic differentiation. In the smaller dykes and along the chilled edges of the larger masses the rock is black and aphanitic, but elsewhere it is green or rusty brown and either medium or coarse-grained, with a distinct ophitic structure. In the narrow dykes which occur on lot 51, range II, La Reine township, on the right bank of Turgeon river one mile above the junction of Garneau river, and on the right bank of Turgeon river 3 miles below the junction of Détour river, a remarkable porphyritic texture was observed, phenocrysts of pale green plagioclase (labradorite) over half an inch in diameter being embedded in a black matrix of fine-grained diabase. In the last mentioned occurrence the phenocrysts are in greatest abundance near the central part of the dyke and do not occur in the marginal zones for a distance of 3 or 4 inches from the contact.

A thin section of the coarse quartz diabase from Oditan hill was found to consist of abundant laths of labradorite, augite, and a micrographic intergrowth of quartz and feldspar; accessory minerals are orthoclase, brown biotite, magnetite, and apatite. The rock is quite fresh-looking, though some of the feldspar crystals are clouded by incipient alteration. The micrographic intergrowth of quartz and feldspar was not observed in slides of finer-grained quartz diabase, though in all other particulars these thin sections conform to the above description.

Some of the olivine-free diabase appears to be lithologically similar to the quartz diabase, but quartz is either lacking or so scant that it can only be regarded as an accessory mineral.

The olivine diabase which occurs on the summit of Rifted hill is a medium-grained, greyish green rock locally characterized by nodular prominences on the weathered surface. The nodules appear to be of the same texture as the rest of the rock, but contain a greater number of plagioclase crystals. Microscopic examination of this rock shows that the first essential mineral to crystallize was olivine, this being followed by plagioclase, augite, and hypersthene successively. The olivine is in irregular and roughly six-sided crystals, and is only slightly altered along its boundaries and fracture lines to magnetite and serpentine. It is not uniformly distributed, but is abundant in certain small areas. The laths of labradorite are fresh and unaltered and terminate abruptly at the margins of the olivine crystals. Augite and hypersthene fill the interspaces between the other crystals. Accessory minerals are apatite, ilmenite, and magnetite.

A pink aplitic phase of the normal diabase, representing an acid differentiation product, was found in tiny dykes and indefinite stringers through the diabase on lot 55, range VIII, Languedoc township. It is medium to fine-grained and is composed of pink feldspar, black hornblende, and green epidote, rod-like crystals of which are seen in the hand specimen. A thin section was seen to consist of a micropegmatitic intergrowth of quartz and orthoclase, and orthoclase and plagioclase, through which run lath-like crystals of green hornblende and fibrous bunches of epidote.

An aplite of somewhat different type occurs as dykes in the diabase of Plug hills. It has the appearance of a coarse-grained granite, consisting of quartz, white feldspar, hornblende, and a percentage of calcite, which varies considerably from place to place, as does also the quartz.

Structure.

All but one of the diabase outcrops appear to be dykes cutting either the rocks of the Abitibi complex, the Harricanaw sediments, or the granites. In the case of the diabase forming Plug hills, the entire range of hills is composed of diabase and rises as somewhat conical masses for 200 feet above the muskeg plain with no known linear continuity, so it is assumed that they are eroded and glaciated volcanic necks. The trend of the dykes differs in different parts of the region and no general parallelism is to be observed. Where the diabase intrudes foliated rocks it sometimes follows the schistosity and sometimes cuts across it. The dykes, so far as could be observed, were always nearly vertical.

Metamorphism.

The diabase, as seen in the field, appears fresh and unaltered. That found at the contact with the older rocks is fine-grained, dense, and black, but so far as known its composition is not greatly different from that of the mass as a whole. The contact effects on the intruded rocks are usually slight or in the case of intruded granite nil. The greenstone in contact with the diabase on lot 55, range VIII, Languedoc township, is altered to a dense, fine-grained, black amphibolite for about an inch bordering the contact; farther away it passes gradually into normal hornblende schist.

Origin.

The numerous small dykes of diabase of similar composition and age scattered through this and the adjoining regions suggests that these were only the uppermost tongues from some huge deep-seated magma of basic composition.

Age.

The diabase dykes are younger than any of the other consolidated rocks found in this region, so they are post-batholithic. However, their lithologic similarity to the Keweenawan diabase of lake Superior and the abundant occurrence at numerous intervening points, of rocks of the same type, allows one to give their age as Keweenawan with some degree of confidence. No evidence was found in this region whereby the olivine diabase could be distinguished in age from the other types, but in the Montreal River district where similar rocks were observed the olivine diabase is younger than the quartz diabase.[1]

PLEISTOCENE AND RECENT.

GLACIAL.

During the period of continental glaciation in Pleistocene time, an extensive covering of boulders, gravel, sand, and boulder clay was deposited irregularly on the smoothed but uneven floor of Pre-Cambrian rocks. The evidences of glaciation are plainly visible in the rocky parts of the district. The hills, viewed from a distance, are smoothly rounded. The higher prominences are much steeper and rougher on their south sides than on their northern slopes. Polished rock surfaces and glacial grooves and striæ are well preserved on all the harder rocks. Pot-holes were found several feet above the present high water-level on the right bank of Turgeon river 14 miles below the junction with Détour river.

Three sets of glacial striæ were found in the district. Striæ trending south 80 degrees east were observed on rock outcrops on Harricanaw and Turgeon rivers near their junction, and at Pavement camp on Harricanaw river 10 miles below its junction with Plamondon river. In the last mentioned locality the striæ are found on a boulder clay in which the heterogeneous pebbles and boulders have been pressed into contiguous positions and evenly planated (Plate IIIB). Striæ, trending south 30 degrees east, occur abundantly in all parts of the district. In some previously mentioned outcrops these striæ are found to be later than those trending south 80 degrees east. The ice advance from north 30 degrees west appears to be the one which has had the greatest effect on the minor topographic features of the district. Glacial striæ trending almost due south were found on the western shore of Obalski lake and on Makamik lake; in both localities they cross the older striæ trending south 30 degrees east.

Boulder Clay.

On account of the thick growth of moss which covers practically all of the district, the distribution of the various types of drift deposits cannot be determined. The greater part of the drift in the region is believed to be boulder clay, though only a few outcrops were observed which possess all the normal characteristics of deposits of this nature. The boulder clay around Beauchamp lake is of the same type as that which occurs so abundantly in southwestern Ontario. Boulders and pebbles of granite and greenstones, ranging in diameter from several yards down to a fraction of an inch, are irregularly scattered through a matrix of blue clay (Plate IVA). A boulder clay of similar character occurs on Wawagosik river 10 miles below its junction with Ménard river. It deserves mention because it contains several rounded and

[1] Collins, W. H., Geol. Surv., Can., Sum. Rept., 1910, p. 199.

subangular blocks of fossiliferous limestone, some of which exceed 2 feet in diameter. Fossils from these boulders were submitted to Dr. Kindle who reported as follows. "The fossils present in the collection are referred to the following species:

Stromatopora sp.
Favosites cf. *niagarensis*.
Diamesopora sp.
Camarotoechia cf. *whitii*.
Pentamerus cf. *oblongus*.

These fossils represent a horizon of Silurian age."

This occurrence suggests that an outlier of Silurian limestone may be found within the sheet in a northwesterly direction from this point. The outcrop of boulder clay at Pavement camp on Harricanaw river, 9 miles below its junction with Plamondon river, is remarkable in that it shows evidence of having been overridden by an ice-sheet. Pebbles and boulders of various granites, gneisses, and greenstones are closely packed and evenly planated; blue clay occupies the small interstitial spaces. In a gravel pit in lot 11, range VII, La Sarre township, boulder clay 5 feet in thickness was found overlying stratified lake clays, the contact being irregular. The stratified clays unconformably overlie a kame-like deposit of stratified sand and gravel. This exposure is of particular interest since it indicates the variety of conditions which obtained at this point during successive stages in the Ice Age.

In the central and northern parts of the sheet the drift is chiefly unstratified blue clay, through which boulders are sparsely and irregularly scattered. This type of boulder clay is such as would be formed by the ploughing up and reworking, by an overriding glacier, of deposits like the stratified lake clays which occur to the south. Particularly good exposures of this material were seen on the west shore of Mistawak lake.

A boulder clay which is believed to be of a different origin from the normal type is abundantly exposed on cliff faces on Turgeon river between the junction of Ninemile portage and Burntbush river and on the Partridge and Wawagosik rivers above their junction. A matrix of blue clay contains abundant pebbles, the majority of which are less than 1 inch in diameter; about half are rounded and half angular. A suggestion of sizing was found in the various horizons of each exposure, explaining the appearance of stratification when viewing the deposit from a distance. Close examination, however, shows no distinct bedding and occasional large boulders are found in various horizons all through the deposits. The pebbles are, for the most part, separated from each other by clay, and those which are flat or elongated have their longer axes inclined at various angles and not horizontal. This type of boulder clay is believed to have been deposited in water from melting ice blocks which rafted the glacial debris from the ice front.

Moraines.

A large moraine occurs near the north boundary of the sheet extending along Turgeon river from its junction with Harricanaw river, approximately south 80 degrees west, to Grand Bend, a distance of 22 miles. Harricanaw river has cut through this moraine; and the large boulders, which could not be transported, are prominently exposed in the river valley in the vicinity of Tanbell rapid (Plate IIA). This obstruction is believed to have caused the sudden change in direction of Turgeon river whose course, for the 28 miles before the moraine at Grand Bend is reached is north. The moraine consists of huge, rounded and angular boulders and gravel with varying amounts of clay and sand; it forms a broad irregular ridge standing 20 or 30 feet above low water-level. Numerous small moraines were encountered on all the streams of the district. Many of these are overlain by clay deposits and the boulder and gravel belts stand out like natural dams where the streams have cut down to them.

Fluvioglacial Deposits.

Kames and eskers are numerous in a belt 10 miles wide, extending from Desmeloizes township to Béarn, with southerly extensions in western La Sarre and in Trecesson townships. These deposits have been used as gravel pits by the railway builders in La Sarre and Trecesson townships. An extensive outwash plain of sand and gravel extends from Desmeloizes to Béarn township; two extensions from this project to the northeast for several miles, one from Chikobi lake, the other from the headwaters of Authier river. This deposit is characterized by a plain-like surface pitted with numerous kettle holes, many of which contain clear-water ponds. In the southwestern part of Berry township, the sand is fine-grained and free from boulders. Here, shifting dunes are found where a forest fire has removed the vegetation and exposed the surface to the wind. The dunes are now encroaching on the green jack pine forest and several dead trunks are to be seen projecting through the sand mounds.

Lacustrine Deposits.

Exposures of stratified clay were found on the banks of Turgeon river near its junction with Détour and Garneau rivers. No other lacustrine deposit was found north of Concretion creek. Stratified sands and clays were observed at numerous localities along the line of the railway, on lakes Makamik, Chikobi, and Obalski, and also on Authier and Octave rivers and Concretion creek. All of the outcrops east from Makamik lake were small and could not be traced laterally for any considerable distance. In fact, the lack of continuity of the stratified clay deposits in areas which show no sign of intense subsequent erosion, and the variability in thickness of these deposits strongly suggest that they were not all laid down at the same time in one huge lake, but began in a number of lakes more or less completely separated from each other by the still unmelted remnants of the glacier which probably coalesced as melting proceeded. The lake clay of the adjoining districts has been named Ojibway clay, following the conception that this deposit was laid down in a huge glacial lake, which has been named Ojibway[1]. The lacustrine deposits of the Harricanaw region consist of interbanded silt and clay in beds ranging from one-third of an inch to one inch in thickness, the thicker beds being characteristic of the more silty varieties. The colour is either pale grey or banded light and dark grey. An occasional boulder

[1]Ann. Rept. Ont. Bureau of Mines, 1909, pt. 1, p. 284.

of granite or greenstone can be found in these deposits. Limy concretions of fantastic shapes occur in all the stratified clay deposits in the region, except the occurrence on the lower Turgeon river. The concretions are often broad and flat, conforming to the stratification, and either discoidal or irregular in outline. The projections on the irregular varieties and the growth lines frequently show a bilateral symmetry. Rosette and ring-shaped forms were also found. A number of linear markings occur irregularly or in radiating groups on the concretions of Concretion creek (Plate IX).

A small, chitinous sponge spicule was found in a sample of the stratified clay from Concretion creek which was examined under the microscope. Lacustrine sand deposits are intimately associated with the stratified clay on Obalski lake and Octave river. The deposits consist of alternate layers of silt and fine sand ranging in thickness from 1 inch to 2 inches. They overlie the clay conformably in both occurrences. In all the lacustrine deposits which were examined the beds appeared to be slightly warped. This may be due to the irregularities of the surface upon which they were deposited.

RECENT.

