CANADA

DEPARTMENT OF MINES

GEOLOGICAL SURVEY BRANCH

HON. W. TEMPLEMAN, MINISTER; A. P. LOW, LL.D., DEPUTY MINISTER;
R. W. BROCK, DIRECTOR.

PRELIMINARY REPORT

ON

GOWGANDA MINING DIVISION

DISTRICT OF NIPISSING
ONTARIO

BY

W. H. COLLINS

OTTAWA
PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST
EXCELLENT MAJESTY
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13739—1

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ILLUSTRATIONS.

R. W. BROCK, Esq.,

Director Geological Survey Branch,

Department of Mines.

SIR,—I beg to submit the following preliminary report upon work done in the Gowganda Mining Division during the field season of 1908.

I have the honour to be, sir,

Your obedient servant,

W. H. COLLINS.

CHICAGO, March 8, 1909.

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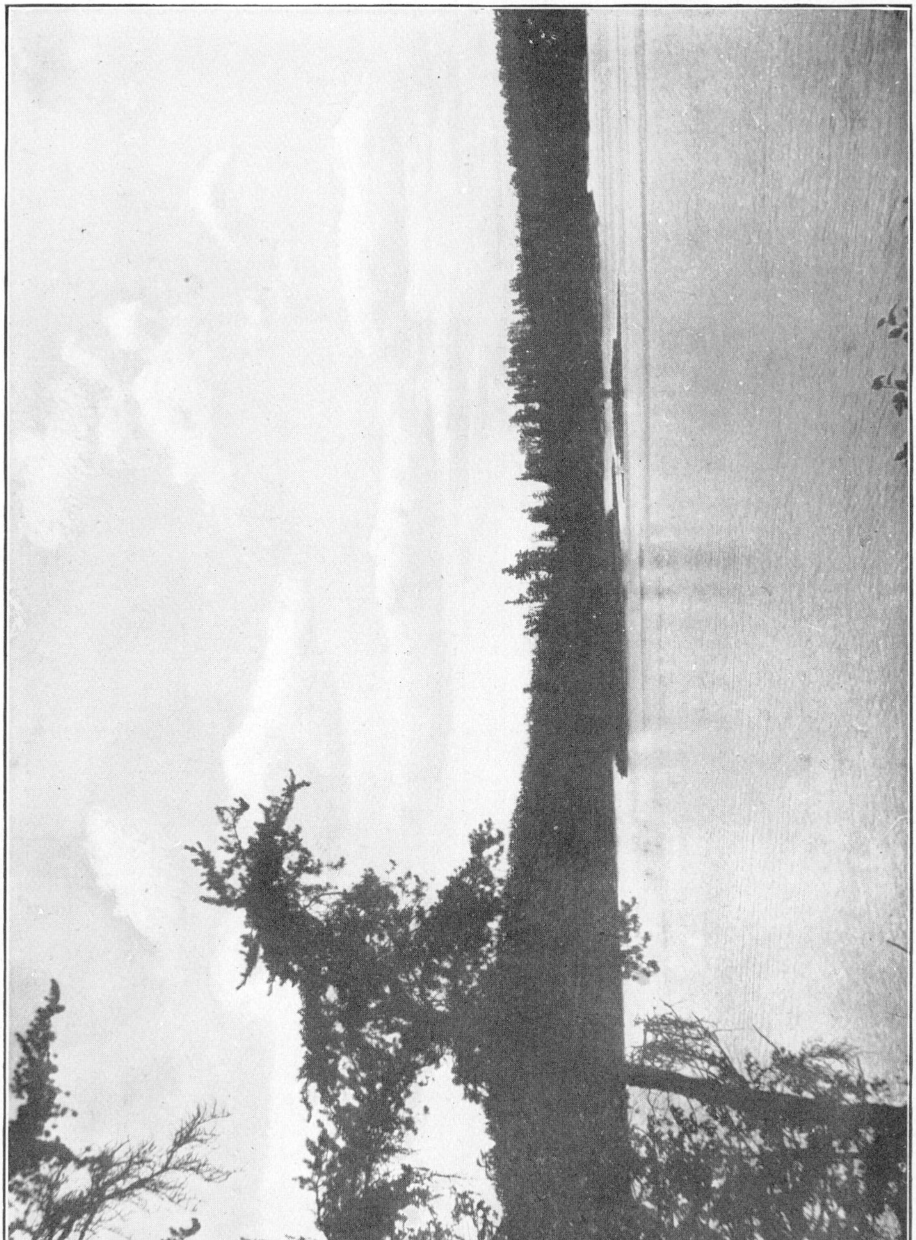

Fig. 1. View at foot of Duncan Lake.

PRELIMINARY REPORT

ON

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DISTRICT OF NIPISSING, ONTARIO

BY

W. H. COLLINS.

INTRODUCTION.

LOCATION AND AREA.

The portion of the Montreal River region with which the present report deals lies in the extreme western part of the District of Nipissing, in the neighbourhood of N. Lat. 47:45, and about 85 miles north of the town of Sudbury. It includes an area of 350 square miles, most of which lies between the two large branches of the Montreal river, which empties into Lake Timiskaming on the west side.

STATEMENT OF WORK.

The Algoma-Nipissing boundary line was run in 1897 by Alexander Niven, O.L.S. These surveys, with representations of some of the larger lakes, had been compiled by the Geological Survey of Canada on a scale of 16 miles to one inch;[1] and on a scale of eight miles by the Crown Lands Department of Ontario. With these as a guide and summary of the existing geographical knowledge it was decided to make a micrometer and prismatic compass survey of both branches.

During the past season a prismatic compass and micrometer survey was made of both branches of the Montreal river and all navigable waters adjoining them. This work was done by Messrs. T. Firth, J. R. Marshall and A. B. Moffatt. Most of the small ponds lying some distance from a canoe route were located by rapid chain and compass methods, and in a few instances west of Duncan lake by a compass triangulation from hilltops; the larger ones have been

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[1] Sketch map of Abitibi region, 1901. No. 760.

measured by pacing or chaining, the smaller ones sketched. Some of the more prominent hills were located by triangulation, and their heights ascertained by aneroid determinations. The water levels were obtained in the same way, but cannot as yet be referred to sea-level.

The geological work was performed by the writer, assisted by Mr. Firth. Besides a thorough examination of all the surveyed routes, a systematic examination of the intervening country was carried out as closely as the time and varied requirements of the area would permit. As this was the first season spent in the district and a continuation of the work is anticipated, the present results are offered as incomplete and subject to revision.

HISTORY OF DEVELOPMENT.

Since the discovery of silver cobalt ores at Cobalt in 1903, exploration has shown the adjacent country to be locally enriched by mineral veins of the same character and genesis. At the close of 1907 an area 65 miles long in a north and south direction, and about 45 miles wide, extending from Lake Timiskaming and the Ontario-Quebec boundary westward, was known to include at least ten mineralized districts besides the principal one at Cobalt, of which the most recently found lie near the Montreal river. It has also become known gradually that these deposits are closely connected with the post-Huronian quartz diabase of the region. This diabase was known to extend for a very considerable distance farther west, leading to the inference that more discoveries were to be expected in that direction. The spring of 1908 saw interest centred upon the Montreal River finds, and early in the season active exploration had commenced. The Montreal river, up to that time, had not been regarded with special favour, the diabase being considered of no economic importance, but with the new conceptions gained by exploitation of the silver-cobalt district, this formation in the west began to attract attention. At the beginning of the field work, early in July, a considerable number of prospecting parties were on the ground, as far west as Duncan and Pigeon lakes. During July and August this movement, encouraged by the succession of mineral discoveries that were being made near Bloom and Everett lakes, increased steadily, in spite of the scarcity of available topographical and geological information dealing with the region.

Early in August discoveries of native silver were made almost simultaneously by Messrs. Mann and associates, and by Messrs. Crawford and Dobie on the west side of Gowganda lake, but were not made public until the first week in September when the claims were recorded at Elk Lake and specimens were exhibited. Twenty-four hours later the leading canoes of an inrushing body of prospectors had reached the new field, and within two weeks most of the promising country between Gowganda and Elkhorn lakes and northward had been staked, regardless of the mineral discoveries necessary to validate the claims. Since then numerous discoveries have been made, and the news of a new silver field, until recently confined to the Montreal River and Cobalt districts, has spread widely. As a consequence, a mid-winter rush is now in progress, and hundreds of prospectors, regardless of deep snow and severe cold, are entering the country. Much inadvisable staking will be done, no doubt, before spring, but the disappearance of the snow and reopening of river navigation will certainly be followed by an increased rush of prospectors.

SUMMARY AND CONCLUSIONS.

The results obtained from the field work indicate that the Montreal River district does not differ essentially from the Cobalt or other neighbouring districts. The surface has the same rugged monotony of the pre-Cambrian peneplain, relieved somewhat by ridges of Huronian, which stand from 300 to 550 feet above the general level. The country is well watered, and offers exceptional facilities for canoe travel. Pleistocene deposits are thin, and nearly everywhere the rock formations are well exposed.

A basement complex underlies the entire region, either appearing at the surface or hidden beneath areas of Huronian sediments. This basement consists largely of Laurentian biotite and hornblende gneisses, with patches of vertically foliated, Keewatin schists caught up in the former; the intervening contacts forming indefinite zones, in which intrusive action is manifested. In this report, for convenience, this complex will be referred to as the Archæan. The Archæan possessed a peneplanated surface, not greatly different from the present one, which is well preserved where overlain by erosion remnants of Huronian sedimentary rocks, but which at other points has been further denuded. The Lower Huronian rocks are of clastic nature, consisting in ascending order, of conglomerate, greywacke, slate and quartzite, which pass conformably into an upper conglomerate; while a granite-like, arkose member is believed from its similarity to rocks of the same character in the Cobalt area, to be possibly of later, Middle Huronian age. They are remarkably well preserved, and show only slight indication of disturbance. A later intrusion of quartz diabase has developed a system of dikes in the Archæan and large tongue-shaped areas in the Huronian believed to represent sills of several hundred feet thickness, lying in the bedding planes of the Huronian sediments. The diabase magma has been notably differentiated, giving rise to forms ranging from gabbroid to syenitic in composition, and to younger aplite dikes. With the diabase is associated a group of veins containing an association of cobalt and silver ore identical with that of Cobalt and vicinity. The veins cut both diabase and aplite as well as the Huronian, and are therefore younger, but probably not much younger than the aplite, since it contains some of the minerals found in them. The distribution of the veins so far as known is confined to the larger diabase areas, the dikes and smaller bodies being undifferentiated and unmineralized; but the Huronian adjacent to the diabase also contains veins, somewhat more siliceous, yet evidently of the same age as the others. Alteration and impregnation of the country rock has taken place to an unknown, but, presumably, limited extent. Some of the veins are remarkably rich, and many of them occupy persistent, well defined fissures. The cause of these fissures is not yet known, but they appear to be too large and continuous to have resulted from contraction alone.

GENERAL CHARACTER OF DISTRICT.

MEANS OF ACCESS.