The solid rocks of the district have been only slightly eroded since Glacial time. The most marked effect was seen on certain soft, micaceous schists where about one inch of the rock has been eroded around the upstanding ridges of quartz veins whose edges show glacial polish (Plate VA). On the more resistant rocks and all those which have been protected from weathering until recently, by the soil, the glacial markings are still preserved. The streams have cut through 40 feet of drift in some places, but usually the erosion valley is much less. It is only where prominences in the rock floor are encountered that the streams have cut through to bedrock. River deposits have built the banks of many stretches of the various streams higher than the country inland. These deposits are formed during the spring floods when the waters overflow their banks and drop part of their load among the marginal bushes and trees.

CHAPTER V.

ECONOMIC GEOLOGY.

GENERAL STATEMENT.

Very little prospecting has been done in the Harricanaw-Turgeon basin except along the line of the National Transcontinental railway, and [illegible] river.

Until recently, prospectors found no incentive for working in the region on account of the difficulties of access and the knowledge that it lay in the clay belt. At the present time, however, the railway simplifies transportation, and the geological knowledge recently gained is expected to be of interest to [illegible] prospectors. The large interstream area in the northern half of the sheet is, indeed, a very unalluring field, since it is almost entirely occupied by muskeg; but, even in this northern area many outcrops of the green schist complex, which have not been prospected occur along the rivers, and no attempt has been made to follow them inland. The southern half of the sheet is much more promising. Between the railway and the Mistawak batholith the greater part of the rock floor is composed of the schist complex, and numerous bare hills supply a field for the prospector which he might not have anticipated from a knowledge of the district as seen from the canoe routes.

There are no producing mines and only a few mining claims in the map-area at present, but the fact that gold, silver, chalcopyrite, and galena are known to occur, warrants the expectation that prospecting will reveal other deposits, possibly of commercial importance.

GOLD.

Gold has been found in quartz veins of two different types: (1) pegmatitic quartz veins which cut the Abitibi volcanics near the granite contact and are apparently connected with the batholithic granitic intrusives, and (2) quartz veins in a ferruginous dolomite associated with quartz porphyry.

In the veins of the first type no gold was observed in the field but a few sulphide-bearing veins showed a small gold content upon assay. Of these, the quartz veins from the south side of Main peninsula, Chiboki lake, showed a trace of gold; the vein from the upper end of the 66-chain portage on Harricanaw river returned a heavy trace; and the copper-bearing vein on the Tremblay property, 3 miles northeast of Amos, gave a gold value of $1.48 per ton. In the last mentioned occurrence the vein is found in schisted, rhyolite tuff, and in the other cases the veins cut altered andesites—in each case, the granite contact being nearby.

The geological relationships at these occurrences are probably equivalent to those which obtain in the gold deposits around De Montigny (Kienawisik) lake, near the headwaters of Harricanaw river[1].

[1]Bancroft, J. A., "Mining operations in the province of Quebec," 1912, p. 199.

The topographic conditions in the Harricanaw-Turgeon basin are particularly favourable to the prospector in search of gold deposits of the Kienawisik type. Numerous bare hills rise from the drift-covered plain in the interstream areas in the southern half of the sheet. A majority of these hills are composed either of granite near the greenstone contact, or of greenstone near the granite contact. Pegmatitic quartz veins are abundant in the marginal zone of the intruded greenstone—a striking example of this being seen on the hills to the south and west of Chiboki lake.

On the west bank of Harricanaw river, 14 miles in a straight line below Allard portage, a rusty-weathering, grey, ferruginous dolomite was found to carry fine gold and abundant fine crystals of pyrite. The whole exposure is cut by a meshwork of tiny quartz veins. A sample of this rock assayed 3·86 ounces of gold to the ton, and smaller samples of the same rock which did not include the quartz veinlets yielded 0·10, 0·10 and a trace, respectively, per ton. Chemical tests of this material revealed the presence of tellurium.

The ferruginous dolomite is an unschisted, finely crystalline rock which appears to pass gradationally on the northern part of the outcrop, into a massive quartz porphyry. The latter rock shows numerous phenocrysts of colourless quartz about 1 mm. in diameter, together with a few feldspar crystals of similar dimensions scattered through a pale grey, translucent matrix which somewhat resembles chert. A few tiny grains of a substance which had the appearance of gold were seen in the matrix of this rock, but no gold was found when the rock was assayed. The gold in the ferruginous dolomite is believed to have been derived from the magma which gave rise to the quartz porphyry.

The outcrop, at the time of the writer's visit, extended 68 feet along the river bank and sloped back for a height of 5 feet, above which it was drift-covered. The trend is probably north 52 degrees west, or approximately the same as that of the river. No extension of the ferruginous dolomite was found upstream, the Mistawak granitic batholith coming in at from 2 to 5 miles above the gold occurrence in a drift-covered section.

On the south shore of Chikobi lake, 20 chains west of the extreme east end, a large boulder was found composed of pale grey, silicified, ferruginous dolomite, through which were scattered numerous small scales of bright green mica, probably fuchsite. The rock was cut by numerous intersecting veinlets of quartz. The surface of the boulder was entirely coated with rust. Glacial striæ near this point trend south 35 degrees east. A sample of this rock assayed a trace of gold.

The ferruginous dolomite in this region is lithologically similar to the rock in which gold occurs in the Larder Lake district, and its association with quartz porphyry indicates that the geological relationships are similar in both localities. Regarding the origin of the gold, Mr. Wilson[1] says: "In the Larder Lake district and vicinity, gold was found in quartz veinlets in aplite on the Gold King claim, and in quartz porphyry on the property of the Pontiac and Abitibi Mining Company to the northeast of lake Opasatika. Gold telluride has been found associated with the gold in the latter. It is, therefore, possible that the gold in these stockwork deposits of the Larder Lake district is genetically related to

[1]Geol. Surv., Can., Mem. 17E, 1912, p. 52.

these intrusives and since such intrusions are commonly derived from more deep-seated granite masses, the gold may be indirectly related to the granitic rocks of the region."

On account of the widespread drift covering in the map-area and the fact that the ferruginous dolomite and quartz porphyry are not characteristically found on the high hills, the prospector in search of gold deposits of the Larder Lake type is seriously hampered. In addition to the previously mentioned locality, small outcrops of ferruginous dolomite were found on Authier river, 10 miles northwest from Chikobi lake; on the northeast shore of Rest lake; and on the west shore of McKenzie lake. Quartz porphyry, lithologically similar to that which occurs on Harricanaw river 14 and 19 miles below Allard portage, was observed on Harricanaw river 3 and 5 miles, respectively, above the junction with Turgeon river; on Burntbush river 1 and 7 miles above its mouth; on the southern part of the east shore of Rest lake; and 2 miles south of the east end of Chikobi lake. No gold was found in any of these outcrops.

SILVER.

Silver is not known to occur in economic quantity in this or any neighbouring region, but traces of silver have been found, by assaying, in pegmatites and quartz veins, which cut the rocks of the Abitibi group near their contact with granite masses.

A pegmatite quartz vein in lots 7 and 8, range VIII, La Reine township, cuts the green schists near their contact with the Abitibi granitic batholith. The mineral association includes galena, sphalerite, pyrite, and fluorite. An assay of this material yielded: silver 2·02 ounces per ton; gold 0; lead 0·46 per cent. This vein is on the property of Mr. Joseph Ferland and gold values are reported by him in other assays.

Traces of silver were found in the assays of the sulphide-bearing pegmatitic quartz veins which occur near the middle of the southern shore of Main peninsula in lake Chikobi; at the upper end of the 66-chain portage on Harricanaw river; and in the Tremblay vein 3 miles northeast from Amos.

Quartz diabase occurs at several widely separated localities as dykes, and at Plug hills, 9 miles south of the Harricanaw-Turgeon junction—probably in the form of volcanic necks. This rock is lithologically similar to that which is believed to be the source of the silver at Cobalt. No sign of mineralization was observed in any of the outcrops in this district, though the presence of calcite veins and aplite dykelets was noted on Plug hills.

COPPER.

Chalcopyrite was observed in four localities, and, in one of these, the quantity of ore was sufficient to make it of commercial value.

On the right bank of Patten river, 3 miles above its mouth, a dyke of fresh-looking porphyry, about 10 feet wide, intrudes ellipsoidal andesite. The dyke rock is of intermediate composition; the phenocrysts are of white plagioclase, and the matrix is of pale green, finely crystalline material. Quartz-calcite stringers with a maximum width of 2 inches occur in the intruded rock, striking east and west and dipping 30 degrees to the north, parallel to the dyke. The veins carry fibrous green hornblende, pyrite, and a small amount of chalcopyrite. An assay of the vein yielded 0·60 per cent copper and a trace of gold. On lot 54, range VIII, Languedoc township, several pegmatite dykes intrude the Abitibi green schists. At the edge of one of these dykes a small amount of calcite was found carrying a few grains of chalcopyrite. A small amount of chalcopyrite was observed in the ellipsoidal andesite on a projecting point on the east shore of Obalski lake, 1 mile northeast from the inlet. None of these occurrences appear to have any commercial significance.

Tremblay Claim.

In August, 1915, Mr. Joseph Tremblay discovered chalcopyrite on lot 42, range II, Dalquier township, 3 miles northeast of the village of Amos. The writer visited the claim in September of that year. This part of the district is chiefly muskeg with occasional rock hills or ridges, burnt bare, rising above the general level. The claim embraces one of these ridges, the trend of which is north 65 degrees west, and the copper deposit occurs on its southern slope. The rock composing the ridge is a pale grey sericite schist, in places finely banded with darker grey, micaceous and also siliceous phases. Occasionally the appearance of an original clastic structure can be seen in the rock, though fragmental and interfragmental materials seem to be of the same composition. The rock is believed to be a schisted rhyolite tuff, and possibly also schisted rhyolite, of the Abitibi group. In the neighbourhood of the deposit the schistosity strike of the rock is north 65 degrees west; the dip approximates 90 degrees, but fluctuates from north to south, indicating deformation since foliation was developed. A thin section of the schist was found to consist of abundant quartz and sericite and smaller amounts of orthoclase, albite, chlorite, a carbonate (probably dolomite), and pyrite. The quartz occurs as small phenocrysts, and around such crystals a mosaic of tiny quartz grains either radiates or tails off in the direction of schistosity. Some of the small orthoclase and albite crystals are angular. The greater part of the rock is composed of an extremely fine-grained mass of quartz and sericite, the latter occurring in radiating fibres and parallel plates. Certain areas are marked off by more abundant sericite around their borders; this is the only indication, observed under the microscope, of a clastic structure.

On the south side of the ridge three small, irregular, lenticular veins occur close together, all striking north 63 degrees west, and each offset to the south by a few inches, from the continuation of the neighbouring vein on the east. The total length of the three veins is 20 feet and their maximum width is 2 feet. In the 8-foot pit which had been sunk, the veins were found to pinch out at a depth of 4 feet, but another vein of similar shape and dimensions to those at the surface was observed coming in on the south side of the pit at a depth of 3 feet, and pitching toward the north at a high angle. Running part of the distance across the west wall of the pit a small fault plane filled with gouge was seen in a horizontal position; the deformation in the schist indicates that the rock below the fault plane moved relatively south a short distance. The veins and the adjacent schist carry abundant chalcopyrite. The mineralized zone has a maximum width of 8 feet and pinches out at the ends of the veins, giving a total length of 20 feet. The gangue material in the veins is chiefly quartz, though calcite is locally more abundant. Malachite, chrysocola, and limonite occur in the deposit along solution channels. An average sample taken across the greatest width of the mineralized zone yielded the following values when assayed: gold, 0·02 ounce per ton; silver, trace; copper, 12·05 per cent.

Two small quartz stringers were found about 100 yards east of the deposit striking parallel to the copper-bearing veins. Both are rich in pyrite and in one of them a little chalcopyrite was observed. Several other quartz veins cut the sericite schists on this property, but no metallic mineral was discovered in connexion with them. One of these barren veins, which lies 2 chains west of post No. 1, is 1½ feet wide and trends south 20 degrees west. The foliation in the rock was found to bend south on the west side of the vein, whereas that close to the east side bent north. This indicates that the vein formed in a fault plane and that the faulting took place after foliation had been developed in the rock. This vein is evidently later in age than the veins carrying the mineral deposit. Regarding the age of the copper deposit, it might be said that the vein material was deposited between the time the original rhyolitic rock was altered by intense dynamic metamorphism into a sericite schist, and a later time when this schist was subjected to a less intense dynamic action which resulted in further folding and faulting. The geological relationships in this region suggest that the copper was derived from an underlying body of granite probably related to the Davy River batholith which outcrops 4 miles to the west.

LEAD.

No deposits of lead ore of commercial importance are known to occur in the Harricanaw-Turgeon basin. Galena, however, was found in quartz veins associated with two different intrusives.