In 1908 the most used route to the Montreal River district started from Latchford, a station on the Timiskaming and Northern Ontario railway, 93 miles north of North Bay. From this village, situated on the Montreal river, a line of small steamers made daily trips up the river for 56 miles to Elk lake. This up-river terminus was then a rapidly growing village. In the spring of 1907 it consisted of a single shack and a cluster of prospectors' tents; when seen in October, 1908, it had a population of over 200 people and all the conveniences of a village of that size, including a post office with regular mail service, a mining recorder's office, lately removed from Latchford, general stores, hotels, etc.

From this point, which forms the headquarters and point of departure for Montreal River prospecting parties, a variety of routes lead westward. The Montreal river may be ascended to the Forks, where its two branches unite, but the stream is rapid, and, especially in high water, difficult of ascent, besides offering a very indirect route to the most frequented districts. The Bloom Lake route, a map of which accompanies the Report of the Bureau of Mines, Ontario, 1907, was, during 1908, very commonly used. This route, 9 miles in length and consisting of a chain of small lakes and portages, leads, from a point on the main river 11 miles above Elk Lake, directly west to the East branch. From the East branch a multiplicity of courses are open. Both East and West branches are easily navigable, being for the most part lake-like and sluggish, broken by occasional swift river-like stretches in which rapids occur. Good portages exist at all these places so that travel either up or down stream presents no difficulty. Numerous good canoe routes connect the two branches and Duncan and Pigeon lakes, and allow of easy access to the country in the west.

But since the writer left the field the great influx of prospectors has caused marked improvements in the connexion of the area, especially the Gowganda district, with outside railway points. A sleigh road has been opened from Charlton on the Timiskaming and Northern Ontario railway to Elk Lake, and thence about 32 miles south-westward to the east shore of Gowganda lake. It is understood that heavy grades make travel somewhat arduous, but the trip from Elk Lake is made easily in a day.

On February 4, a sleigh road about 65 miles long was completed between Gowganda and Sellwood, the present terminus of the northern extension from Sudbury of the Canadian Northern railway. A regular stage route now connects Sellwood, Phoenix, Burwash lake, Elkhorn lake, and Gowganda. However, neither the road to Elk Lake nor that to Sellwood are yet suitable for summer use; so that with the coming of spring, canoe travel must be again resorted to. It is also reported that preliminary surveys for the extension of the railway to Gowganda are in progress. Meanwhile a business centre is springing up on the east side of Gowganda lake. A sawmill was put in operation on February 3, but has since been stopped owing to its location within a government timber reservation. A town plot has been laid out at the foot of the lake and lots are now purchasable from the Ontario Department of Lands, Forests and Mines. Buildings are being erected as rapidly as the supply of material permits. A branch of the Royal Bank of Canada has been opened, and the Canadian Bank of Commerce and others propose to be on the ground within a short time. Postal connexions have been established via Sellwood, and as soon as possible a mining recorder's office is to be opened. So swiftly are events transpiring that before the present report takes printed form, this paragraph will be in need of revision. However, only the developments of a permanent nature and of essential interest to prospective visitors to that region have been given. For the 1909 field season Gowganda will probably be the headquarters for prospecting parties in the neighbourhood of the East and West branches and Wapus creek.

TOPOGRAPHY.

Attention is given here rather to the details than the general aspect of the country. It exhibits the usual monotonous succession of low rocky hills and lake-containing depressions, the even horizon seen from the summit of any large hill, being only rarely notched by a prominence of unusual height. In the spring of 1908 virtually the whole area was forested, but during September the extreme dryness of the country and the unusually large number of camping parties combined to cause bush fires over much of the country between the East and West branches. The vegetable loam has been removed from extensive tracts leaving the rock formations exposed, but the charred tree trunks have fallen so as to cover the burnt districts with a 'slash,' which greatly impedes cross-country travel, so that what has been gained in one respect is more than counterbalanced in another. Especially is this the case in the country west of Gowganda and Obushkong lakes, and near the Forks.

The general surface may be characterized as of comparatively low-relief, the hills not often rising over 200 feet, but here and there over the country are conspicuous elevations, visible at long distances, which form useful landmarks and from whose summits comprehensive birds-eye impressions of the surrounding country are possible. Structurally they appear to be, in a few cases, resistant knobs of Keewatin, which project well above the general peneplain level, but more commonly they are tilted ridges of Huronian. A characteristic representative of the latter type forms a long ridge beginning a mile and a quarter north-east of Duncan lake and extending thence for several miles in a north-easterly direction. The south-east side of this ridge slopes gently at an angle corresponding with the dip of the beds, but the north-west face is an abrupt cliff dropping almost perpendicularly for about 400 feet to a flat sandy plain which extends westward and northward for several miles, beyond which are other monadnock-like knobs. The accompanying diagram is intended to represent the structure in vertical cross-section.

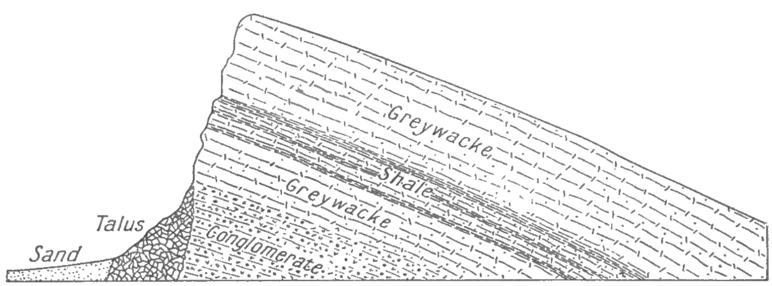

Fig. 2.—Vertical section across Huron Ridge, North of Duncan Lake.

Another ridge of similar character, standing 550 feet above the level of Duncan lake, is visible from the ridge just described and from points on Duncan and Otto lakes, and adjoining country. Its position as indicated on the map is about four miles north of the large island in the middle of Duncan lake, a view of it from this point being shown in fig. 4. In this case the east face is perpendicular. A prominent hill of the same kind is visible from Obushkong lake, lying a short distance to the north-west of that body. Just west of Mosher lake as represented in fig. 5, two round hills of about equal size rise 300 feet above the water level. The more southerly of the two is of Keewatin, while that to the north is composed wholly of diabase, Huronian lying around the base of each. Bold, but less individualized elevations are common in the neighbourhood of Kenisheong lake, and other localities. All these hills are markedly rocky and free from soil.

Less conspicuous than these great masses are certain minor, but persistent features which are directly referable to geological conditions. Within Huronian areas there is a distinct tendency toward the development of a system of parallel ridges similar in structure and mode of origin to the hill at the north-east of Duncan lake. This feature is developed with special regularity in the southern part of the wedge between Duncan lake and the West branch, where a succession of north and south ridges alternate with strips of swampy ground. The western faces of the ridge are bare and cliff-like, while the eastern slopes are gentle, well soil-covered and forested.

The post-Huronian diabase is an equally potent topographical factor. Its surface is one of marked irregularity, but the peculiarly distinctive features occur at its contacts with the Huronian. These contacts appear to be zones of low erosive resistance, and are commonly coincident with ravines, walled on one side by diabase, on the other by Huronian. Small lakes may occur at intervals along them as, for example, between Firth lake and the West branch. This erosion feature is well shown by the configuration of Gowganda lake, where diabase bodies are unusually abundant; both of the long arms to the north-west lie in trough-like depressions marking the edges of the eastern diabase mass. The same tendency in an incipient condition is observable on the east side of the large peninsula where a series of three land-locked bays extend along the contact between the eastern diabase mass and the Huronian. Near the middle of Duncan lake, a diabase-Huronian contact which crosses the lake diagonally is marked by two deep bays, one extending to the north, the other southward. While this tendency is an evident one it is not to be understood as invariable; the large island in Duncan lake between the two above-mentioned bays is sufficient to indicate that contacts may lie in high ground, yet even here there are minor features indicating the contact zone to be structurally weak.

Another less explicable topographic peculiarity becomes apparent only upon scrutiny of the drainage system. A brief consideration of the map shows that both East and West branches follow peculiar zig-zag courses running north for a short distance, then turning abruptly east, this feature recurring repeatedly. In some instances the east-west portion of both branches lies in the same line. In the case of Zigzag lake and adjacent portions of the West branch this feature is repeated with an almost conventional regularity, which precludes attributing it to chance causes. Many of the smaller lakes—Foot lake, for instance—exhibit the same character on a small scale. This abnormality has been commented upon by investigators in the country to the east, the courses there, however, being N.E.—S.W. and N.W.—S.E. Regional faulting is suggested in explanation. The canyon-like east and west walls of Zigzag lake suggest such conditions, but a discussion of the matter must be deferred until further data can be collected.

DRAINAGE.

All the drainage water escapes by way of the Montreal river, whose two chief tributaries are the East and West branches, the latter being considerably the larger. The East branch is without feeders of important size, but the West branch receives a large creek, the Wapus, from the south, and a considerable volume of water enters through Duncan lake.

In common with most rivers traversing the pre-Cambrian region, this water system is marked by a volume of dormant water enormously greater than that being transported at any given moment. With few exceptions the many small tributary brooks rise in lakes or groups of lakes surprisingly large in size, compared with the volume of the out-flowing streams; Otto and Lehmann lakes are drained by a rather sluggish rivulet 8 feet wide and 6″ deep, although their combined area is about two square miles. The larger streams themselves are only successions of irregular lake expansions which empty from one to another by short, river-like portions containing rapids and falls. The descent is therefore accomplished by a succession of abrupt steps rather than an evenly graded slope. This juvenile condition is directly ascribable to the geological character of the country; soil deposits are insignificant in quantity, leaving exposed a resistant and uneven rock floor in which the streams are unable to carve channels for themselves. Failing to do so they select the readiest egress by filling up impervious rock basins and spilling over at the lowest points into lower ones. In consequence of the scantiness of soils and frequency of natural settling basins, the waters of the whole system are free from suspended matter, and hence lack of an effective graving instrument. Exceptions to this general character occur in the extensive sand plain to the north and west of Duncan lake, where the several small creeks that traverse it are of ordinary fluvial form and gradation, and the waters of which transport large quantities of sand to Duncan lake.

FLORA AND FAUNA.

Where not recently burned the country is fairly well forested, the density and character of growth being dependent upon soil and drainage. The best timber is in low ground and near watercourses where conditions for growth are most favourable and the probability of fire least. Recent fires have done much damage around Nest, Obushkong and Gowganda lakes. Probably the best timber lies near Duncan lake. Trees do not grow very large as a rule and are not especially good for making lumber, but provide an abundant supply of materials for pulpwood, railway ties, fuel and for mine use.

White pine is the most valuable species, but although individuals attain thicknesses of 20″ to 40″ they are too scarce to render this timber worth the search. Good red pine is more abundant. Jack pine is a very common tree, especially in sandy districts, *e.g.*, north-west of Duncan lake; but is small and worthless. The common and most widely distributed species are spruce, balsam, cedar, poplar, white and yellow birch. Tamarack is not abundant. Clumps of small red maples were seen to the south-west of Pigeon lake.

The East and West branches are not well suited for carrying logs as there are extensive lake expansions without current on each and the rapids are shallow. Excellent water-power is obtainable at the 40 foot fall on the West branch above Fort Matachewan.

Wild animals are not abundant, and will probably become less so as the country is occupied by prospecting and mining camps. Moose were plentiful in 1908 and some black bears were seen. As a source of food the abundance of pickerel and pike is of much greater importance. Brook trout do not occur in the Montreal River waters, but are caught farther to the west and north.