On the property of Mr. Ferland, lots 7 and 8, range VIII, La Reine township, a pegmatite vein occurs near the contact of the granite and Abitibi greenstone. In the vein, galena is associated with sphalerite, pyrite, and fluorite. The vein material assays 0·46 per cent lead and 2·02 ounces of silver to the ton. In this case the source of the lead is evidently the Abitibi Lake granite batholith. Analogous occurrences of galena are reported from pegmatite veins in the Upper Harricanaw region.

On the east shore of Rest lake, 32 chains north from the outlet, a minette dyke 8 feet wide cuts the Abitibi schist. Small quartz veins occur in this dyke, and in one of them a few crystals of galena were found. The dyke is composed of massive, black rock in which abundant biotite crystals occur porphyritically in a black, fine-grained matrix. A thin section was found to consist of abundant phenocrysts of brown biotite through which secondary penninite bands occur parallel to the cleavage; the matrix consists of fine-grained biotite, quartz, feldspar, and iron oxide; secondary calcite is present in considerable amount.

This rock was not observed in any other locality in the Harricanaw-Turgeon basin, and its age can only be given as later than the Abitibi schists which it intrudes.

Similar dykes of minette are reported to occur in the Kewagama sheet, 33 and 41 miles south from this occurrence,[1] on the peninsula which projects into lake Dufresnoy and on the southwest shore of lake Dufault about 100 yards north of the entrance to the large west bay.

IRON.

The possibility of iron ore being found in the district is indicated by the observed occurrence of banded iron formation, and the abundant deposit of pyrite in a carbonaceous volcanic slate of the district.

Banded iron formation occurs on the south side of Authier river about 10 miles northwest of lake Chikobi. The rock is composed of alternate bands of magnetite and chert, the latter predominating. The rock has been closely folded, the axes of the folds trending east and west. Although the rock exposed at this outcrop is too lean to be of economic importance, it is possible that the iron formation elsewhere in the district may be of value. Localities with abnormal magnetic variations and outcrops of chert which resemble the non-ferruginous part of the iron formation suggest that it occurs in two narrow bands across the district, one north and the other south of the Mistawak batholith.

The carbonaceous slate rock which occurs on the west shore of Rest lake about 1 mile north of the outlet, carries abundant spherical or augen-like masses of pyrite, partly altered to limonite. Some of these have a diameter of 10 inches, and for a width of 20 feet pyrite makes up over 50 per cent of the rock.

A similar rock also containing spherical nodules of pyrite, though not in such large amount, occurs on the left bank of Octave river 1 mile below the upper 10-chain portage.

MOLYBDENITE.

Molybdenite was observed in only one locality in the Harricanaw-Turgeon basin, namely, on the southern slope of Plamondon hill. A few scales of the mineral were found in a small pegmatite dyke which cuts the hornblende schist of the Abitibi group, a few hundred yards north from the granite contact.

Workable deposits of molybdenite occur in the vicinity of Kewagama lake, a few miles to the south of the map-area. The mineral is found irregularly distributed through pegmatite veins near the contact of granite batholiths or apophyses with the older rock.

ASBESTOS.

Small veins of stiff-fibred asbestos occur in the greenstones on the shores of lake Obalski. On a projecting point on the east shore, 50 chains northeast of the entrance of Harricanaw river, asbestos was observed in fibres less than half an inch long; a similar occurrence was found in the ellipsoidal andesite on the west shore about 1 mile north of the entrance of Harricanaw river. The rock in which the asbestos was observed is not a peridotite.

Mr. Bancroft's report[2] refers to other occurrences in this neighbour-

[1] Wilson, M. E., Geol. Surv., Can., Mem. 39, p. 49.
[2] "Mining operations in the province of Quebec", 1912, pp. 156-157.

hood. "Serpentinous peridotites were observed to be present within the most southern portions of the area. On the eastern shore of Obalski lake, at a point about 1½ miles north of the entrance of the Harricanaw river, an exposure of peridotite is traversed by a few irregular veins of stiff-fibred asbestos of no economic value, possessing a maximum width of about half an inch. An exposure of similar rock is reported as being on a hill a short distance north of the railway line 7 miles east of the Harricanaw river and containing small threads of asbestos not exceeding a quarter of an inch in length."

With the exception of the Obalski Lake district no peridotites have been reported in the Harricanaw-Turgeon basin, and it is not considered likely that any deposits of asbestos of economic importance will be found.

CLAY.

The government railway crosses an extensive clay zone. The clay deposits constitute the most valuable as well as the most immediately available resource of the Harricanaw district. The land along the streams crossed by the railway is rapidly being taken up for farms on account of the combined advantages of transportation facilities and natural drainage. The valley of Harricanaw river as far north as the first falls below Obalski lake, and the valleys of La Sarre and Okikodosik rivers near the railway, are composed of clay land suitable for farming, as also are the naturally drained lands around Makamik and Robertson lakes. Boulder clay occurs in the vicinity of Beauchamp lake, where Spirit Lake Internment camp is located, and much work is necessary in the removal of boulders and in drainage before the soil can be made suitable for agricultural development. The valleys of the upper Wawagosik and Partridge rivers, in the central part of the sheet, possess the best agricultural lands which were observed away from the railway.

The clay deposits of the Harricanaw-Turgeon basin, in addition to their importance for agricultural purposes, are in some localities suitable for the manufacture of brick.

The stratified clays of the district represent boulder clay which has been transported by streams or currents and deposited in a huge lake or series of lakes which covered this region at the time of the retreat of one of the ice-sheets. The clay now exposed on the northern part of Turgeon river often contains pebbles of boulder clay and small fragments of limestone and other rocks. This clay is unsuitable for commercial purposes as the lime pebbles burn to quicklime. In many of the stratified clays, concretions of claystone are abundant. Such deposits are of no commercial use under present conditions, since the concretions necessitate either screening or crushing. Some of the stratified clays contain such very thin silt bands that these could only be used if mixed with sand to reduce their shrinkage.

Of a number of clays examined, a few deposits were found near the railway which did not possess the objectionable qualities just mentioned. Concerning these, J. Keele, of the Mines Branch, reports as follows:

"Specimen from range VII, La Sarre township 1¼ miles west of the La Sarre river and ¾ of a mile north of the railway. Brownish, non-calcareous clay, evidently from the surface of deposit, as it appears to be weathered and leached. It is smooth and exceedingly plastic when wet. It burns to a deep red colour and dense hard body.

"Specimen from left bank of Octave river 4 miles above the junction of Concretion creek.

"Light grey, silty, calcareous clay, stratified and laminated with whitish silt films. It is granular in texture and fairly plastic when wet. It burns to a porous light red coloured body, suitable for common bricks. The shrinkages are low.

"Specimen from east shore of Obalski lake 1½ miles southeast of the outlet, lower beds.

"Stratified grey clay, interlaminated with thin layers of silt, the clay bands being about twice the thickness of the silt layers. It is slightly calcareous. This material is very plastic and smooth, but works easily, not being too stiff when wet. It burns to a light red, fairly hard body.

"Specimen from the upper beds of the deposit on lake Obalski, same locality as the above.

"Light grey, non-calcareous, stratified clay, very plastic and smooth when wet. It burns to a good red colour and dense, hard body, but the shrinkages are a little too great.

"This clay and the lower part of it (the previously mentioned specimen) are suitable for the manufacture of common building-brick and field drain tile. The addition of some sand, say 20 per cent, would lower the shrinkage and improve the working and drying qualities."

APPENDIX.

KIENAWISIK GOLD DISTRICT.

GENERAL STATEMENT.

Gold was discovered on the eastern shore of De Montigny lake in July, 1911, by Mr. J. J. Sullivan and Mr. H. Authier. In the autumn of the same year numerous camps were located in this vicinity and general attention directed toward the surrounding region.

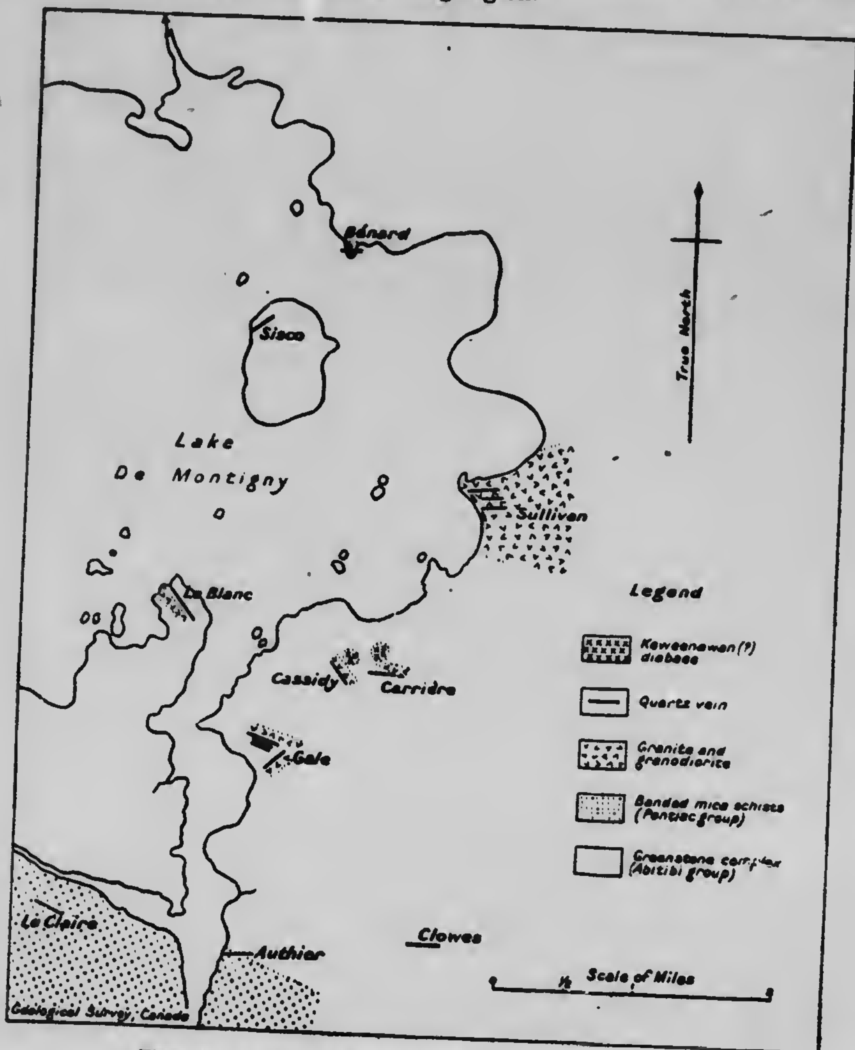


Figure 2. Geological sketch map of Kienawisik gold district.

Toward the close of the field season of 1915 the writer spent a week in examining the rocks along the upper Harricanaw river and certain gold claims in the vicinity of De Montigny lake, in the hope of being able to direct the attention of prospectors to particular areas in the Harricanaw-Turgeon sheet where similar geological conditions might be encountered. The excellent report of Mr. J. A. Bancroft, which appears in the "Report on mining operations in Quebec for 1912" is summarized and given here, together with observations on the progress which has been made since 1912. A geological sketch map has been made from notes taken by the writer (Figure 2).

LOCATION AND TRANSPORTATION.

The upper Harricanaw river is a quiet stretch of navigable water, with several lake expansions, which extends 42 miles south of the National Transcontinental Railway crossing, 141 miles east of Cochrane. This part of northwestern Quebec has been subdivided and the townships through which the waters flow are Desroberts, Dubuisson, Varsan, Malartie, La Motte, and Figuery. All the gold discoveries are located in the township of Dubuisson near the shores of Lemoine and De Montigny lakes.

Transportation facilities are exceptionally good. The whole distance from the railway to the head of lake Mourier, about 60 miles by water, is navigable by gasoline launch. The town of Amos, situated on the railway at the Harricanaw River crossing, has grown very rapidly in the past few years and supplies may be obtained there by parties wishing to visit the district.

GENERAL GEOLOGY.

General Statement.

All the district along Harricanaw river between the railway and the Height of Land is underlain by Pre-Cambrian rocks. The majority belong to the Abitibi complex. Through these appear intrusive masses of granitic rocks, the larger isolated masses occurring in the vicinity of lake Okikeska. The granite near the Height of Land is part of an enormous granitic complex which extends far to the south.

Table of Formations.

In the following table of formations the rocks of the district are arranged in order of age, the youngest first.

Quaternary
  Great unconformity
Keweenawan (?) diabase.
  Intrusive contact
Laurentian (?) (Batholithic intrusions of granite gneiss).
  Intrusive contact
Abitibi group...... (Volcanic complex).
  (Banded schist complex).

Banded Schist Complex.

The group of rocks which had been designated by the name Pontiac by M. E. Wilson[1], outcrops continuously for 11 miles along Lemoine lake and for 3 miles below lake Okikeska.

[1]Geol. Surv., Can., Sum. Rept., 1911, p. 274.

The banded schist complex is chiefly composed of quartz-biotite schists in distinct bands from 3 feet in thickness down to a fraction of an inch. In some places, the banding appears to be due to a slight change in texture in the biotite schists, but more frequently it is due to a difference in mineralogical composition, the darker bands having more biotite (and sometimes hornblende) whereas the lighter bands contain more quartz. Thin sections are composed chiefly of quartz, biotite, and hornblende, with a few small grains of magnetite and pyrite. Biotite is much more abundant than hornblende, very often being present to the exclusion of the latter. Pleochroic haloes are commonly seen in the biotite sections. Some of the bands contain grains of plagioclase and orthoclase. In all the specimens examined the grains of quartz, and feldspar crystals if present, are of about the same size, forming a mosaic within which the biotite and hornblende crystals are arranged with their longer dimensions parallel to each other. In one of the beds on the northwest shore of Lemoine lake, about 2½ miles below its inlet, a strong development of characteristically twinned staurolite crystals occurs in the biotite schist.

On Fire Rangers point, on the southeast shore of Lemoine lake, a few disconnected lenses of pale biotite schist were observed in the darker biotite schist. These lenses were not in exact alignment with each other and their longer axes made a small angle with the schistosity.

All of the rocks in the banded schist complex are highly metamorphosed, recrystallization being their characteristic feature.

The schistosity strike of the banded schists on Lemoine lake, varies from south 30 degrees east to east and west. The schistosity dip varies from 25 degrees to 80 degrees northeast. The banding conforms to the schistosity. Dykes and small irregular masses of granite, granodiorite, and diorite intrude the schists in many localities and quartz veins and stringers are particularly abundant. At several localities the quartz stringers were observed to be contorted as if tightly folded, the amplitude being only a few inches in a fold several feet long.

The contact of the banded schists with the granite shows that the granite is intrusive, and from the coarser grain of the schists near the contact it is evident that intrusion caused or assisted the recrystallization of the biotite schists. The contact of the banded schists with the volcanics of the Abitibi complex is exposed on the narrows between Lemoine and De Montigny lakes, opposite the mouth of Thompson river. Here the rocks of the schist complex are beautifully banded, but the normal biotite schist only occurs in a few bands, the material between being a dense black rock in which no minerals can be determined. Approaching the greenstone the dark bands become wider and wider and one of the bands was identified as a normal andesitic lava. Beyond this point, passing to the north, the rocks are volcanics in which no banding occurs.

In Dr. Bancroft's report, these banded schists are referred to as altered sediments—conglomerates and arkoses. He also notes certain amphibolite bands which may represent altered volcanic tuffs. His evidences of sedimentary origin found on the upper Harricanaw are the banding of the rocks and the presence of staurolite crystals at one locality; also when the contact between the greenstones and the schists is traced toward the northwest, i.e., along the strike of the banded schists, a series of highly metamorphosed but undoubted sediments are encountered and when these sediments are followed across their strike toward the granite on the south, there appears to be a gradational change into the banded schists.

In spite of these facts, the writer is not convinced that the wide belt of banded schists which appear on lake Lemoine is for the most part altered sediments. Lithologically similar rocks in the Harricanaw-Turgeon basin appear to be metamorphosed waterlain tuffs (see page 27).

The assumption that the banded mica schists and the associated normal sediments belong to the same series (Pontiac) presents a baffling structural problem. The banded mica schists dip toward the north, and apparently underlie the greenstone, whereas, the normal sediments, which occur south of lake Kewagama and in line with the strike of the banded schists, stratigraphically overlie the greenstones, as may be inferred from the variety of greenstone pebbles in the conglomerate member. This suggests to the writer that the mica schists and the normal sediments are two distinct series of quite different age. The normal sediments are regarded as a series younger than the Abitibi volcanics; and the banded mica schists are regarded as a series older than the Abitibi volcanics under which they appear to dip, and consequently much older than the associated normal sediments. On the geological map[1] it is to be observed that the Pontiac sediments occupy a narrow belt between the banded mica schists and the Abitibi volcanics. By following the structural trend of these toward the west one encounters the Cobalt series, which, for several miles, also occupies a narrow belt between the banded mica schists and the Abitibi volcanics. By following the structural trend of the Pontiac sediments toward the east, a point north of Lemoine lake is reached where banded mica schists lie adjacent to the Abitibi volcanics, and in this locality there is no conglomerate nor recognizable normal sediment. To the writer this evidence does not imply a correlation between the latter two series any more than it does between the Pontiac sediments and the Cobalt series. The lithological character and the data regarding age are distinct and different between the mica schists and the Pontiac sediments just as they are between the Pontiac sediments and the Cobalt series, and there is no reason for regarding either of the three as other than a distinct series of different geological age from the others. Hence, the association of the younger Pontiac sediments with the banded mica schists does not influence in any way conjectures as to the origin of the latter.

The banding of these rocks is of no diagnostic significance, because the tuffs, if deposited under water, would be in layers similar to sediments. The tuffs of the adjacent district to the north are characteristically banded.

The abundance of ferromagnesian minerals and feldspars in the schists accords mineralogically with what would be expected in the recrystallization of tuffs. The same composition might also be obtained by the recrystallization of arkose and slate rocks, but certainly not from well-assorted siliceous sediments.

The presence of staurolite in the micaceous schist is taken by some geologists to indicate the original sedimentary character of the rock. But there is no reason why staurolite might not be formed by the recrystallization of an igneous or pyroclastic rock if its chemical composition were suitable. Staurolite has been reported in a metamorphosed igneous rock.[2]

[1]Kewagama, Geol. Surv., Can., Map 93 A.
[2]U.S. Geol. Surv., Bull. 209, 1906, p. 58.

The strongest doubt as to the sedimentary origin of these banded schists is raised in the mind of the writer by the restricted distribution of a series which, according to M. E. Wilson, has a thickness of 37,000 feet.[1] A series of such dimensions, folded, with east and west axes, if it had the normal uniformity of thickness of sediments should be found In the area to the north of the railway, whereas only one small outcrop of undoubted sedimentary rocks is found there and this may very well correspond to the narrow band of undoubted sedimentary rocks found just south of lake Kewagama. If, on the other hand, these rocks represent tuffs counterparts might be found in the Harricanaw-Turgeon basin, but in no such well-marked broad band. A difference in continuity of area and distribution might well be expected between sediments and waterlain tuffs, even of the same texture, as sediments are supplied in the upper portions of the water body whereas the debris from submarine volcanoes is supplied from the floor. In the case of sediments, they are spread out from a shore-line and subjected to the distributing influence of waves and currents which are at a maximum at the surface, whereas the submarine volcanic ejecta may be given out at such a depth as to escape this distributing action and may even be piled up in a conical manner.

It is believed that the Pontiac schists on Lemoine lake and below lake Okikeska represent a series of highly altered volcanic tuffs and some lava flows in which younger infolded sediments may occur (but which were not observed), the tuffs being older than the volcanic complex to the north, but belonging to the same great period of igneous activity.

Abitibi Volcanic Complex.

The greenstones of the Abitibi Volcanic complex are the most abundant rocks in the upper Harricanaw basin and underlie the whole area north from lake Lemoine to the railway except for the belt of banded mica schists and the granite batholith in the neighbourhood of lake Okikeska.

This group, which has been referred to as the Keewatin by Bancroft, consists of numerous types of extrusive and intrusive rocks all more or less metamorphosed. The most abundant type is an ellipsoidal andesite. Other lavas occur having various compositions ranging from rhyolites to basalts. These rocks have been altered in some localities to sericite, chlorite, and hornblende schists. Intrusions of peridotites, hornblendites, diabase, diorite, porphyrites, and quartz porphyry have cut the lavas.

Near the granite contacts, the Abitibi volcanics are usually altered into a hornblende or chlorite schist, but where the granite mass is small, very little change appears to have taken place in the greenstones.

The whole of the Abitibi complex appears to be highly folded, but in most of the exposures no information as to the amount of deformation can be gleaned. At the contact between the greenstones and the Pontiac schists at the north end of Lemoine lake, certain layers of greenstone appear conformably interlayered with the micaceous schist, the dip being about 85 degrees to the north.

Aside from the conclusion that the abundant ellipsoidal andesites in the district represent the outpouring of ancient submarine volcanoes, little is known as to conditions under which the volcanic complex originated. The

[1] Ibid. p. 76.

sequence of extrusion of the various rock types has not been worked out satisfactorily as yet. The writer has observed that in general the basic rocks are more highly altered than the acidic volcanics, but, upon considering their relative resistance to metamorphic influences, would hesitate to use this fact as a criterion of age.

Granite and Gneiss.

Batholithic masses of granite and gneiss, together with their differentiates and assimilation products, are irregularly distributed in the upper Harricanaw basin in masses of variable size, the largest occurring on lake Mourier at the extreme south of the district and around lake Okikeska.

The rocks are chiefly biotite granites. Near the borders of the intrusions, hornblende granite, granodiorites, diorites, and hornblendites are common, together with pegmatitic phases of the granite.

Keweenawan (?) Diabase.

Small dykes of diabase are said to occur at the following localities: on a small island three-quarters of a mile north of La Motte lake, crossing the southern boundary of lot 45, range VI, La Motte township; about 200 yards west from the discovery post on Smith's vein (property of Ed. Carriere) southeast of De Montigny lake, also on the adjoining claim to the east; and on range VI, Dubuisson township, just west of Lemoine lake. The diabase has not been dynamically metamorphosed and has not been weathered to nearly the same extent as the rocks of the Abitibi complex. So far as known it is the youngest consolidated rock found in the upper Harricanaw basin.

No veins or minerals of economic importance have been reported in connexion with these diabase dykes.

Quaternary.

Unconsolidated glacial deposits form a mantle of variable thickness, over the irregular, scoured rock surface. These deposits consist of boulder clay, sand, boulders, and bedded lake clays, the latter being the most prominent of the series.

ECONOMIC GEOLOGY.

Gold.

General Character of Deposits. Native gold occurs in a restricted area in the central part of Dubuisson township, and since the majority of the claims are close to lake De Montigny (previously called Kienawisik) the camp is known as the Kienawisik Gold camp.

The gold occurs in quartz and pegmatite veins which in places contain tourmaline, pyrite, chalcopyrite, calcite, galena, and sphalerite; tourmaline is by far the most abundant and widespread. The veins are narrow and lenticular as a rule, and occur either individually, or as stockworks. They occur in the metamorphosed volcanics of the Abitibi complex, and in an intrusive granodiorite or granodiorite porphyry representing an apophysial intrusion from the granitic batholith to the south. Where the veins are not in the granodiorite intrusive, this rock occurs nearby. Gold in small amounts occurs also in the large cubes of pyrite which are locally developed in the granodiorite.

Genesis of the Gold. From the association of the quartz and pegmatite veins, both in time and place, with the granodiorite intrusions, and from the presence of tourmaline in the veins (a mineral characteristically associated with magmatic emanations) it is concluded that the veins were formed by magmatic waters given off from the granodiorite intrusives. That these veins were formed at different times is evidenced by the fact that one set is cut by a later set, as seen on the Le Blanc property. Probably both sets of veins originated from the same magma. The veins now exposed are the remnants of deposits which were formed at great depth, the whole superstructure which at one time overlay the plutonic intrusives having been eroded to a peneplain. Bancroft observed that in the plutonics in the vicinity of De Montigny lake there appear to be more quartz veins in the dioritic type and fewer quartz veins in the more acidic granite. This suggests to him that in the dioritic phases the crystallization of quartz was deferred, thus increasing the acidity of the residual parts of the magma which later formed the veins. It might here be observed that veins are usually more abundant around the borders of an intrusive than through the intrusive itself, hence it is to be expected that veins would be more numerous in the marginal and apophysial parts of the great batholith of this district than within it. From the abundance of amphibolite inclusions in these small granodiorite bodies, the writer considers that their more basic appearance is due to the assimilation of basic Abitibi volcanics which have been included during intrusion.

The rocks around the southern end of De Montigny lake have been mapped as Abitibi volcanics, the only exposure of granite being shown on the Sullivan property. If this area were mapped on a larger scale it would be seen that granite is much more widespread than existing maps would indicate, for it occurs on all the properties which were examined though in such small dykes and bosses that mapping on a scale of 4 miles to the inch would be difficult. The overburden of glacial clay and boulder clay is so general in the district that prospecting is seriously handicapped and even development work on known leads has been greatly retarded.

Following is a description of properties examined in the autumn of 1915. Attention was especially given to those on which development work had been done since Mr. Bancroft's visit in 1912.

Prospects.

Sullivan Claims. More work has been done on this property, on which the original discovery was made, than on any other in the district. The claims include an area of 240 acres on the east shore of De Montigny lake, 4 miles southeast from its outlet.

All the known veins are located on a low, rocky hill near the shore. The rest of the property is rolling, drift-covered land, heavily forested.