GENERAL GEOLOGY.

OUTLINE OF GEOLOGICAL HISTORY.

Though the geology of the region presents considerable complexity of detail, the general historical facts are distinct and go to show that the whole complex of formations and systems is capable of separation into four major divisions widely different from one another. The mutual relationships of these divisions, a knowledge of which is essential to a thorough comprehension of the geology, are succinctly expressed by the accompanying diagram.

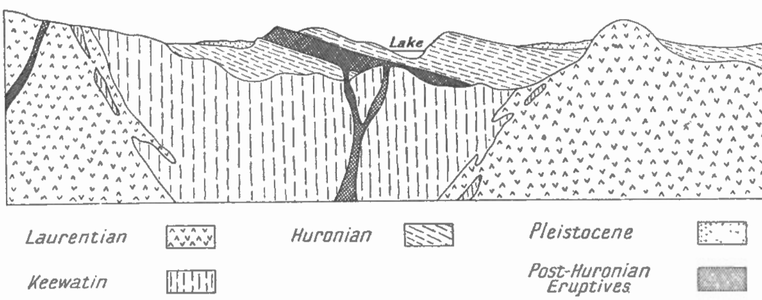

Fig. 3.—Diagram illustrating geological relationships of Montreal River district.

The oldest division, the Keewatin, comprises a complex association of metamorphosed rocks, principally eruptive, characterized by well-developed, secondary schistosity and prevalently dark colours. They dip at angles approaching 90° and range in texture from soft, fissile, chorite schists to fine-grained gneisses or altered diabases. In the Montreal River district the Keewatin areas are not entirely visible, being overlain by other rocks, but they are thought to represent the bottoms of trough-like folds, produced by the upward intrusion of igneous matter which now constitutes the Laurentian. The latter forms the second division, its origin being apparent from the foregoing statement. It is wholly igneous, consisting of granite and allied coarsely crystalline rocks essentially pale-coloured owing to their richness in quartz and feldspars. Gneissic structure has been developed in varying degrees, so that all gradations between granite and gneisses exist; but it never attains the perfection found in the

Keewatin. Near their contacts with the Keewatin, the gneisses are apt to contain dark bands and ribbons of the latter so highly crystalline as to conceal their identity.

Wherever visible the surface of the Keewatin and Laurentian presents an irregular, deeply worn appearance, the result of extremely protracted exposure to erosive agencies. To the best of geological knowledge the same conditions hold where they lie buried under the Huronian, indicating that a great period of denudation separates the latter from the Archaean. The combined Keewatin and Laurentian, or Archæan system, is therefore to be conceived as forming at all points in the district an ancient denuded foundation or floor upon which rests the much younger Huronian system.

This third division is, in the Montreal River district, wholly sedimentary and easily distinguished from the other rocks by its bedded structure and clastic nature. As it is the only sedimentary system represented, its members are not easily confused with any other, especially as their original structure is not obscured by metamorphic alteration. Locally this is not strictly true; in the vicinity of diabase intrusions they have been hardened and shattered so as to simulate the Keewatin, but the zones of alteration are narrow and readily identified by their gradation into adjacent areas of less altered types. At present the Huronian forms a discontinuous rock mantle over the Archæan, formerly more complete, but now worn through in places so as to expose portions of the crystalline basement.

The fourth division includes all eruptives known to be younger than the Huronian. Owing to the discontinuity of the latter it is not always easy to decide what rocks should be included in this group, for in some cases rather fresh-looking eruptives occur in the Keewatin which probably would also intrude the Huronian were it present; lacking the necessary information their chronological position can be only loosely fixed. By far the most extensive and important of the post-Huronian eruptives is the diabase with which the silver deposits are associated. This penetrates both Archæan and Huronian, but is ordinarily distinguishable by its unusual freshness, dark colour, and crystalline appearance. In certain cases, to be described subsequently, it may be confused with certain other diabases. Magmatic differentiative processes have evolved diabase types of very dissimilar appearance and mineralogical composition, of which a pink aplite occurring in dike form is the most extreme. Olivine diabase dikes are also present in the region, but in far less abundance.

Of little importance are the sands and gravels of glacial origin which lie thinly in the depressions and lower lands of the present glaciated surface.

TABLE OF FORMATIONS.

The geological events may be briefly enumerated in ascending order as follows:—

Deposits of glacial débris and weathering products of present surface.

Erosive period with glaciation.

Diabase intrusions.

Huronian sedimentation.

Erosion period.

Laurentian intrusion.

Keewatin.

KEEWATIN.

General Features.

This system is considered as a complex assemblage of metamorphosed igneous rocks whose common and marked characteristics are pronounced alteration and deformation, accomplished in pre-Huronian times. A limited amount of sedimentary material, such as the iron ore formation, is also represented. These old diabases, porphyries and related types are much altered and have developed a more or less uniform schistosity through the secondary development of micaceous minerals, but in other respects the complex shows extreme inconstancy and variety from point to point. For this reason the various localities are separately described. By inspection of the map three fairly well defined areas are distinguishable, in addition to which are portions of several others.

Obushkong area.

Much of the country between Obushkong and Firth lakes is underlain by Keewatin. On the east, south and west sides, these rocks disappear beneath the Huronian or are interrupted by masses of diabase, but on the north they merge into Laurentian gneiss, the contact with which is ill-defined. Although some of them retain much of their original massive character, well defined schistosity is the dominant feature. The schists stand vertically or at angles little less than 90° and trend in a general east and west direction. A series of compass observations made at points over the whole area show the strike to vary from N. 65° E. to S. 75° E.

One of the most abundant rock types is a stratiform, finely speckled hornblende gneiss or schist, the black hornblende cleavage faces giving it a glistening appearance on newly broken surfaces. It is quite fresh, perfectly crystalline and usually eminently fissile, but sometimes grades into a nearly massive dioritic form of undoubted igneous nature. Extensive exposures occur around Gould lake where the gneiss is traversed by numerous stringers of quartz, rusty in colour from the oxidation of pyrite. It is also well exposed near McLaughlin and McIntosh lakes and to the east and south-east of Foot lake. A fine grained chlorite schist of dull greenish black colour is common in this and all the other areas in the district. To the north-east of Serpentine lake it appears as a sheared phase of a weathered diabase, but it has also been derived from porphyry, exposures being seen between Foot and Obushkong lakes, where feldspar phenocrysts appear on weathered surfaces of the schist as pale, oblong spots. What is probably iron formation was observed at points 25 chains south of Gould lake, and 10 chains south of a little pond just east of Serpentine lake. Both outcrops consist of banded, grey quartzite interlaminated with chlorite schist, but magnetite-bearing bands were not found. Occasionally, narrow bands of pale grey, felsitic schists may be seen among the more common darker rocks. From evidence obtained at various points, these appear to have resulted from the decomposition and shearing of granite porphyry dikes probably connected with the Laurentian, and which penetrated the Keewatin during the time of Laurentian intrusion. Serpentine was observed between Foot lake and Obushkong at 20 chains from the latter. The surface is covered by a loose network of fine seams of asbestos which weather white and render the rock somewhat conspicuous Its recognition is further simplified by the dull green, amorphous appearance of fresh surfaces, the slight translucence of thin edges and the glistening green seams of asbestos which traverse it abundantly. The same rock is more extensively exposed on the south-west of Serpentine lake and on Firth lake half a mile north of the portage leading to the former, also at less than a quarter of a mile south of this portage. It is associated with and derived from a dark green massive rock to which the name wehrlite is applicable, and a more detailed description of which appears later.

Duncan Lake Area.

A Keewatin area of considerable extent lies between Duncan lake and the West branch in the vicinity of L'Africain and Beaverhouse lakes. Unlike the Obushkong area, the prevalent strike of the schists is nearly north and south, the greatest divergence noted being 25° W. In the former case Laurentian lies to the north, while in the present one it occurs on the east; in both cases the schistosity coincides approximately with the direction of the line of contact. On account of the swampy character of the country just west of the river and the scarcity of outcrops, this area was not completely explored, but wherever examined the Keewatin, as in the Obushkong area, consists predominantly of hornblende and chlorite schists, greenstone and decomposed diabase; but serpentine was not found. A nearly black diabase containing small grains of pyrite was observed 20 chains south-east of the southerly extending bay on Duncan lake, and outcrops of the same material were traced for about half a mile northward. Probably the same type was encountered just north of Beaverhouse lake and at some other points. Its unfoliated condition and fresher appearance than the adjacent rocks lead to the opinion that it is really post-Keewatin and intrusive, but the absence of younger rocks with which to correlate it, renders its exact age indeterminable. This rock exhibits enough resemblance to fractured contact edges of the post-Huronian diabase to make their distinction in the field rather difficult. At half a mile east of the south end of L'Africain lake is diabase which from lack of sufficient data has been mapped as Keewatin, although it may be identical with the post-Huronian variety. L'Africain lake lies in glistening hornblende gneiss with which are associated ribbons of a coarser hornblende gneiss belonging to the Laurentian of the area farther east. Greenstone and chlorite schists are the principal rocks around Beaverhouse lake. Associated with them and to the northward, are dikes of light coloured, granite porphyry, usually only a few feet wide, in some of which the original massive structure remains, while others show various gradations toward a felsitic, sericite-bearing schist. The isolated patch of

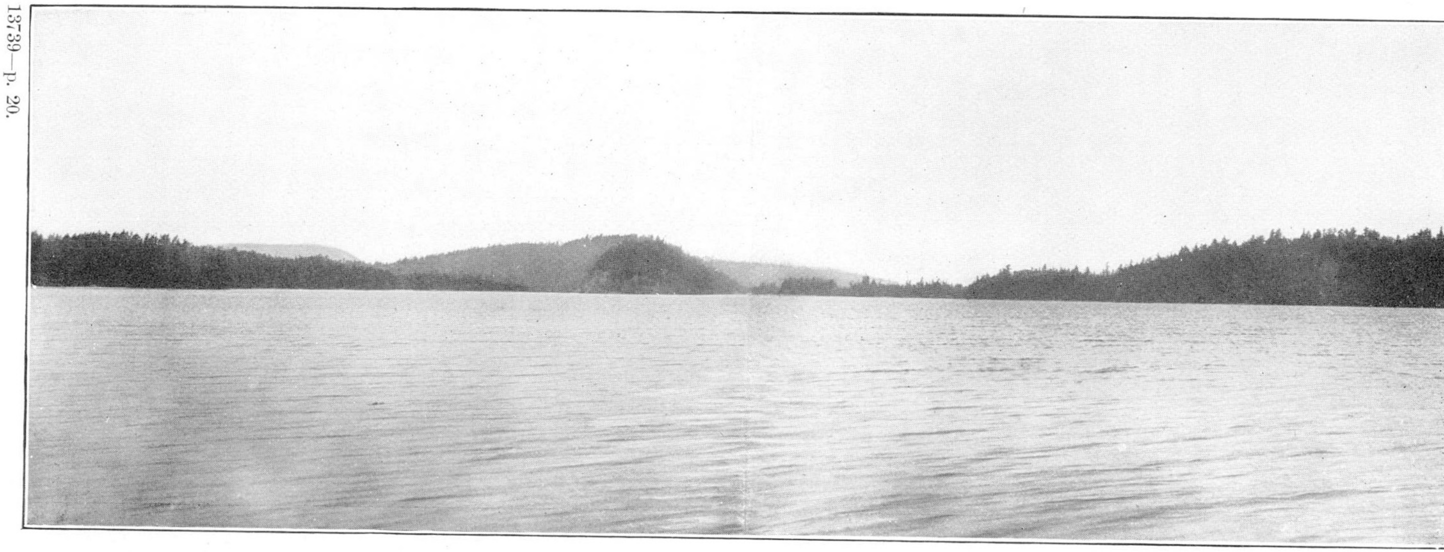

Fig. 4. View looking north from middle of Duncan Lake, 550′ hill in distance.