The rock exposed is a granodiorite which includes several lenses and irregular masses of hornblende schist representing fragments of the older, Abitibi volcanics. It varies from a diorite to a granite. The texture is usually granitoid and medium-grained, though a porphyritic texture, due to the presence of plagioclase phenocrysts, is quite common. A gneissoid structure can be distinguished in a few localities on this property, being most pronounced near the hornblende schist inclusions toward the south.

In the hand specimen, the rock appears to be weathered. The feldspar crystals and quartz, when present, are the only easily recognizable crystals, the material between these being a greenish-grey complex of secondary minerals. Under the microscope the rock is seen to consist chiefly of plagioclase, chlorite, tremolite, and calcite, with smaller amounts of orthoclase, quartz, sericite, and a few grains of magnetite, zircon, and apatite; of these, chlorite, tremolite, calcite, and sericite are secondary. The feldspar crystals, although still recognizable as albite-oligoclase, have been largely altered to a felt of sericite crystals. Mr. Bancroft mentions the presence of sphene in the typical granodiorite, but this mineral was not observed in thin sections of rock from the Sullivan property.

Numerous faults were observed in connexion with the veins, the direction of rock movement being recorded in striations on the slickensided rock material and in fracture cleavage. In the northern and central parts of the outcrop it was observed that the southern part of the rock mass moved upward and to the east relative to the northern part.

In the sheared granodiorite near the vein containing the original discovery of gold and in the granodiorite adjacent to the central part of the vein No. 4, huge cubes of pyrite occur as secondary replacements, sometimes enclosing a considerable amount of the rock material. The largest cube observed measured 2 inches on the edge. Mr. Bancroft reports that two such crystals from this locality assayed $33 per ton in gold. The writer examined one cube in thin section and observed small amounts of native gold in a few cleavage cracks in the pyrite and at the contact between an irregular inclusion of feldspar and the enclosing pyrite.

Ten veins are now uncovered on this property, and in all of these gold has been found. There are also numerous, small, irregular stringers of quartz. All of the veins are lenticular, though some are drawn out to a greater extent than others. It is commonly found that after a lens has pinched out another occurs along its strike. Thus the vein on which the original discovery was made is a lens with a length of about 12 feet only, but similar lenses occur beyond more or less continuously for 700 feet. Three such veins can be traced for over 300 feet; the others are either covered by drift or are too irregular to follow over any considerable distance. The width of the veins usually ranges from 2 feet to mere stringers, though vein No. 4 in one place is slightly over 3 feet.

The main veins strike slightly north of east; the smaller veins and stringers of quartz strike in various directions, though the majority trend northeast and southwest. In a majority the dip varies from vertical to a steep inclination to the south, though at the original discovery the dip is toward the north. Faulting has taken place along some of the veins and in vein No. 4 a pegmatite has been brecciated, the interstices between the fragments being filled with quartz and tourmaline. A fault not marked by vein material was observed on the side of the hill cutting across vein No. 1, but no evidence of lateral displacement was observed.

Inclusions of Abitibi volcanics are more abundant near the main veins than elsewhere in the granodiorite. It is supposed that the hornblende schist inclusions formed lines of weakness especially favourable for the formation of openings in which the vein material could be deposited.

The veins are for the most part composed of white, glassy quartz, but locally the presence of large feldspar crystals shows their pegmatitic nature. Tourmaline in black fibrous bunches is common in the quartz; in some places, as in the breccia of vein No. 4, the vein material is black with it. Specks of native gold occur both in the pure white quartz and in that carrying abundant tourmaline. The veins also include pyrite, chalcopyrite, galena, sphalerite, and molybdenite, all except the pyrite, in very small amount.

The value of gold found in an average sample taken across vein No. 1 near the original discovery, was found by Mr. Bancroft to be $15.80 per ton. An average sample across vein No. 4 and even including some of the chlorite schist, assayed 3·52 ounces of gold to the ton and a trace of silver. Mr. Sullivan states that the average value of gold in all the veins on the property was approximately $33 per ton. Country rock near vein No. 1, assayed by Mr. Bancroft, did not yield a trace of gold.

On this property the gold-bearing veins appear in the granodiorite body near its contact with greenstone. It is evident that they are near their source and it is quite probable that the values indicated in these veins give an indication of what is to be expected at greater depth in the gold-bearing veins which occur in the intruded Abitibi rocks in adjoining properties.

Le Blanc Claim. The Le Blanc property includes the peninsula at the south end of De Montigny lake just west of the inlet. The peninsula is for the most part high and rocky, but the overburden of clay is so deep in all parts, except the north face, that comparatively little rock can be seen. Development has consisted in following back a multiple quartz vein exposed on the north face and in sinking a 7-foot shaft on its upper part.

The rock is schisted andesite, both simple and ellipsoidal, belonging to the Abitibi complex. The schistosity strike is north 36 degrees west, the dip 70 degrees to the southwest. A dyke of granodiorite porphyry, similar to the intrusive on the Sullivan property, with a width of 30 feet, cuts the schist about 50 feet southwest of the vein. This dyke was only observed on the lake shore, but it is supposed to parallel the schistosity. No quartz veins or stringers were observed in it, but since the gold-bearing vein dips toward the southwest, it probably passes into the granodiorite at depth. It was also observed that the quartz vein on being followed to the northwest bent toward the west after leaving the shore, suggesting that it might join the dyke under the lake.

The vein is composite. On the north face of the peninsula it is seen to be composed of numerous nearly parallel quartz stringers, making an almost solid mass of quartz for a width of 15 feet. These veins are of different ages, for the schistosity of the greenstone flows around some of the lenticular veins indicating that some of the deformation took place after the vein was present, while later quartz veins cut across both the schist and the older veins at small angles. There are several small blocks of greenstone schist enclosed by the vein material, giving the appearance of a breccia in some places. To the southeast, the vein is irregularly lenticular, pinching out, then widening again. At a point where it is about 3 feet wide, a 7-foot pit has been sunk. Specimens of free gold have been collected in the quartz in this locality. No evidence was gathered indicating whether the gold occurs in both or only in the older set of veins; but both appear to be rather pure quartz veins. Near the shaft only one vein was observed; this evidently belonged to the older series.

The mineral association in the Le Blanc veins is very simple, so far as known; pyrite is the only metallic mineral which occurs along with the gold. A sample weighing two pounds 4 ounces, taken by the writer across the vein at the bottom of the pit, assayed 0·80 ounces of gold to the ton. Other assays made by the owner in the wider composite vein are said to have yielded higher values.

Gale Claim. This claim, previously known as the Callinan property, is situated on the east side of Harricanaw river one mile south of De Montigny lake. The rock surface here is low-lying with many small irregularities. Except for a few rocky prominences, the whole claim was drift-covered. A considerable amount of work has been done in stripping and several veins have been exposed.

An ellipsoidal andesite, with abundant amygdules at the borders of the ellipses, is intruded by two dykes of porphyritic granodiorite. The ellipsoidal andesite in this locality is remarkable in that it has not suffered dynamic or contact metamorphism except for a distance of a few inches from the actual contact of the granodiorite. The ellipsoids are composed of a light, greenish grey rock containing quartz amygdules; a dark material composed of chlorite, calcite, and quartz fills the interspaces. The dykes are composed of a massive dark porphyritic granodiorite with rounded or subangular phenocrysts of white plagioclase in a dark matrix of very fine-grained hornblende, plagioclase, and quartz. The contact of one dyke with the greenstone runs north 70 degrees west; the other, to the south, is south 52 degrees west, suggesting that they intersect at an acute angle toward the east. Stripping has not exposed this supposed junction point, nor the total width of either dyke. The lack of metamorphic phenomena in the greenstone suggests that the dykes are narrow. The dyke to the north appears to have intruded vertically and the one to the south dips 83 degrees to the northwest.

The principal quartz vein consists of a series of long, narrow lenses in a narrow band of greenstone schist bordering the north dyke of granodiorite. Maximum widths range from 1 to 6 inches. The vein was observed almost continuously along the contact for 3 chains. Spectacular showings of gold were found in this vein. At one point, it is joined by an 8-inch quartz vein running west into the greenstone; near the junction pockets were observed into which numerous small prisms of quartz projected freely. One pocket was partly filled with calcite. Fine gold was observed embedded in and also lying on the surface of some of the quartz crystals surrounding these pockets.

Going south across the greenstone outcrop four other veins were observed similar to the one at the contact and running parallel to it. These were spaced at distances of from 20 to 30 feet. Small showings of gold were observed in all of them.

Farther to the south, the second dyke is encountered and here also a narrow, gold-bearing quartz vein occurs at the granodiorite-greenstone contact. The trend of this vein differs by 58 degrees from that of the others, but stripping has not shown whether they intersect or not.

Pyrite is abundant in the veins and the neighbouring greenstone. No other metallic mineral was observed associated with the gold.

The veins on this property appear to be as well mineralized as those on the Sullivan property, but they are very narrow.

Clowes, Authier, and Le Clair Claims. Clowes' property is situated 2 miles east of the extreme north end of Lemoine lake, Authier's claim is on the eastern shore at the extreme north end, and the Le Clair property is 1½ miles west of the Authier property. All are situated near the contact of the Pontiac schists and the Abitibi greenstone, and in each case the veins are lenticular masses of smoky or dark-coloured quartz.

Very little development work has been done on the Authier or Le Clair property since Mr. Bancroft's visit in 1911. At that time assays showed no trace of gold in the quartz veins.

Clowes' claim was not visited, but Mr. Clark, who was in charge of development work, stated that a 26-foot shaft had been sunk on a vein of smoky quartz and that gold had been found in place. No assay returns were available.

Carriere Claim. This claim of 135 acres was one of the most promising in the district five years ago when its principal vein was discovered by S. G. Smith. Since that time the property has been restaked more than once, the gold showings have been removed, and no further development is taking place. It is situated one-third of a mile south of the first bay east of the inlet of De Montigny lake. The vein is situated on a bare, rocky hill.

The geological relationships found on this claim are quite similar to those on the Le Blanc property. The rock is Abitibi green schist. The schistosity strikes north 85 degrees west; and dip from vertical to 80 degrees south. A massive, porphyritic diorite dyke similar to the intrusive on the Le Blanc property cuts the schists on the northern face of the hill. This dyke is 35 feet wide and strikes north 40 degrees west. On the eastern part of the outcrop a 2½-foot dyke comes off to the south from the larger one. A small exposure of Keweenawan (?) diabase occurs on the trail in low land 2 chains northwest of the hill; its presence does not appear to have any relation to the mineral deposit.

The quartz vein in which the gold occurs is on the rocky hill and extends in a direction north 60 degrees west from the smaller dyke of porphyritic diorite. The vein dips toward the south at angles of from 35 degrees to 55 degrees. It consists of a succession of long lenses, from 3 inches to 14 inches wide; which can be followed continuously for 73 feet to the west of the diorite dyke. It there becomes drift-covered, but beyond along the projection of the strike another quartz vein is said to occur.

The quartz is in places glassy, in other places sugary. It is colourless or white except where stained by iron in the neighbourhood of pyrite crystals. One cavity was observed lined with large, projecting quartz crystals.

The mineral association in the quartz vein is pyrite, chalcopyrite, gold, black tourmaline, calcite, and epidote.

Mr. Bancroft mentions a spectacular display of gold in a fragment taken from the upper part of this vein. At the time of the writer's visit no gold was to be seen even in the place where it was said to be best mineralized. Mr. Bancroft's average sample of this vein yielded only 20 cents per ton in gold whereas that collected near the gold showings yielded $1.20 per ton in gold.

Cassidy Claim. The Cassidy property lies south of De Montigny lake and adjoins the Carriere claim on the west. Several low, rocky hills occur in this locality with swampy, drift-covered country lying between.

Gold is reported from a vein on one of these hills about one-quarter mile southwest of the Smith vein. The rock on this hill is an andesite schist striking north 60 degrees west and dipping vertically. It is intruded by a porphyritic granodiorite dyke. One side of this dyke was observed in contact with the andesite, the trend following the schistosity strike; the other side of the dyke was drift-covered beyond the base of the hill. A short distance to the north of this hill, a dyke of Keweenawan (?) diabase outcrops in the lower ground. This is probably part of the dyke observed on the Carriere property.

The quartz vein occurs in the granodiorite a few feet in from the schist contact. Its trend is north 55 degrees west. Toward the northwest face of the hill the vein is 5 feet wide, a few blocks of country rock being included in the quartz. It was followed 80 feet to the southeast where it divides into several veins; one of these, 3½ feet in width, curves to the east for a short distance then resumes its former direction before being lost under the drift covering.

The quartz in the vein is white. Pyrite grains and radiating bunches of black tourmaline are common in it. Visible gold was reported, but none could be found in place at the time of the writer's visit.

Sisco Claim. The Sisco claim is located on the west side of the largest island in De Montigny lake. Here, as in the case of the above-mentioned property, a small quartz vein cuts a granodiorite dyke which is intrusive in green schists. Specimens collected from this vein by the owner contained several small pieces of gold.

Benard Claim. The Benard claim is located on the northeast shore of De Montigny lake on the peninsula which is closest to the largest island. At the end of this peninsula is a low, drift-covered hill, which projects to the south. Where the waves have removed the drift on the west side the rock is seen to be Abitibi greenstone. On the east shore of this small peninsula at the south end and 60 feet north of this, the Benard veins are exposed. Very little development work has been done on this property.

The oldest rock on the peninsula is an Abitibi chlorite schist. The schistosity strike is due west, the dip vertical. This rock is intruded by a dyke of granite about 54 feet wide. Another 8-foot dyke carrying several small veins occurs 60 feet south of this. The main dyke is cut by a stockwork of veins, so abundant that at first glance the whole exposure appears to be vein material. The veins are for the most part less than 10 inches wide and trend in an east-west direction, sometimes dividing and joining again, making a pattern like a drawn out net. Small inclusions of dyke material are abundant in the veins, the feldspathic minerals being arranged in lines giving the vein a gneissic appearance.

The dyke rock on this property is quite different in appearance from that on the other claims, but it is believed to be derived from the same magma. In the hand specimen, it is fresh-looking, medium-grained, granitic rock in which quartz and pale green and white feldspars are determinable, with abundant small tubes of pyrite uniformly distributed through it—a pyritiferous binary granite. In thin section, it is seen to consist of albite, quartz, and pyrite, with small amounts of rutile, zircon, and apatite, and the secondary minerals calcite and sericite. The quartz contains numerous, tiny liquid inclusions and in places is micrographically intergrown with the feldspar. Minute rutile prisms occur individually in the feldspar crystals and also in diamond-shaped intersecting aggregates. Mr. Bancroft states that the fresh pyritiferous dyke material assays $1.40 to the ton in gold.[1]

The quartz veins, which cut the dyke, contain abundant needles of black tourmaline and a few specks of chalcopyrite. Finely granular, iron-bearing carbonate, feldspar, and pyrite occur in streaks near dyke rock inclusions. A sample of vein material collected across the entire width of the exposed network assayed merely a trace of both gold and silver. No visible gold has been reported.

[1] "Mining operations in the province of Quebec", 1912, pp. 225, 226.

PLATE II.

A. Tanbell rapids on Harricanaw river at northern limit of this exploration. (Page 50.)

B. View from Rifted hill to eastward, showing Obalski lake and typical even skyline. (Page 8.)

A. Upper part of the long series of cascades on Harricanaw river 22 miles north of Amos, at low water. The most promising source of water-power in the district. (Page 15.)

B. Glaciated boulder pavement on 25-chain portage, Harricanaw river, 12 miles below junction with Plamondon river. (Page 48.)

PLATE IV.

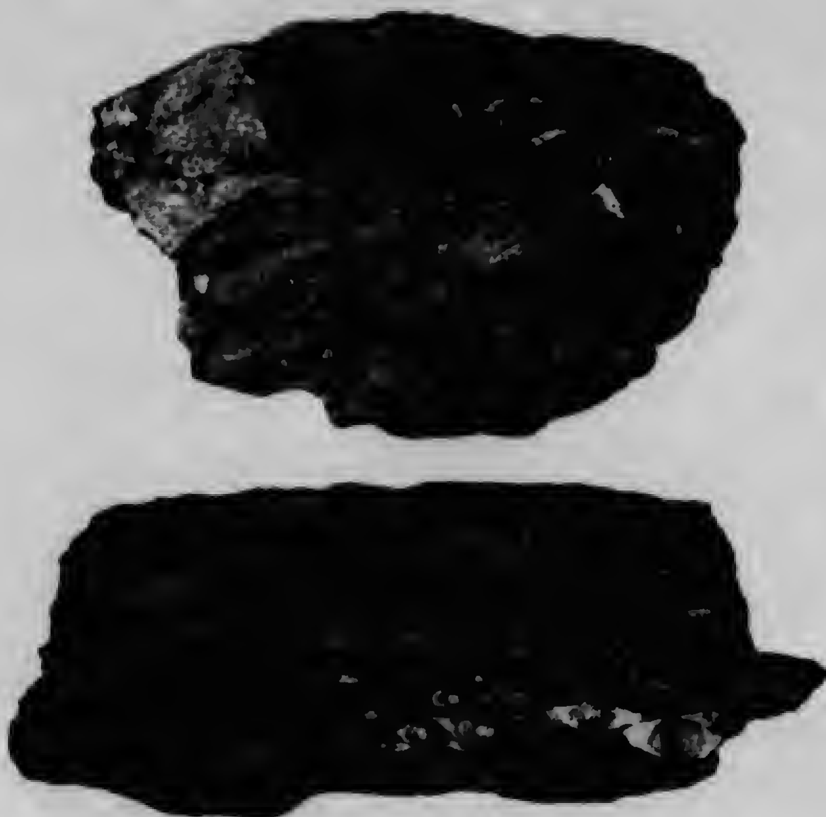
A. Boulder clay at Spirit Lake Internment camp. (Page 48.)

B. Ellipsoidal andesite, Harricanaw river, 7 miles above junction with Turgeon river. (Page 22.)

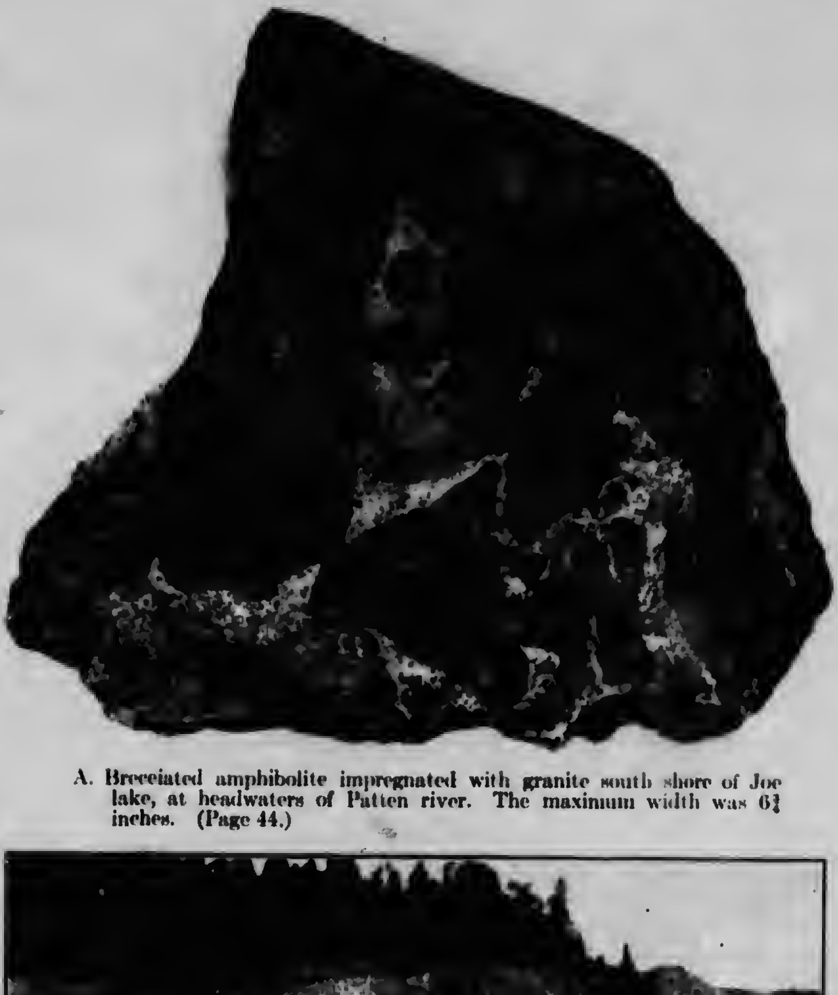
A. Banded mica schist (altered waterlain tuff) cut by quartz veins and showing differential weathering, Turgeon river, 4 miles below Corset island. (Pages 26 and 51.)

B. Photomicrograph of mica schist (altered tuff), Turgeon river, 4 miles below Corset island. Magnified 20 diameters. (Page 26.)

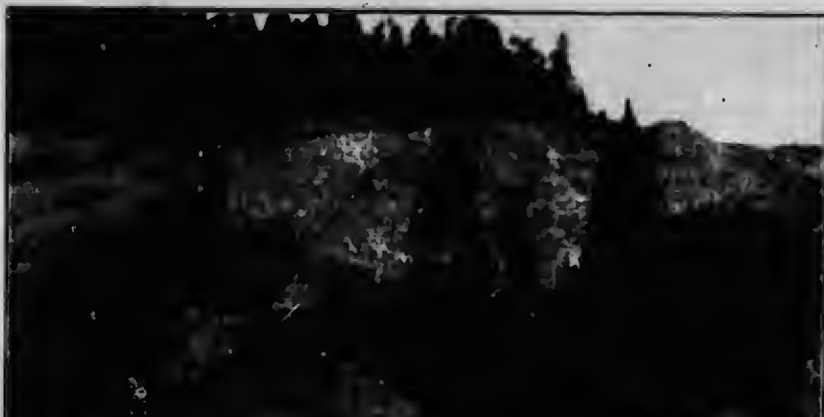
PLATE VI.



Carbonaceous slate rock, containing disseminated and nodular pyrite, Octave river, 1 mile below the upper 10-chain portage. The maximum width of the larger specimen was 6 inches. (Page 30.)



A. Brecciated amphibolite impregnated with granite south shore of Joe lake, at headwaters of Patten river. The maximum width was 6¾ inches. (Page 44.)



B. Large flat blocks of hornblende schist included in coarse granite, Turgeon river, 3 miles above junction with Theo river. The large plate-like inclusions stand nearly parallel to each other and have not been corroded by the granite. (Page 44.)

A. Angular blocks of amphibolite in granite, lower end of 20-chain portage on Turgeon river. The separation of the original block into two took place while the granite was molten. (Page 44.)

B. Rounded block of porphyritic, biotite-hornblende granite in coarse-grained, biotite granite, northwest shore of Otter lake. The inclusions probably represent a partly digested xenolith derived from the intruded schist complex. (Page 44.)

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)

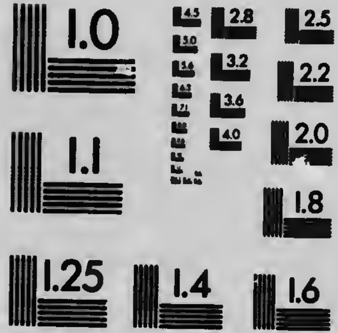


PLATE IX.

Concretions from stratified clay. The specimen with netted surface of dark linear markings is from Concretion creek, the others are from the north shore of Chikobi lake. The maximum diameter of the largest specimen was 4$\frac{9}{16}$ inches. (Page 51.)

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PAGE

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V.

W.

79°30'
79°15'
50°00'
49°45'
Extension L.
Var. 13° W.
Var. 12°40' W.
Sand bars
Var. 11° W.
Var. 12°30' W.
Level clay land
Brulé
Rapid
Old Brulé
Var. 12°30'W.
Var. 12°45'W.
Muskeg
Brisson L.
Old Portage
Var. 12°10'W.
Old Brulé
RIVER
Var. 11°30' W.
Rapid
Rapid 2'
Rapids 8'
Muskeg
Sandy knolls
Rapid 1
Rapid 8'
Rapid 4'
TURGEON
ONTARIO
QUEBEC
Speight's Base Line 1900
Muskeg
Rapid 2'
Coral L.