Keewatin indicated on the map as occurring about half a mile east of the wide portion of Duncan lake, is a well foliated green schist in which oval white spots represent squeezed feldspar phenocrysts.

Pigeon Lake Area.

West of Pigeon lake and the Montreal river, much of the country examined is underlain by Keewatin. Schistosity is less developed than in either of the preceding areas. The rocks are chiefly diabases and porphyry much decomposed and locally squeezed. Diabase occurs on both sides of Pigeon lake near its central islanded part and along the bay which extends south to Brush lake. An original diabase structure is sufficiently well preserved to show lath-like feldspars in hand specimens, but frequently the rock is altered to a chloritic mass. Around the bay extending toward Brush lake, this old diabase forms a rude wall intersected by a reticulating system of fractures filled with calcite, the resultant structure simulating that of a breccia. Shear zones seen on the east shore exhibit a pseudo-conglomeratic structure, the more resistant pieces of diabase having been partially rounded by the shearing movement and embedded in a matrix of finely pulverized rock matter. The same diabase apparently occurs all along the Montreal river where it follows the Algoma-Nipissing line. About half a mile above Pigeon lake it forms a 90 foot cliff on the west side of the river, near the top of which is a fresher looking, unfoliated eruptive. The form of this body was not ascertained, but microscopic examination of the specimen taken, determines it to be a hornblende lamprophyre, so probably it is a dike or thin sheet. The rock is fine-grained, dark green in colour and characterized by stout prisms of hornblende about one-quarter of an inch long, embedded in a finer, microcrystalline ground mass. Under the microscope it appears much decomposed. This rock was also observed near mile post 67 of the Algoma-Nipissing boundary, near the east end of the 63 chain portage leading to Breese lake and at other points, in all cases the exposures being of small extent.

In the last mentioned locality the predominant rock is an altered porphyry of ash grey colour. Around Porphyry lake it occurs in a fairly massive, easily recognizable condition, the feldspars showing as square white spots one-quarter of an inch in diameter in a grey, ground mass. On Breese lake it has been squeezed to a felsite schist, striking N. 20° W. In small amounts it is associated with post-

Huronian diabase on the hills lying near the Montreal river and just south of the 63 chain portage.

The 300 foot hill south-west of Mosher lake is composed of a fine Keewatin greenstone whose surface is curiously weathered so as to suggest a spheroidal structure. It is marked off into round areas a foot or more in diameter by a sinuous network of weathered-out grooves. The main body of the rock is ordinary fine-grained greenstone, but the enclosing grooves have been formed in porphyritic zones about an inch in width. Among other types of less abundant distribution is an actinolite rock seen by the unassisted eye to consist of a felty mass of acicular crystals of actinolite, sometimes half an inch long. This rock was observed 12 chains east of the islanded part of Pigeon lake; also at points west of Montreal river below Pigeon lake.

Unfinished Areas.

The Keewatin formation occupies the space between Near lake and the West branch, only part of which has been mapped. The rocks of this area are well foliated, standing as usual, vertically, and striking about N. 60° E. The exposures on the east shore of Near lake are entirely of fissile, chlorite schist, abundantly traversed by small barren quartz veins. Farther east the chlorite schist gives place to glistening, stratiform (laminated) hornblende gneiss with which are associated bands of a coarser hornblende gneiss, evidently the equivalent of granite. In one locality the stratiform rock contains subangular fragments of the coarser variety, quartz and a greyish eruptive rock, the resultant structure resembling that of a metamorphosed conglomerate or breccia. As some of the brecciated fragments occur near by in continuous bands within the stratiform gneiss, the clastic structure is to be ascribed to deformative movement instead of original sedimentation. A number of fine-grained quartz diabase dikes occur in the immediate vicinity.

A considerable portion of the east shore of Kenisheong lake consists of high, bare Keewatin hills, composed largely of chloritic schists, vertically inclined and striking east and west. Secondary calcite is richly disseminated, causing free effervescence when the rock is treated with acid. Pyrite is also abundant, sometimes segregated to form a lean ore, and at several points weathered superficially to limonite, colouring the cliffs dull red. Much-altered diabase like that on Pigeon lake is also present in subordinate amount.

Fig. 5. West Branch Montreal River, near Mosher Lake.

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Keewatin rocks also occur just east of Gowganda lake. A single brief visit was paid for the purpose of observing the iron formation which appears at this place, and further mention of which is made on a subsequent page.

LAURENTIAN.

General Features.

Practically all the Laurentian lies in a continuous area, east of the West branch and extending beyond the limits of the map sheet. A smaller body occurs just west of Pigeon lake. The foliation in the Laurentian is less distinct than in the Keewatin and much less perfect. Its component rocks are mainly granite and allied plutonic types which pass by easy gradations into well-defined gneisses. Two principal granites are distinguishable; one containing black mica as its chief coloured constituent, the other hornblende. Both exhibit local variations in composition and crystalline texture, but are always pale grey rocks of ordinary granitic appearance.

The hornblende granite is a medium grained, fresh looking rock of speckled appearance, owing to the black hornblende crystals which lie scattered through the main mass of light grey feldspar and quartz. It is of uniform aspect, local variations of colour and texture being insignificant. As revealed under the microscope by a single thin section, it is an ordinary hornblende granite verging towards a syenite. Common green hornblende of idiomorphic prismatic habit, and usually twinned parallel to 100, is the principal ferromagnesian mineral. It is quite fresh, hence a few flakes of chlorite in the section were taken to represent an original small content of biotite; an acid oligoclase and orthoclase are the most abundant constituents; quartz is subordinate. Apatite, zircon and iron ore, probably magnetite, are accessory.

Hornblende granite is the commonest Laurentian rock in the neighbourhood of L'Africain and Sedge lakes, where it is in contact with the Keewatin. It also occurs on the East branch just below Obushkong lake. The area west of Pigeon lake seems to be composed wholly of this rock, outliers of which extend to Brush lake, and the islands and east shore of Pigeon lake. Here, however, it is distinctly syenitic, quartz being subordinate or absent. A distinctly porphyritic structure is apparent on Pigeon lake; the feldspars being well crystallized and lying in a finer grained, holocrystalline ground mass.

Biotite granite and gneiss are most prevalent in the northern and eastern portions of the area. No microscopic examination of these rocks has been made by the writer, consequently, little can be said regarding their composition. They are of much the same texture as the hornblende type, but show a somewhat higher degree of gneissification. Biotite is a fairly abundant constituent, but is more or less altered to chlorite. Sometimes, as may be seen on the East branch, two miles below Obushkong lake, chloritized mica forms enclosing films about the large feldspar grains, developing a slight 'augen' structure. Stockwork-like quartz veins are frequent, particularly on the West branch between Near and Sedge lakes and at the south end of Kenisheong lake. At the latter point the biotite gneiss is well foliated and steeply tilted. A body of deep red, biotite granite of undetermined extent and relationship was observed on the east side of Kenisheong lake. Pegmatite dikes almost certainly occur in this region, although not actually observed. Near Crotch lake the granite is locally of unusually coarse texture, although not truly pegmatitic.

Although the two granites described appear to be the essential constituents of the Laurentian they usually contain a variable proportion of other material, some of which at least is not really Laurentian. Over the entire area, but more noticeably in the vicinity of contacts with the Keewatin, they include narrow ribbons or lenses of a glistening stratiform hornblende gneiss, closely resembling the gneiss of this sort described under the Keewatin system. In some cases these bands are portions of the Keewatin caught up by the Laurentian material at the time of its intrusion and highly metamorphosed by it. Excellent examples of this may be seen on the East branch at the foot of the marshy stretch two miles below Obushkong lake. These inclusions are mapped as Laurentian, being an almost constant feature, and for map purposes inseparable from it. They are to be distinguished—a difficult matter—from other dark inclusions believed to be drawn out, basic segregations of Laurentian magmas; the latter are commonly less sharply defined.

Like the other formations of the region, the Laurentian is cut by diabase dikes of post-Huronian age which, owing to their dark colour, are conspicuous among the lighter granite rocks. In the neighbourhood of Zigzag lake they are abundant, and are usually from twenty to sixty feet or more in width, the smaller of which are not large enough to map.

The relationships of the Laurentian to the other systems of the region are expressed by the contacts with them. Between Obushkong and Firth lakes and toward L'Africain lake it is largely in contact with Keewatin. This contact is a vaguely defined zone rather than a line, the formations being separated by the intermediate strip containing mingled portions of both. Proceeding across this strip from the Laurentian to the Keewatin, the gneisses of the former become charged with ribbons of highly crystalline schist, already described. Near the Keewatin edge these increase in quantity and sometimes appear as tongue-like protrusions of that system. This condition exists along the east of L'Africain lake; on the shores of the lake the formation is dominantly Keewatin, but the stratiform hornblende gneiss is traversed along the strike by thin bands of Laurentian hornblende gneiss. A few chains eastward the gneiss bands are wider, and, at a distance of 10 chains, hornblende granite is continuous.

Where terminated by diabase the contact is definite and not marked by notable alteration on either side. Contacts with the Huronian are equally sharp and unconformable, in every case the Laurentian disappearing beneath the sedimentary formation; at the south end of Kenisheong lake the Huronian has been trenched to a depth sufficient to expose the underlying gneissic floor near the water's edge.

HURONIAN.

General Features.

Much of the area mapped, especially the north-western portion, is composed of Huronian rocks. Originally they must have been much more extensive, probably continuous, but erosion has removed them partially or entirely, leaving irregular remnants distributed over the Archæan. The top of the series is gone; consequently complete vertical sections cannot be found. In other respects they are little changed and preserve almost perfectly their bedding and clastic structure. Even their positions assumed at the time of deposition have changed little for the present strata seldom dip more steeply than 30°. They are overlain only by unconsolidated Pleistocene materials.

Basal Conglomerate.

The basal member of this system is a conglomerate, the areal exposure of which is inconsiderable for the whole region or for any part, but erosional sculpturing has brought it to light at many points. Both top and bottom and probably all intermediate portions are visible, but a complete section from which to determine the thickness could not be found. The greatest continuous vertical section observed, in a hill lying one mile south of the 550 foot hill north-west of Duncan lake, is about 200 feet, but neither upper nor lower terminations were seen. In the neighbouring Cobalt district an estimated thickness of 500 feet has been assigned.

From a study of the pebbles contained, this conglomerate appears to be composed largely, or entirely, of Archæan materials, the majority of which are rock types occurring in situ at many places in the district. Both the hornblende and biotite granite and their gneissic phases are abundant. Pegmatite pebbles are sometimes found, but more usually that rock is represented by fragments of feld-spar. Pieces of glistening stratiform hornblende gneiss and similar stratiform mica gneiss or schist, greenstone, fine-grained porphy-roids and sheared basic rocks represent the Keewatin. Vein quartz is also present, sometimes mineralized. In addition to these some pebbles were observed which closely resembled slate, and one which is undoubtedly conglomeratic. A thin section of this pebble exhibits distinct clastic structure, and the assembled fragments are hetero-geneous, so far as distinguishable, including an actinolite rock resem-bling that found in the Keewatin near Pigeon lake, and a quartzitic type composed of a colourless, microcrystalline mosaic. The cement has been altered largely to chlorite, but small grains of quartz are discernible in it. It would seem, therefore, that sedimentary deposits antedate the basal conglomerate and supply a portion of its mate-rials; most of these, however, are recognizable as igneous members of the Archaean, such as occur in the vicinity.

The pebbles of the conglomerate exhibit remarkable variety in form, size and abundance, as well as composition. Normally they are well rounded and owe their form evidently to water action. But along with these are others which are angular or sub-angular. The exposure near the north end of Shallow lake shows all these forms, the materials also being quite diverse. Ordinarily the pebbles range in size between 2″ and 3″ diameter, frequently more, and are abundant; but, at points on Duncan lake, on Wapus creek and the West branch, the conglomerate nature is indicated only by occasional well-rounded pebbles, embedded in greywacke cement at intervals of several feet or even yards. These isolated pebbles are often 6″ or more in diameter, and in striking contrast with the uniformly fine grain of the matrix. Sometimes the enclosed bodies attain the dimensions of boulders; on an island in Duncan lake, 2½ miles from the foot, a granite boulder nearly 5 feet in diameter was observed, the associated materials being of very much smaller size.

The cementing material also presents some variety. Usually it ranges from coarse grit to greywacke. The coarser material is less abundant than cement of a finer type; near the foot of Pigeon lake, also at the south end of Kenisheong lake the conglomerate is quite porous, the interstices between the pebbles being incompletely filled. In the latter instance these spaces are occupied by hematite. In other cases; a good example of which occurs on the east side of Pigeon lake, half a mile from its north end, the cementing substance is a fine black shale. On the whole there appears to be little relationship between the texture of enclosing and enclosed matter.

Greywacke Slate and Quartzite.

By the disappearance of pebbles the basal conglomerate changes into a greywacke or a shale according as the cement is one or the other. Frequently this transition is marked by an alternation of lenticular beds of conglomerate with the greywacke, probably indicating varying conditions of depth or current in the water in which they were deposited. With the greywacke and shale is associated an impure quartzite or arkose, the whole forming a thick series whose members are not sharply separable one from another and do not occupy definite relative positions. For the well laminated finer grained beds the term slate is in general use, although a secondary cleavage by which this kind of rock is distinguished from shale does not exist. Nearly all the prominent hills in the north-western part of the area are composed of this series.

Upper Conglomerate.

The greywacke-slate-quartzite series passes conformably upward into a conglomerate differing little from that at the base. Indeed, where conglomerate outcrops are small and isolated a distinction between the two cannot be made with certainty.

Arkose.

In addition to the above there is an arkose forming at least two well defined areas, whose relations with the rest of the Huronian are in some doubt. This rock is of distinctive appearance, resembling at first glance an ordinary granite, but on closer inspection it is seen to consist of clastic materials such as would result from the disintegration of a granite. Occasional conglomerate streaks in which pebbles of quartz and greenstone are recognizable, demonstrate its bedded character, but ordinarily it is massive looking. Part of the large island in the middle of Duncan lake and the shore to the south are of this formation. It is much more widespread on Obushkong and Gowganda lakes, the bedding being unusually well shown on the large island in the latter body of water.

From its apparent relationship in either of these localities it might be taken to be a member of the Lower Huronian series just described, and equivalent to the basal conglomerate. In the Obushkong area it is probably underlain by Laurentian, for it lies nearly horizontally, and Laurentian is known to occur a short distance east of the lake. In the neighbourhood of Lake Timiskaming it is said to grade imperceptibly into granite, and is believed to be derived from the latter by detrition in situ. Arkose, apparently identical with that under consideration, occurs in the Cobalt district, and is thought to lie unconformably with the greywacke, and for this reason is classified as Middle Huronian. In these pages it is given no definite position in the formational succession, and as there is no field evidence of its Middle Huronian position, is not differentiated from the lower series.

Structural Features and Disturbances.

The Huronian has been subjected to no very severe disturbance, judging by its present condition and attitude. Frequently the strata lie almost horizontally, as for instance at the south end of Firth lake, and in the vicinity of Lake Lehmann, but over the most of the region they rest at inclinations as high as 30°, this attitude remaining constant over extensive areas, and developing a characteristic topographical feature. From Pigeon lake eastward the dip is uniformly to the east at angles ranging between 15 and 30 degrees and the beds overlap one another after the fashion of slates on a roof, the resultant topographical expression of which is a succession of north and south ridges with gentle eastern slopes, while the western sides form escarpments. This condition appears constant over all the Huronian east of a line midway between Pigeon and Duncan lakes. To the extreme north-west, however, a westerly dip was observed; the strata forming the 550 foot hill west of Duncan lake are also either horizontal or dip gently to the west. A confident statement cannot be made until further work has been performed, but the condition just outlined suggests a large anticlinal structure whose arch lies a little west of Duncan lake. However, there seems reason to believe that the structure is more complicated than would result from simple arching and erosion. If the present overlapping system represents the original succession of strata a total thickness of over two miles would be necessary, and there would be not two but several conglomerate horizons, which is improbable. A satisfactory solution is hindered by the general fact that planes of possible dislocation occur in low ground and are obscured by swamp or water, but it seems evident that tilting was accompanied by lateral or vertical displacements.

Certain abrupt disturbances of the general uniform attitude suggest differential movements. Along the West branch below Wapus creek the dip and strike of the shale and greywacke are constant, until where the river's course changes to due east. Along the shores of this stretch the rocks are mostly hidden by swamp, but where they do outcrop they are standing vertically or dipping steeply to the south, and the strike corresponds with the course of the stream; that is, their positions are at right angles to those farther south. Disturbances of this sort are known, due to the contiguity of igneous intrusions, but at this point no such intrusive is known. It will also be seen from the map that exactly in the same line the East branch makes a similar abrupt change in course. Whether a line of low relief is continuous across the interval between the two streams at this point is not easily determined; however, as a possible explanation of the conditions stated, faulting along this line is suggested. A similar abrupt change from conditions of approximate horizontality to a dip S. 60 W., $< 80°$ and strike of S. 30° E. was noted on the west side of Firth lake.

Relations to other Formations.

The intrusion of the quartz diabase into the Huronian was gently accomplished at most points, and the beds of the latter, both above and below the intrusives, are inclined only a few degrees more steeply than in localities where no diabase can be found. Evidence of intrusion, however, is common, and at some points the Huronian next to the diabase has suffered local but intense physical change. Near the middle of the east shore of Firth lake a rocky islet only a few square yards in extent consists of coarse diabase and conglomerate in intimate contact, little tongues of the former being protruded into the sedimentary rock and peripherally chilled. Most remarkable, however, is the change in condition of the conglomerate; a few chains away on the main shore it is of ordinary character, but on the islet the pebbles lie within a fairly well foliated schist, standing vertically and striking about east and west. An identical condition exists at the south end of a little pond lying 40 chains west of Mosher lake. The vertical foliation of the conglomerate suggests the neighbouring diabase intrusion to have been by vertical ascension rather than lateral spread, so that these points may represent portions of vents through which the diabase magma ascended, and for that reason are more affected than where sills have been quietly injected.

Ordinarily these contacts occur in low ground, usually ravines, the bottoms of which are soil filled and consequently unfavourable for geological observation, but at some points on Duncan lake the contacts are exposed and the Huronian is seen to be much fractured across a zone extending many feet from the diabase. In addition to the fracturing the greywacke is hardened and the bedding planes rendered obscure, the total effect being to weaken its power of resistance to erosion.

In the neighbourhood of these contacts the Huronian is well supplied with quartz veins whose 'comb' structure and chalcopyrite-galena mineralization identify them with similar veins in the diabase. Also the sediments exhibit certain mineralogical alterations referable to action of the diabase. West of Gowganda, on the West branch below Duncan lake and at other places the greywacke for a width of about two feet from the diabase has been hardened, bleached a light grey colour and filled with circular black spots $\frac{1}{16}$″ in diameter. Microscopic examination shows the main portion to consist of a mosaic of small quartz, orthoclase and acid plagioclase grains, through which are distributed patches of chlorite. This spotted phase of the greywacke evidently represents an early stage

Fig. 6. Fifth Portage on the West Branch of Montreal River, showing Huronian Slate.

in the development of adinole, a characteristic contact product of shales, intruded by basic rock.

The relations of the Huronian to the Archæan, exhibited in larger as well as minor features, indicate that the surface of the latter had been carved into a condition not greatly unlike the present topography, before its submergence and sedimentation in Huronian times. Some of the hills of this ancient land have been uncovered by the removal of their sedimentary blanket, leaving vestiges of the latter around their bases as in the case of the hills south-west of Mosher lake. There the dip of the sedimentary beds is much less than the slope of the hills, so that the latter must project up through them as cores. In the bay on the east side of Pigeon lake Huronian shales dipping with an angle of about 15° abut against the side of an Archæan hill composed of hornblende granite and green schist. At almost any part of the region where both Huronian and Archæan occur together, similar evidence is available concerning the unevenness of the pre-Huronian land surface. The amount of topographical relief cannot be estimated with any degree of accuracy, for tops of the Keewatin hills now exposed have probably been removed by post-Huronian erosion, the lowest depressions are still filled by Huronian and the whole may have been disarranged by post-Archæan faulting. However, near Mosher lake there was a minimum relief of 300 feet.

This old pre-Huronian surface is not often accessible for study, the contacts being vertical or hidden by soils and vegetation. At one point, however, at the end of the portion of Wapus creek shown on the map, exceptionally favourable circumstances were encountered. Here glaciation has developed a rounded knoll of mixed Keewatin and Laurentian rocks upon which are tightly fastened a few scale-like vestiges of Huronian conglomerate. A few square feet of the original Archæan surface exposed by chiseling away the Huronian, was found to be much more highly polished than the immediately adjoining, recently glaciated surface which had been exposed to the atmosphere. The protected material seemed to be of about the same freshness as that exposed. This pre-Huronian surface is evidently a water-worn one, or the result of Huronian glaciation, but no characteristic markings were observed upon it.

Origin and Correlation.

From the foregoing consideration of the Huronian as seen in the Montreal River region it will be plain that it is composed at all points of clastic sedimentary deposits. Fossils have never been found, so the correlation of these rocks in various areas is based upon their lithological similarities and continuity. Upon these grounds the Huronian of the present district is considered to be equivalent to the same formations in the Cobalt, Larder Lake, and other neighbouring districts, known as the Lower Huronian. The succession and physical character of the different formations are essentially identical. It is not necessary to review the facts upon which the decision to so place these formations is based, the evidence being the harmonious results of years of investigation by capable geologists. Accepting their conclusion, and calling the main sedimentary series of the Montreal River district, Lower Huronian, it is of interest to note indication of sedimentary materials still older. The conglomerate pebble found in the basal conglomerate on Pigeon lake must have originated by the destruction of a pre-Huronian conglomerate formation.