LEGEND

Canada
Department of Mines

HON. MARTIN BURRELL, MINISTER. R.G. MCCONNELL, DEPUTY MINISTER

GEOLOGICAL SURVEY

WILLIAM MCINNES, DIRECTING GEOLOG

Canada
Department of Mines

Burrell Minister, R. G. McConnell, Deputy Minister

GEOLOGICAL SURVEY

William McInnes, Directing Geologist


78°00'
Lake
Low and flat
Level
River
Very low
Flat
High sandy clay land
Flat country
High clay bank

LEGEND

PRE-CAMBRIAN

Basic intrusives (Keweenawan)
quartz diabase, olivine diabase

Acid batholithic intrusives
granite, granite-gneiss, granodiorite, diorite, aplite, pegmatite (outcrops indicated by symbol thus)

2

Harricanaw series
arkose, conglomerate, greywacke

1

Abitibi group

Hornblende schist or mica schist
Diabase, gabbro, basalt
Diorite, andesite, porphyrite
Ellipsoidal andesite
Quartz porphyry, rhyolite
Agglomerate
Tuff
Carbonaceous volcanic mud
Carbonate rock
Iron formation
Chert rock

Symbols

Geological boundary
(position defined)

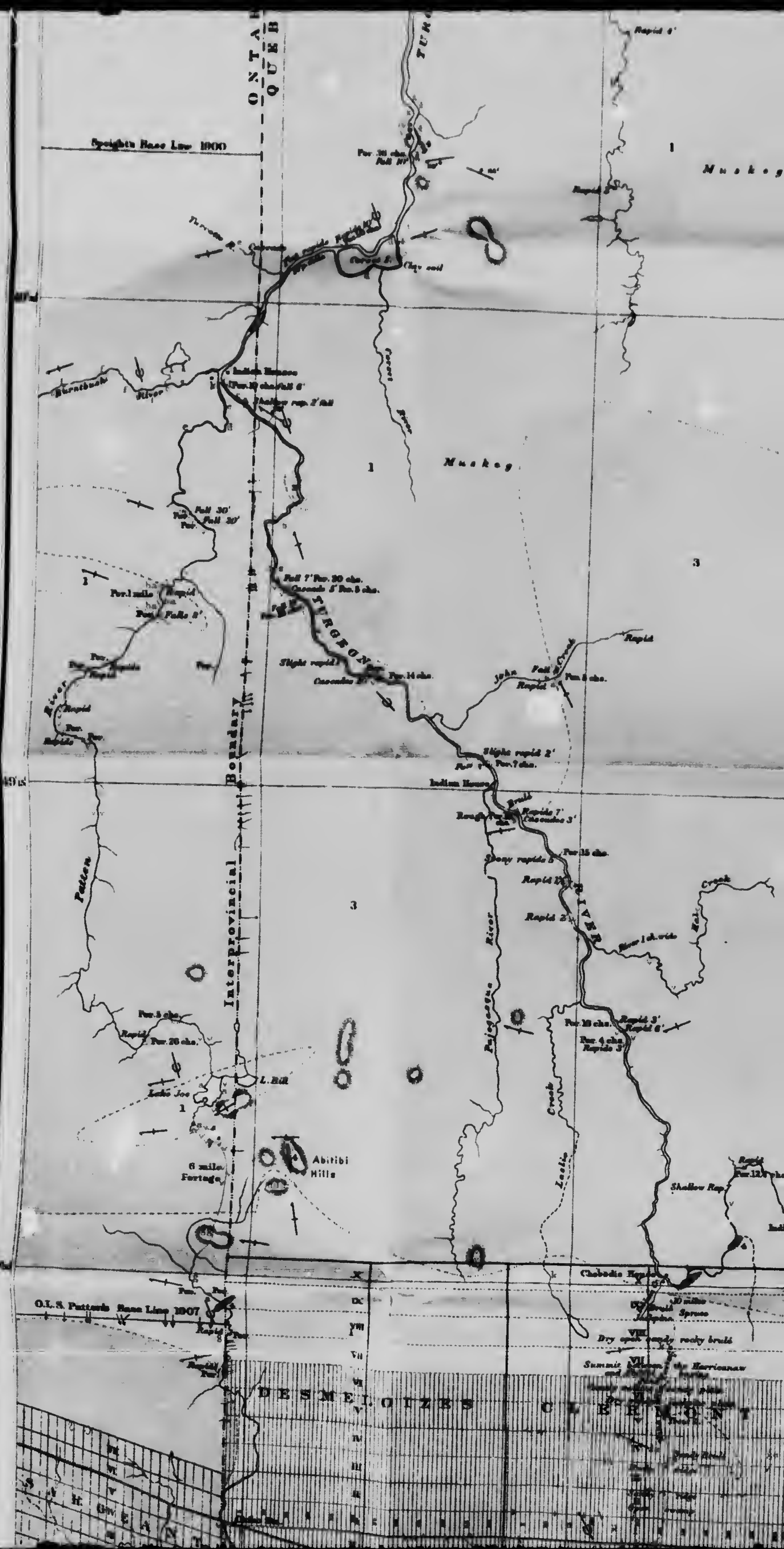
Geological boundary
(position assumed)

Glacial Striæ

Strike and dip
of schistosity

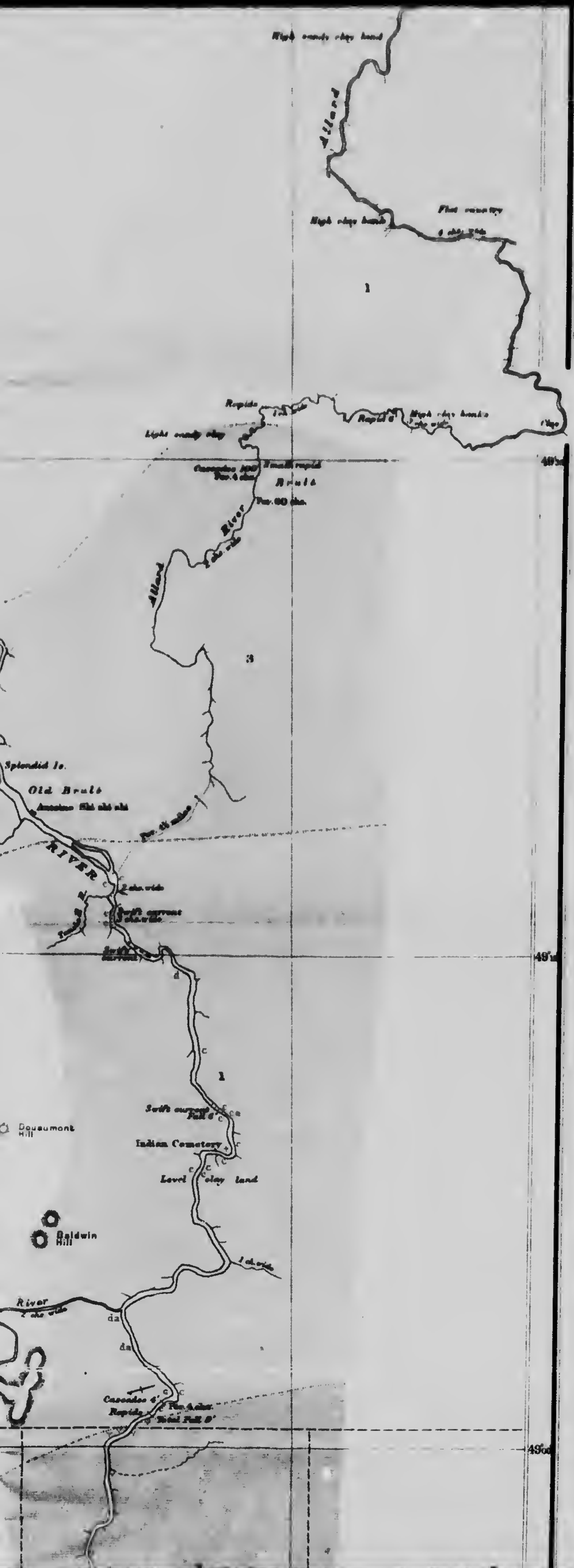
Vertical schistosity

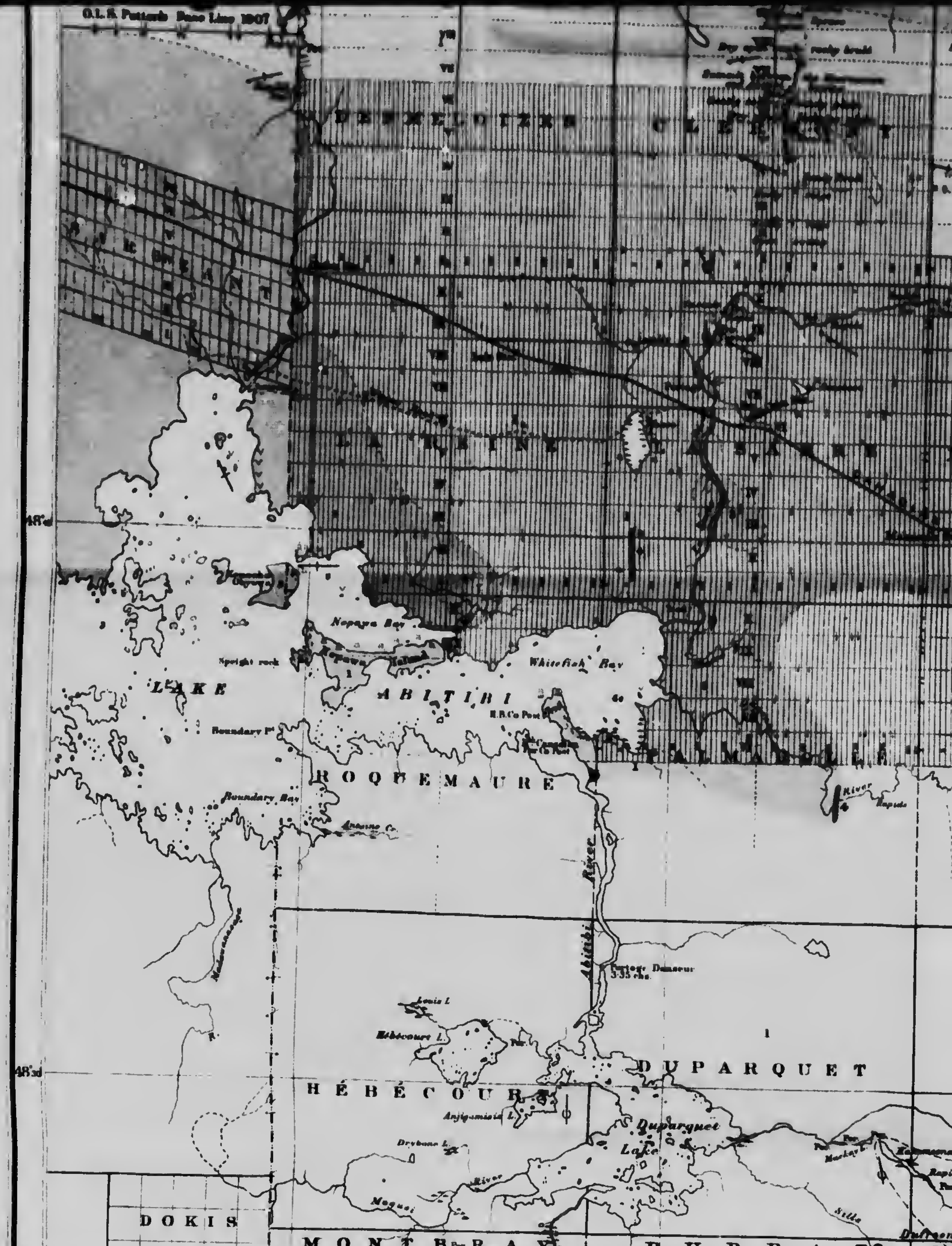
Geographical position based on latitude and longitude observations at Liskeard, by Dominion Astronomical Branch, Department of the Interior.



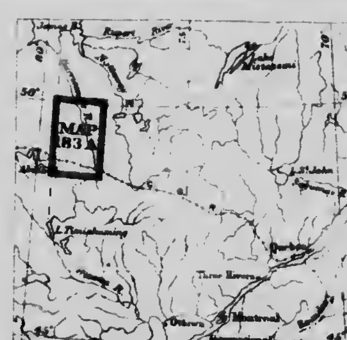
Muskeg
Old Brulé
Lake Noniska
Beaver Meadow
Low swampy land
Clay land
Level clay land
Lake Mistawak
Lake Wawagosik
Triangle Lake
Plamondon
Plamondon River
Plamondon Hill
HARRICANAW
Old Brulé
Slight rapids 6'
Brulé
Splendid Is
Gale River
Wawagosik
Large poplar spruce
Partly Old Brulé
Partly burnt
Level clay land
Small rapids
Cabin
Rapid
Palisade Ridge
Swift current
Fall 12'
Rapid 2'
Partridge
Rapid 2½'
Rapid 1½'
Beaver dam
Beaver House
Jackpine plain
Hebert Hills
Dououmont Hill
Baldwin Hill
Fenouillet Hills
Saucer Hills
Lake Otter
Indian Cemetery
Revillon Bros. (old post)
Swampy
Low level clay land
Muskeg
Alder Cr.
Old Brulé
Nipising Hills
CHAZEL
DISSON
LIGNERIS
DESBOUES
Ootave
Ootave R.
Small rapids
Concretion
Dam 6'
Falls
Rapid 8'
Small rapid
St. Eloi Hill
Gemini Hills

Muskeg
Old Brulé
Muskeg
Lake Newiaka
Rapid 3'
Old Brulé
Slight rapids 6'
HARRICANAW
Low swampy land
Lake Mistawak
Plamondon
6 Boulder dams
Triangle Lake
Brulé
Portage 212 chs.
Rapid 6'
River
Lake Wawagosik
Jackpine plain
Splendid Is.
Rapid 6'
Old Brulé
Rapids
Gale River
Brulé
Brulé
Old Brulé
Old Brulé
Beaver dam
Hébert Hills
Plamondon River
Wawagosik River
Saucer Hills
Beaver dam
Concession
Dam 6'
Falls
Por. 4 chs.
Small rapids
River
Octave
Rapid 8'
Small rapid
Por. 10 chs.
LIGNERIS