It has also been stated that ground for differentiating between a Lower and Middle Huronian in this area has not been obtained, although the similarity of the arkose to a formation in the Cobalt district believed to belong to the Middle Huronian suggests it to be of the same age. It is, therefore, thought desirable to apply to the whole the term Huronian. No clearness or additional truth would be gained by making a distinction between Lower and Middle divisions in this district, and so far as the economic exploitation of the district is concerned the arkose seems to be as much a part of the Lower Huronian as the conglomerate or greywacke.

POST-HURONIAN ERUPTIVES.

There are two kinds of diabase known in the district, one of which greatly exceeds the other in extent and economic importance. This disparity is tacitly recognized by the common use of the generic term diabase for the important quartz diabase, the other member of the family being ignored or unknown.

Quartz Diabase.

Character of contacts and distribution.—Bodies of this rock are not restricted to any one formation or locality; but, as may be seen by reference to the map, occur with various dimensions over the whole area, with the exception of the country lying north-west of

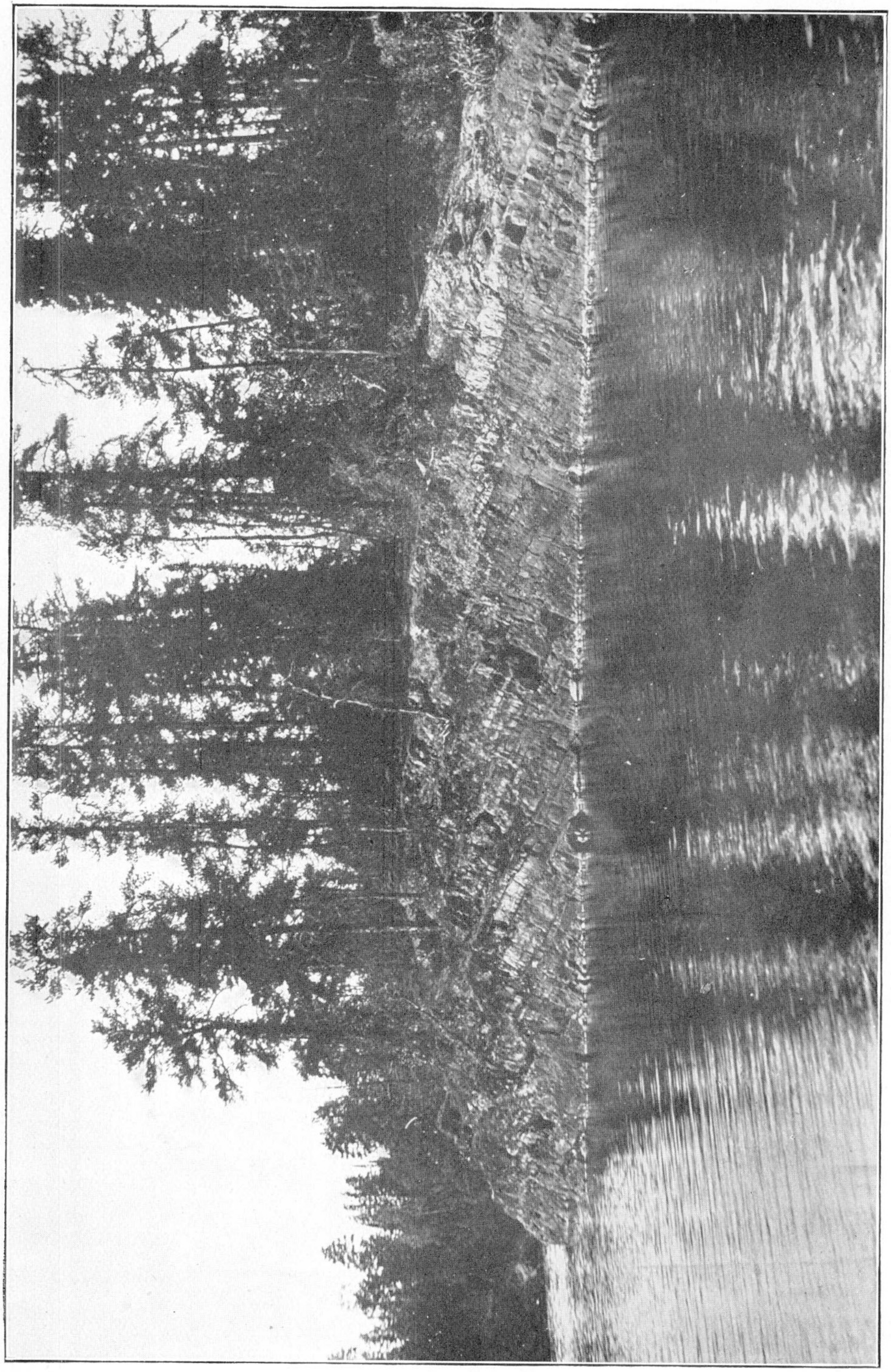

Fig. 7. Inclined Huronian Beds, Duncan Lake.

Duncan lake. It may be noted that virtually all the large areas are enclosed by Huronian, the bodies within the Archæan being numerous but small. It is not proposed to apply this distinction generally, but in the Montreal River region it seems to be more than an expression of the law of probability. In the Archæan practically all of the observed diabase bodies are dikes, in approximately vertical positions, seldom 100 feet in width and of undetermined length. A knowledge of all those in the Huronian could not be obtained, but in some cases they are sills, whose greater exposed dimensions are parallel to the bedding planes of the enclosing sedimentaries.

Macroscopic character.—It is fortunate for the easy recognition of the diabase that it is more or less continuously exposed, and that there are not many other igneous rocks of similar character in its proximity, for it presents a variety of types such that a representative collection of hand specimens presents surprisingly great petrological differences. During the process of solidification, magmatic differentiation evolved from the cooling material a group of forms of different mineralogical composition and physical appearance, the end members of which are very unlike.

The common type is a dark green massive diabase, ranging in texture from one in which the individual minerals are barely distinguishable to others containing amphibole crystals an inch in length. The combination of black amphibole—an alteration product of augite—and grey or flesh-coloured plagioclase give the surface of ordinary textured phases a colouration of sufficient determinative value. In a large diabase body the coarseness is equal to that of ordinary granite, and the diabasic structure is not readily perceptible. At the edge of the large dikes and throughout the smaller ones the rock is black in colour and much finer grained on account of its more rapid solidification.

In the dikes the mineralogical composition is tolerably constant, and specimens selected from different points show no notable difference except that they are usually less decomposed than the coarse grained varieties. Within the larger bodies, where cooling may be considered to have been slower, a series of rock types differing from one another in mineral composition, and consequently in physical appearance, are associated. At many localities these differentiated varieties are intimately intermingled, so that withtin an area of a few square yards almost the whole series may be found. Conditions of this sort were first and best observed in the Lett properties on Wapus creek, where the extensive stripping and trenching greatly facilitated geological study. A suite of specimens was obtained which exhibit an unbroken gradation from ordinary gabbro to the fine grained pink rock known as aplite. With a decreasing pyroxene content and increasing abundance of feldspar the rock grades from a dark green diabase at the basic end through a reddish phase into a type which, in the field, might be termed a syenite, being of granitic texture, red colour, and without visible quartz. These phases are cut by aplite dikes which at first glance do not very closely resemble them, but their comparison has shown that they too include a group whose coarsest and most basic form does not differ greatly from the syenitic type of the diabase series. From a pale flesh-coloured rock of fine granitic texture in which a little dark mineral is visible, the successive phases of the aplite graduate toward a dike material of light pink colour and saccharine texture almost devoid of ferromagnesian constituents.

Microscopic character.—The consanguinity of diabase and aplite is further established by microscopic study. It was intended to make a somewhat complete comparative study; but, at the outset, the materials, although fresh looking in the hand specimens, were found to be much decomposed, sometimes so completely that the original composition could not be satisfactorily inferred, and an outline must suffice therefore until fresher material is secured.

The common gabbro type consists essentially of long prisms of plagioclase embedded in light reddish augite. This ophitic structure, upon which the distinction between diabase and gabbro depends, is well developed, but does not show in hand specimens, so that for field use the distinction is impracticable; ordinarily the term gabbro is applied to the coarse grained, and diabase to the medium and finer grained varieties. The plagioclase of the coarse grained specimens could not be identified, being entirely altered to a coarse saussurite in which the epidote was aggregated into large grains. The augite is almost equally changed to strongly pleochroic hornblende possessing green and blue green pleochroic tints. This hornblende is not a fibrous variety but forms compact individuals, hence in the specimens studied it could not be certain that some of it was not primary. In some cases it is further altered to chlorite. Reaction between plagioclase and pyroxene seems to have taken place, for chlorite occurs among the plagioclase decomposition products as well as those of the pyroxene. Next to these, ilmenite is the most abundant constituent, occurring as irregular masses largely altered to leucoxene in which the original 'gridiron' structure is distinct. Quartz is present in subordinate amounts usually in micrographic intergrowth with the plagioclase. Small, well defined hexagonal rods of apatite, titanite crystals, and rare zircons are also present. The structure and mineral constitution render the term quartz-diabase appropriate. Finer grained specimens secured from dikes were found to be much fresher than the coarser types and yielded more satisfactory thin sections; the ophitic structure is more pronounced, but the mineral composition is the same. The plagioclase laths of one section were determined optically to be an intermediate labradorite. Small flakes of biotite partially altered to chlorite occur accessorily.

The aplite is also so much weathered that doubt sometimes exists as to its original composition. Thin sections consist very largely of plagioclase and quartz, coloured constituents being small in quantity. The plagioclase is twinned according to albite, pericline, and carlsbad laws, and in one case a baveno twin was observed; optically it behaves as almost pure albite and is decomposed to sericite instead of epidote. A poikilitic arrangement is more or less distinct; the feldspar is also micrographically intergrown with quartz. No orthoclase could be identified in any of the specimens. Quartz does not appear to be much more abundant than in the diabase. The only recognizable ferro-magnesian mineral is a strongly pleochroic reddish brown biotite, which occurs sparingly in small ragged flakes, partly altered to chlorite. Leucoxene representing ilmenite is surprisingly abundant considering the scarcity of iron bearing silicates. Apatite is an abundant accessory mineral, forming small prisms, while zircon crystals are rare. The rock in the specimens examined is remarkably rich in calcite, which in amount ranks next to the plagioclase.

Comparison of sections from specimens intermediate between the aplite and the ordinary diabase brings out some features of the differentiating process. The governing changes are in the proportion of pyroxene, and in the composition of the plagioclase. A specimen somewhat paler in colour than the typical diabase was found to contain considerably less augite and more abundant plagioclase, the other constituents remaining fairly constant. The plagioclase was an acid andesine of the composition (Ab 65 An 35). A still lighter coloured type possessed oligoclase (Ab 72 An 28) and a small amount of blue green hornblende, representing the wholly altered pyroxene. Orthoclase could not be found in any of the sections, so that none of these rocks can be properly called syenite or granite.

Local description.—Diabase is most abundantly exposed in the area between Gowganda lake and the portage route connecting Firth and Elkhorn lakes, where it forms three parellel tongues of approximately equal dimensions. Coarse grained types prevail in which the differentiation of acid phases is pronounced. Aplite dikes up to 10 feet in width, fairly coarse grained and sometimes tolerably rich in dark constituents, are abundant. The rugged surface of this part of the country is largely due to the presence of the diabase, the peculiar arrangement of which has produced a constant system of north and south ridges. The contacts with the Huronian occupy the bottoms of gullies, with the main body of diabase forming high ground. This highly relieved and consequently well exposed surface has greatly facilitated the exploitation of this area, as indeed is the case for the whole district. Terminally each of the three bodies tapers out or forks, but these details were not closely mapped. In the case of the most easterly one the portions reaching the east side of Firth lake are darker and more decomposed than the ordinary diabase, and during the field operations were considered of other character. Laboratory study of the specimens shows them, however, to be basic diabase in which hornblende has completely replaced the pyroxene. In consequence of this misconception the connexions of the exposures on Firth lake were not well worked out, but they almost certainly lie as shown in the map and may form a continuous connexion with the large diabase body farther north. The two areas northeast of Firth lake present much the same appearance as those of the Gowganda district.

The most extensive body is that which coincides in direction with Duncan lake, resembling a great hook, the shank of which is traceable for twelve miles, the crooked end lying about midway between the West branch and Firth lake. Neither termination was found, on account of the swampy or sandy character of the country, so that the present representation may not be complete. Just east of L'Africain lake there are some diabases which may be continuations of it, but owing to their altered appearance they could not be distinguished with certainty in the field from similar Keewatin forms. Along Duncan lake it appears to represent the edge of a sill about 300 feet thick lying in the bedding plane of the Huronian sediments which lie both above and beneath it. From the attitude of the latter the sill is believed to dip eastward at an angle of 30 or 40 degrees. The exposed width is usually less than in the Gowganda area and its composition is more homogeneous, but at the wider portions the same intermingling of basic and acid phases and aplite dikes obtains, as for example where it crosses Wapus creek. The full extent of that portion which extends north-westward from Mosher lake is not known. The formation at that point is obscured by gravelly soil; it appears, however, to be unusually wide and well differentiated. An apparently large body of diabase lies between the north part of Duncan lake and the West branch. The mapping of this was left incomplete, so that its total southern extent cannot be given. Its northern part presents nothing unusual, but about Vipond lake a syenitic phase is developed, probably indicating a mingling of differentiated rock varieties as at Gowganda lake or Wapus creek.

The remaining diabase bodies are dikes. Probably these are very numerous and widespread, but this can only be determined by work of much more widespread nature than the economic possibilities of such an investigation warrant at present. They are most frequently seen in the Laurentian, probably not so much because they are more numerous there, but because they are more conspicuous in the granites than in the Keewatin schists and Huronian, from which they differ less in colour. They attain widths of 60, 100 or more feet, in which cases the texture is like that of the large masses, but differentiated types and aplite dikes do not seem to accompany them. The smaller dikes, diminishing to a width of 1 foot, are compact black rocks of microcrystalline habit, but like the gabbroid varieties mineralogically.

Age.—The time of intrusion of these rocks can only be defined as post-Huronian or post Middle Huronian, there being no younger formations with which to correlate them. They are identical with the diabase in other parts of the Montreal River region and of Cobalt. As already noted the larger masses have produced very limited metamorphic changes in the adjoining rocks, developing incipient adinole zones in the Huronian greywackes, besides hardening and fracturing them. Usually the contact edge of the diabase has been deeply eroded along with the adjoining rock to form narrow ravines, but wherever it persists a slight chilling is perceptible. The fine grained edges are much more apparent in dikes where the mass of hot material being much less was more susceptible to the influence of cold surroundings. The intrusive nature is also demonstrated by angular blocks of Huronian materials enclosed within the diabase, instances of which may be seen on Wapus creek.

Olivine Diabase.

At the first rapid above Kenisheong lake the Huronian is cut by a broad dike of different character from those belonging to the quartz-diabase intrusion. It is a remarkably fresh compact rock of dark grey colour and medium texture in which an ophitic structure is prominent, acicular prisms of glassy feldspar penetrating the dark main mass. Its density is 2·991. Under the microscope it is holocrystalline and the constituent minerals occur in only one generation. The constituents as determined by linear measurements were found to be plagioclase, 67·5 per cent; olivine, 14 per cent; augite, 1·5 per cent; iron ore, probably ilmenite, 5 per cent; apatite, 1·8 per cent; biotite, 1·3 per cent; and zircon, 0·03 per cent. The rock is remarkably fresh, even the olivine showing no signs of decomposition. The plagioclase was determined by optical methods to be a labradorite of the composition Ab 1 An 1. It forms laths, twinned according to albite, pericline and carlsbad laws, which penetrate the ferromagnesian minerals. A few large crystals show fine zonary lamellation. Olivine is in idiomorphic or rounded grains, occasionally bordered by a little rim of biotite, possibly a product of reaction during the period of crystallization. The augite is reddish brown in colour and later than either olivine or plagioclase, filling the interstices between the feldspar laths. Irregular masses of black iron ore, probably ilmenite, are scattered throughout the section, in some cases showing good crystal forms. A deep brown strongly pleochroic biotite with a very small optical angle occurs accessorily in small shreds. Apatite is mostly in slender but sometimes stout hexagonal prisms. Minute crystals of zircon are rare.

The rock may be designated an olivine diabase of markedly fresh aspect. It penetrates the Huronian, but judging by its unusually fresh condition it must be comparatively young.

PLEISTOCENE.

The present glaciated pre-Cambrian surface is scantily covered by unconsolidated glacial sands and gravel which are being collected by natural agencies from the hills and more elevated parts into the depressions. As a consequence the hills are bare, while the valleys and ravines are soil-filled and support a strong forest growth. Neither sand nor gravel show signs of stratified arrangement. They play an unimportant part in the topographical appearance of the country; the only elevation composed of such materials being a small gravel hill to the east of Porphyry lake. Between that point and the hills near Mosher lake is a considerable extent of flat sandy country, the gentle contour of which contrasts with that of the surrounding hills.

A rather peculiar low apron of sand occupies the very end of the peninsula between Duncan lake and the West branch. It is of small extent, and is probably due to river deposition, the West branch at this point being sluggish and the surface of the sand showing indications of shifting stream beds.

An extensive area of sand lies at the end of Duncan lake, from whence it extends northward for several miles, also westward and south-westward toward the 550 foot hill shown on the map. Seen from any neighbouring hill this plain appears flat in comparison with the ordinary surface of the country. It consists of a fine, yellowish, unstratified sand. The several brooks crossing it are distinguished from those of other parts of the country by their tortuous courses which are constantly changing, and which render them unfit for canoe travel. The shallow character and sandy shores at the north end of Duncan lake have been caused largely by the transportation of sand into it by these brooks.

Glacial boulders are scattered over the whole district.

ECONOMIC GEOLOGY.

Silver.

DISTRIBUTION.

With the knowledge acquired from exploitation of James township, and other of the more recently discovered silver-cobalt camps, prospectors in the Montreal River district gave exclusive attention to the diabase formation, recognizing it to be closely connected with mineralizations of this kind. Some work was done in 1907 and more in the following season, with the result that on August 4, the first native silver discoveries were made, almost simultaneously and at short distances apart, by Messrs. Mann and Dobie, in the diabase just west of Gowganda lake. The remarkably rich surface showings at once attracted the attention of the whole prospecting body in the Elk Lake country, and an activity began which, since the spreading of information to outside points, has developed into a 'rush' of large dimensions.

The known silver bearing area is restricted as yet to about ten square miles lying between Gowganda lake and the portage route from Elkhorn to Firth lakes, and is commonly known as Gowganda. Extensive prospecting only commenced in September, about the close of the field season, so that only the earlier discoveries are known to the writer, and a knowledge of the surface details could only be derived by examination of the few beginnings of patient and continued exploration by claim owners. The present account must accordingly be accepted as incomplete and by no means representing the present status of the Gowganda camp.

SURFACE INDICATIONS.

Conditions in the region are such as to demand exploration of the closest and most intensive order, for the indications of mineralization are negative rather than positive in character. The Gowganda area was entirely forested at the beginning of 1908, and a carpet of moss and vegetable mould covered most of the rock surface. Glacial materials are also fairly abundant, and sometimes thick enough to render surface exploration arduous and expensive. Added to this the veins are eroded more deeply than the country rock, and are represented at the surface by crevices filled with soil, and thereby rendered inconspicuous. Were the country a flat one the difficulties in the way of successful prospecting would be very serious, but fortunately it is rugged, especially near the diabase. Steep ridges of this material are a regular topographical feature. The sides of these ridges are bare or readily exposed and offer fine opportunities for examination. It is significant that the first silver discoveries were made in the sides of such rock walls. The pink bloom found at the surfaces of the veins and the adjacent country rock is also an indicator whose value is fully understood by those working in the region.

STRUCTURE OF VEINS.

The deposits are in the form of well-defined veins occupying fissures in the diabase. The amount of surface work done in September was not enough to throw much light on the continuity of the veins, but a few had been traced for distances of 300 or 400 feet, and in one case across several contiguous mining claims, so that they may be said to occupy persistent fissures. They vary in width from 1″ up to 20″. Little could be learned concerning their attitudes except where they traverse hillsides; in such cases they are approximately vertical. It is not yet known whether any regularity exists in their arrangement, but some extend east and west while others are north and south. The diabase shows no signs of extensive deformation, all geological evidence indicating that since its solidification its history has been uneventful, yet the cracks which the veins occupy appear too persistent to be the result of contraction by cooling. Besides the strong veins there are others of the gash type, but the latter are small, not very continuous and poorly or not at all mineralized.

COMPOSITION OF VEINS.

From comparison of veins at Gowganda, Duncan lake, and Wapus creek a general uniformity of structure, though not of mineralization, is found to obtain. The whole mineral association is not found in any one vein, nor are the relative proportions either of ore or gangue at all constant. The gangue minerals are quartz and calcite, always mutually arranged in definite manner. The sides of the veins are composed of white quartz, which may form only an insignificant coating on the walls or may occupy nearly the whole space, but in all cases there remains a central cavity into which the pointed ends of quartz crystals project freely. At the surface this central portion is empty owing to weathering, but farther down it is filled by calcite.

Veins with predominant quartz filling seem especially abundant in the Huronian adjacent to the diabase. The rich veins near Gowganda, so far as ascertainable, are poor in quartz.

Practically all of them carry chalcopyrite either as diffuse grains or in considerable amounts. Pyrite is equally abundant but less constant. Galena is not uncommon. All these occur with the quartz; their presence in the calcite is not certainly known. Many of the veins show diffuse stains of reddish pink colour due to cobalt bloom, which though not in itself of value is important as a sign of the existence of smaltite from which it is formed by oxidation. The minerals enumerated thus far are widespread, but economically insignificant; the silver-cobalt association is present in some cases, however. Little opportunity existed in 1908 for favourable study of these minerals, so that only a list of those found at the surface can be given. There native silver, argentite, smaltite and cobalt bloom have been found, and a few feet down small lumps of native bismuth. Because they occur either in calcite or in loose decomposition materials filling the space which the calcite formerly occupied they are believed to be associated with that gangue. Infrequently gangue minerals are almost absent and the vein filled by massive ore.