Allard
Flat country
High clay banks
Rapids
Light sandy clay
Small rapid
Brule
River
Allard
Splendid Is.
Old Brule
RIVER
Swift current
Indian Cemetery
Level clay land
Douaumont Hill
Baldwin Hill
River
Rapids

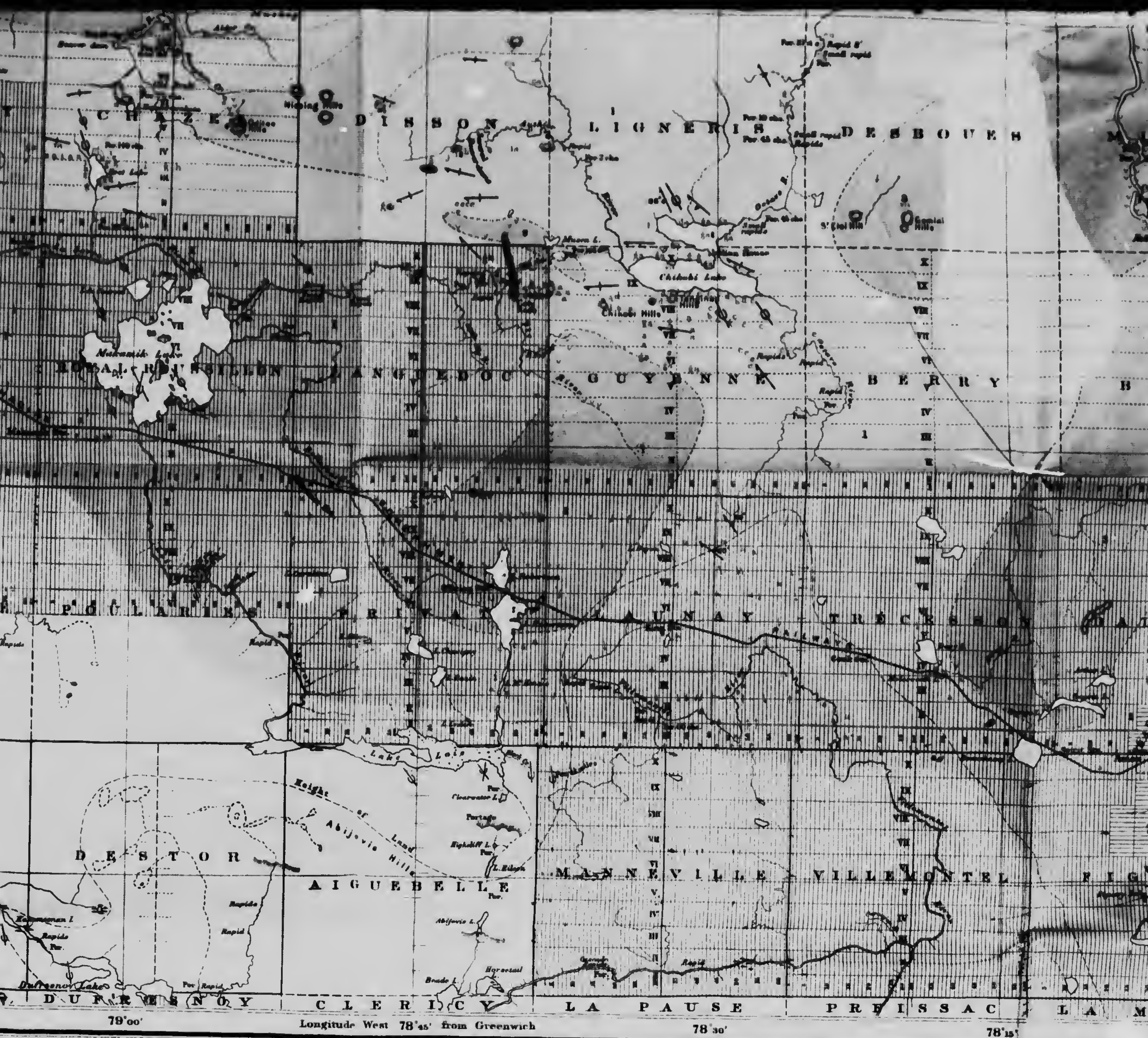


C.O.Senécal, *Geographer and Chief Draughtsman*



Scale, 250 Miles to 1 Inch

To accompany Memoir by T.L. Tanton



MAP 183 A
(Issued 1918)

HARRICANAW-TURGEON BASIN

ABITIBI, TIMISKAMING, AND PONTIAC

QUEBEC

Scale, $\frac{1}{253,440}$

Miles

Kilometres

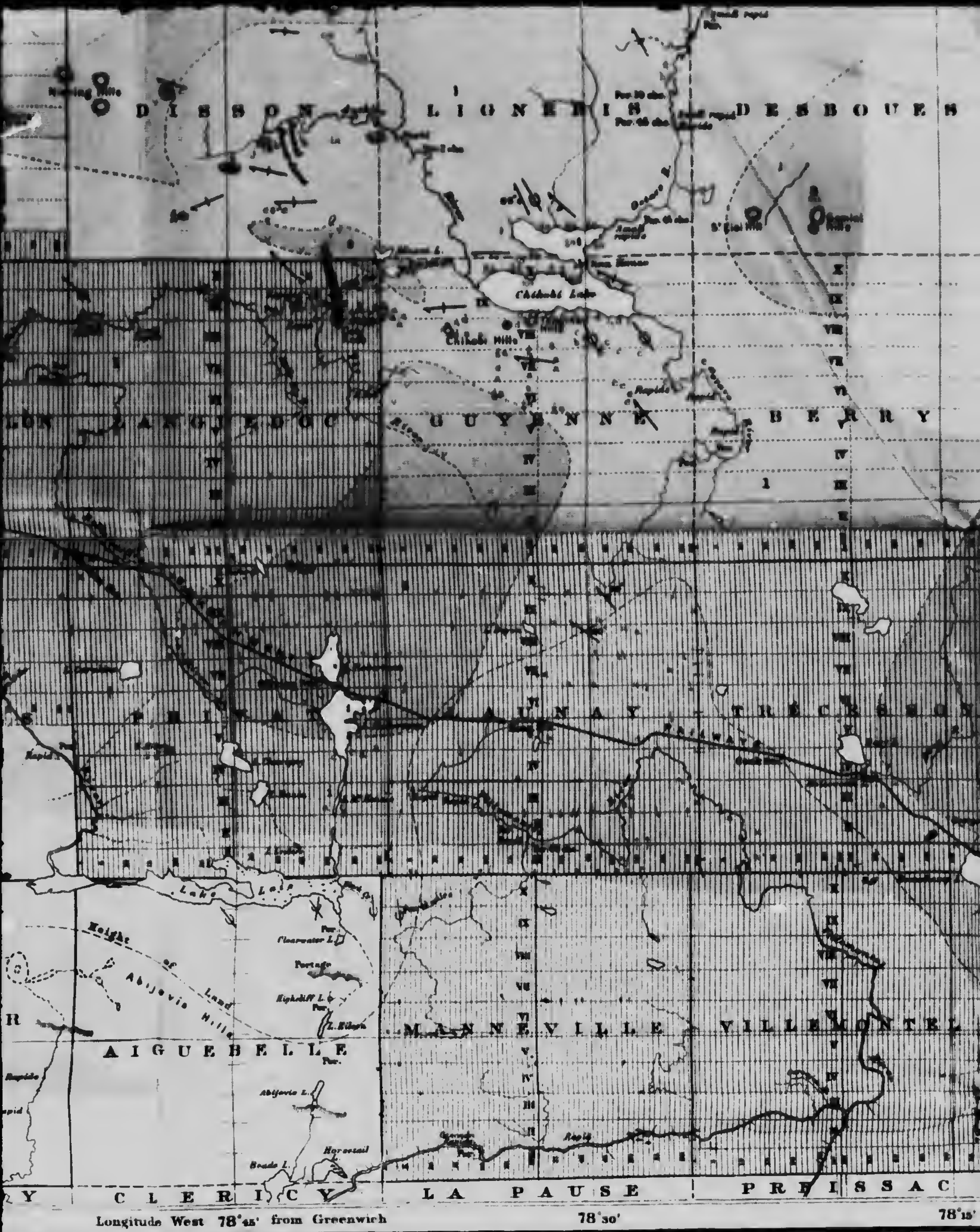
4 MILES TO 1 INCH

Sources of Infor

Geography from "Map of the ... Department of Lands and Fore... "Map 93 A Kewagama", Geologic... *and from surveys by* T.L.Tant...

Geology from surveys by T.L.T... *and from* "Map 93 A", Geologic...

Map compilation by A.Jones...



MAP 183 A
(Issued 1918)

CANAW-TURGEON BASIN

ABITIBI, TIMISKAMING, AND PONTIAC

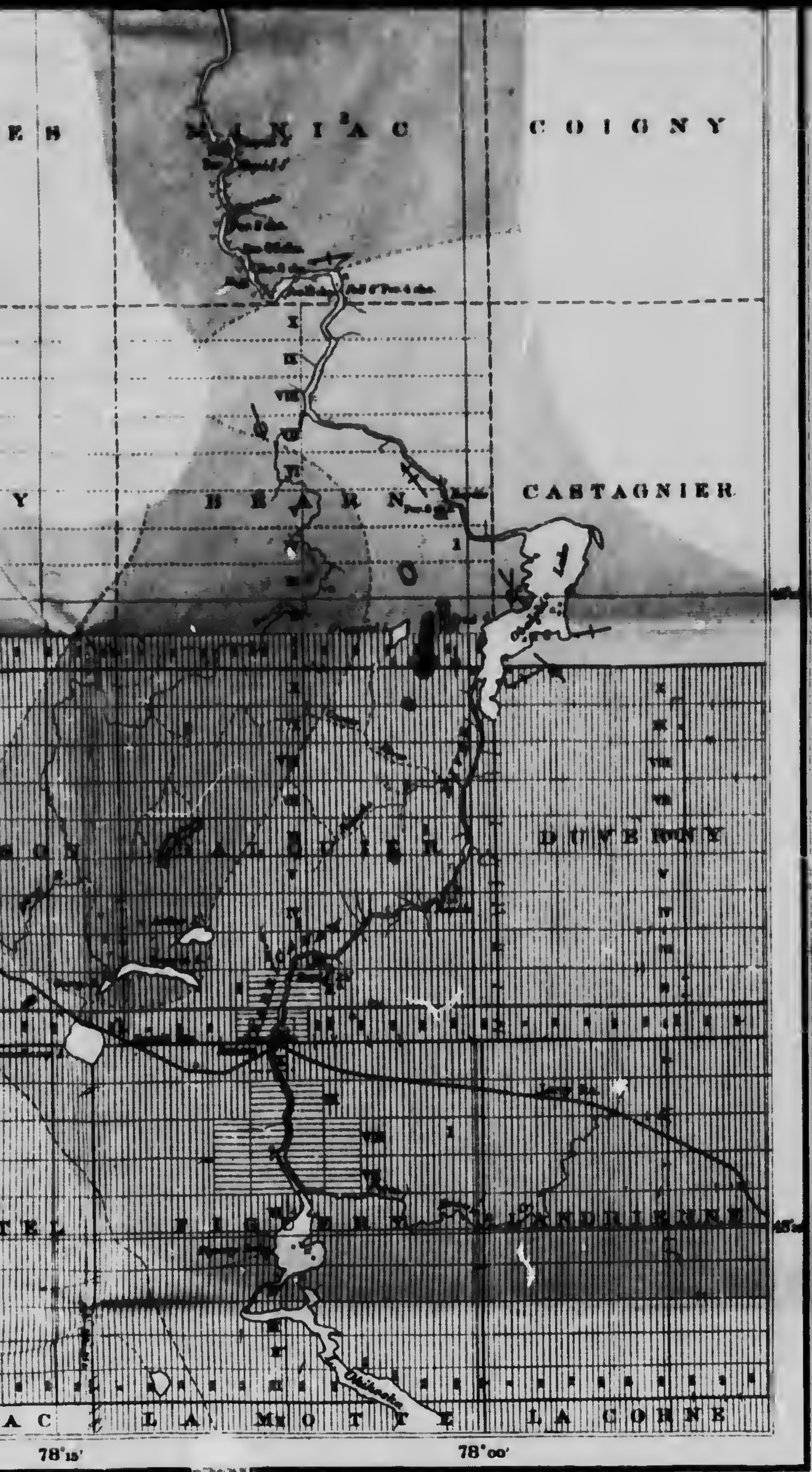
QUEBEC

Scale, $\frac{1}{253,440}$

Miles

Kilometres

4 MILES TO 1 INCH



Publication Nº 1630

Sources of Information

Geography from "Map of the Abitibi Region", Department of Lands and Forests, Quebec, 1911; "Map 93 A-Kewagama", Geological Survey, 1913, *and from surveys by* T.L.Tanton, 1914, 1915.

Geology from surveys by T.L.Tanton, 1914, 1915. *and from* "Map 93 A", Geological Survey.

Map compilation by A.Jeanes.