LOCAL DISTRIBUTION.

Valuable argentiferous veins were known in 1908 only in the Gowganda district, and, so far as yet known, discoveries have been confined to the diabase west of that lake. Most of them occur in the southern portion of the central diabase strip which lies a short distance from the shore and extends northward for about seven miles from Elkhorn lake. On one of the Mann claims (T.R. 1966), now owned by Messrs. Foster, an east and west vein averaging 4″ or 5″ in width had been traced for 300 feet, the original discovery being made in the exposed face of a low diabase wall. At its surface the vein material had been weathered out for a depth of about 15″ and the cavity filled by a brownish mass of the decomposed matter mixed with vegetable mould and sand. Nuggets of mossy or arborescent silver were scattered richly through this dirt, and a fairly continuous spine of the same metal, sometimes an inch thick, extended along the middle of the crevice. A test pit sunk about 8 feet, but barricaded at the time of the writer's visit, had exposed, according to Mr. Mann, silver and smaltite in a calcite vein. On the adjoining claim (T.R. 1982), a vein of massive smaltite about

1″ wide was seen; a little silver had been found at its surface and streaks of argentite and disseminated grains of smaltite were seen in the wall rock. Aplite dikes on another claim were found to be stained by cobalt bloom, and full of disseminated chalcopyrite.

The properties owned by Messrs. Crawford and Dobie about half a mile farther south were not visited, but were generally reported to be of about the same richness as that in T.R. 1966. Immediately north of Hanging-stone lake Mr. F. A. McIntosh was conducting active prospecting in a coarse gabbroid, locally syenitic, form of the diabase, intersected by aplite dikes. A discovery of native silver has been made since then and the property sold to Messrs. F. R. Bartlett & Co., of Toronto, together with other claims located between the north-east and north-west arms. Other discoveries are reported just south-east, also a short distance north of Milne lake.

No silver had been obtained in the eastern diabase strip, although the geological conditions appear identical and calcite veins are abundant. An exceptionally large vein, about 18″ wide, and traceable across two adjoining claims was seen on the property of Messrs. McLaughlin and McIntosh, about half a mile north-east of the north-west arm. Mineralization in it near the surface was very slight. Several veins carrying small amounts of chalcopyrite, pyrite, bloom and smaltite were seen on the properties of Messrs. Elstone and Reilly (T.R. 1961, 1962 and 1903). In one of them small amounts of bismuth are present; another contains an unusually heavy black substance which proved to be calcite filled with minute crystals of magnetite.

In the western strip less exploration had been performed and little could be learned about the ore deposits. Loose pieces of native silver had been found by W. H. Margueratt in narrow fissures on M.R. 1798, but the vein material was not exposed.

Outside the Gowganda area systematic prospecting was in progress at only one point—Wapus creek. Under the management of Mr. Robert Lett a group of nine claims was being stripped and trenched, with the result that numerous calcite veins had been traced through a diabase showing the same complex intermingling of basic and acid phases and aplite dikes as at Gowganda. Chalcopyrite and cobalt bloom were abundant, and smaltite had been found as disseminations in the wall rock. Lumps of native bismuth weighing several ounces had been taken from a fissure in an aplite dike, analyses of which showed it to contain silver.

Tentative exploration was being conducted along Duncan lake and east of Firth lake, but not with the closeness and persistence which the topography of these veins require. In general the veins seen on Duncan lake are exceptionally rich in quartz, and gash veins are common. Chalcopyrite, pyrite and galena are the most noticeable metalliferous minerals, but cobalt bloom stains are frequently observable. So far as known no attention has been given to the large diabase body between Duncan lake and the West branch, although its size and varied composition are thought to make it a desirable prospecting ground.

FUTURE POSSIBILITIES.

The present knowledge of the Gowganda area indicates it to be highly mineralized, at least in so far as number of veins and surface showings are concerned. The number of discoveries within its area of ten square miles is steadily increasing. The area, character of the mineral association and the richness of the surface showings are comparable with those of Cobalt. There is a general similarity in the geological conditions. The mineralized veins in Gowganda occur in the diabase as do some of the good Cobalt veins. There are, it is true, local differences, but the resemblances are more pronounced than the differences and lead to the hope that exploitation will reveal similar underground conditions. The well mineralized veins are sufficiently long and uniform on the surface to suggest similarly persistent vertical dimensions. Further geological work may reveal something definite concerning the character and size of the diabase bodies which form the country rock, and thus afford a basis for predicting their subterranean distribution. While there are grounds for hoping that the veins will persist in depth, this has not yet been proved, nor, if this is the case, that the mineralization and values are also persistent.

The relative importance of Gowganda is therefore a matter of uncertainty as yet, but it may be confidently affirmed that for its state of development the outlook is very favourable, and the number of veins, area of mineralization and rich surface showings afford good grounds for hoping that some at least of the veins will be found to be commercially important.

The details of igneous intrusion, differentiation and mineralization may never be sufficiently understood to allow of accurate prediction regarding the location of silver deposits, but a general conception of the sequence of events culminating in their formation does permit of the formulation of certain criteria useful in the search for ores. Evidence is accumulating to show that the silver-cobalt mineralizations in the Timiskaming region are connected with a late stage of differentiation in the magma which supplied the quartz diabase and aplite. It seems reasonable, therefore, to anticipate ore deposits in or near such bodies, especially if they are of large size and have undergone important chemical differentiation, that is, if they contain a varied and extensive association of basic and acid phases of the diabase. Pre-existing channels to receive the mineralizers are also necessary and their distribution a matter of vital importance, but in this region they appear to have been everywhere abundant.

These conditions appear to exist quite as fully at several other localities besides Gowganda. At Wapus creek they seem identical and, indeed, results obtained thus far indicate that some mineralization of the silver-cobalt type exists. Between Duncan lake and the West branch the conditions require further study, but, as now known, are not discouraging.

COPPER.

The chalcopyrite, which seems a much more constant constituent of the veins associated with the quartz diabase, is sometimes aggregated into bunches which yield ore specimens of such excellent appearance as to arouse interest. The ore is, however, confined to veins a few inches in width and so scattered as to render them valueless. Occurrences of this kind characterize most of the great diabase bodies, examples of which occur on Mosher lake, between the North-east and North-west arms of Gowganda lake and elsewhere. The chalcopyrite is sometimes superficially altered to malachite and azurite.

IRON ORE.

Hematite.—Excellent specular and kidney ore is known to exist a short distance east of Nest lake, but the locality was not visited owing to the more urgent requirements of other portions of the district. Specimens of the ore obtained, however, proved to be of excellent character, with little admixture of silica or other foreign matter. The ore body is thought to be of vertical tabular form, occupying a fissure-like space. Its limits are not known, consequently nothing can be yet stated regarding the commercial possibility of the deposit.

Specular ore was seen on mining claim T.R. 2009, near the north-east end of Firth lake, occupying a fissure in the Keewatin. The ore is of good quality, but the outcrop is of insignificant size, the fissure being only about 2 feet wide, and no ore occurring in either the chlorite schist or reddish granite which lie on either side.

Specular ore also occurs in the basal conglomerate of the Huronian series, filling the interstices between the pebbles where an original cement was deficient. At the south end of Kenisheong lake the conglomerate appears at the water's edge, and the hematite may be observed while paddling near shore. The same thing occurs at the narrows on Duncan lake, just south of the central expansion. In neither case is the ore in commercially valuable quantity.

Magnetite.—Keewatin iron formation exists about one-half mile to the north-east of Gowganda lake. A brief visit was paid to some claims belonging to Mr. Cryderman where the formation is well exposed. The Keewatin, which is partially overlain by Huronian and traversed by diabase, consists of dark grey or black, banded chert or quartzite associated with chlorite schist. The dark bands, usually only a few inches in width, are full of disseminated magnetite grains. No concentrations were noticed and the richest bands would probably yield less than 30 per cent metallic iron, consequently the present showings cannot be considered valuable.

ASBESTOS.

Distribution.

In the Keewatin area between Firth and Obushkong lakes there occur masses of a basic igneous rock through whose decomposition serpentine and asbestos have been developed. The localities given in connexion with the description of the Keewatin may be briefly restated. Two bodies were found. One of these, lying east of Foot lake and 20 chains from Obushkong was traced for a width of 4 chains, but nothing learned of its north and south extent. It consists very largely of green serpentine traversed by a network of fine, white weathering veins of asbestos. More extensive outcrops exist along the east shore of Firth lake. At somewhat more than a mile from the foot of the lake and near a small log shack at the water's edge a considerable mass of partially decomposed wehrlite, serpentine, and asbestos is visible. The main mass is of dark green colour, the asbestos traversing it abundantly as a series of glistening bright green threads. The seams are small, none being found more than ¼″ in width, but the asbestos fibres are fine and elastic. The serpentine is often coarsely fibrous but brittle.

ORIGIN.

Microscopic examination shows the serpentine and asbestos to be the product of decomposition of the wehrlite, a nearly black medium grained igneous type. Alteration has obscured its original character, but sufficient of the primary constituents remain to admit of its determination. It consisted of olivine, diallage, and common hornblende, with considerable ilmenite and apatite, but plagioclase is apparently absent. Hornblende and diallage form the basis of the section in which lie abundant rounded or idiomorphic grains of olivine. The latter is completely altered to a matted intergrowth of fibrous serpentine containing scattered grains of black iron ore. Diallage persists as colourless bi-refringent remnants enclosed by a felted mass of decomposition products, chiefly long scales of talc. The hornblende is fresher and strongly pleochroic, the tints being green; its alteration begins by bleaching, followed by development of colourless fibres of low bi-refringence, possibly serpentine. Primary ilmenite is replaced by irregular patches of leucoxene, showing gridiron structure. The final product of alteration is a soft green serpentine rock composed almost wholly of that mineral.

The limits of these masses are exceedingly difficult to define, owing to the fact that they are associated with other Keewatin rock and basic forms of the post-Huronian diabase, to which it presents considerable resemblance. The asbestos actually seen is probably too short and small in amount to be valuable, but the high commercial value of this material renders delimitation of the wehrlite masses advisable. Asbestos of very good quality has been found by Mr. George Rahn in the vicinity of Sinclair mountain, so that this mineral may be one of the district's latent resources.

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DEPARTMENT OF MINES

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859.	Salt.				

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No. *102.	For 1874-5.	No. 169.	For 1882-3-4.	No. 580.	For 1894.
*110.	" 1875-6.	222	" 1885.	616	" 1895.
*119	" 1876-7.	246	" 1886-	651	" 1896.
126	" 1877-8.	273	" 1887-8,	695	" 1898.
138	" 1878-9.	299	" 1888-9.	724	" 1899.
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*260. Yukon district, by G. M. Dawson. 1887. Maps Nos. 274, scale 60 m.=1 in.; 275-277, scale 8 m.=1 in.
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SASKATCHEWAN.

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815. Ekwan river and Sutton lakes, by D. B. Dowling. 1901. Map No. 751, scale 50 m. =1 in.
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