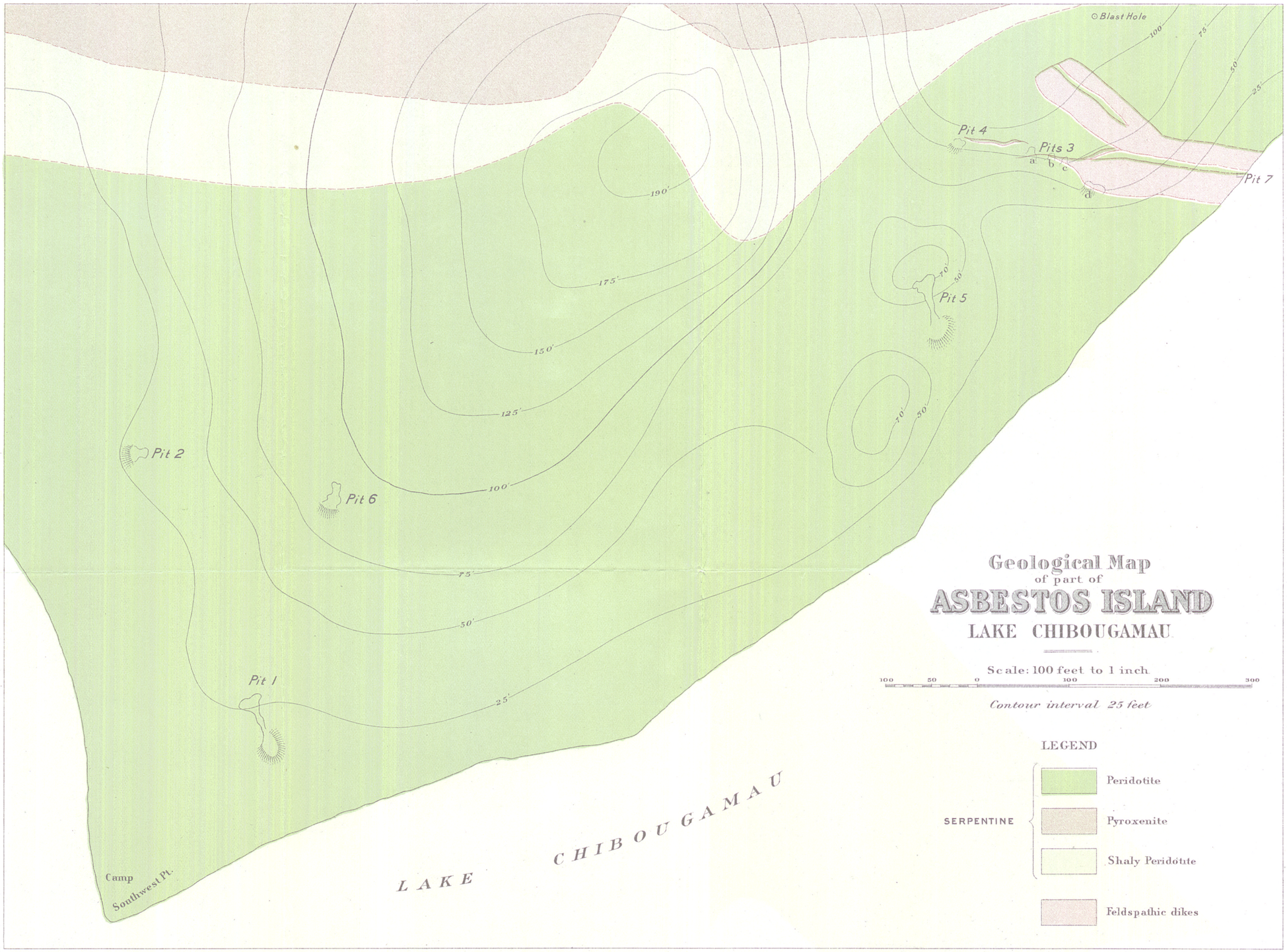

Blast Hole
100'
75'
50'
25'
Pit 4
Pits 3
a
b
c
d
Pit 7
190'
175'
150'
125'
100'
75'
50'
25'
70'
50'
Pit 5
Pit 2
Pit 6
Pit 1
Camp
Southwest Pt.
LAKE CHIBOUGAMAU
Geological Map
of part of
ASBESTOS ISLAND
LAKE CHIBOUGAMAU
Scale: 100 feet to 1 inch
100 50 0 100 200 300
Contour interval 25 feet
LEGEND
SERPENTINE
Peridotite
Pyroxenite
Shaly Peridotite
Feldspathic dikes

GEOLOGICAL MAP of the CHIBOUGAMAU REGION

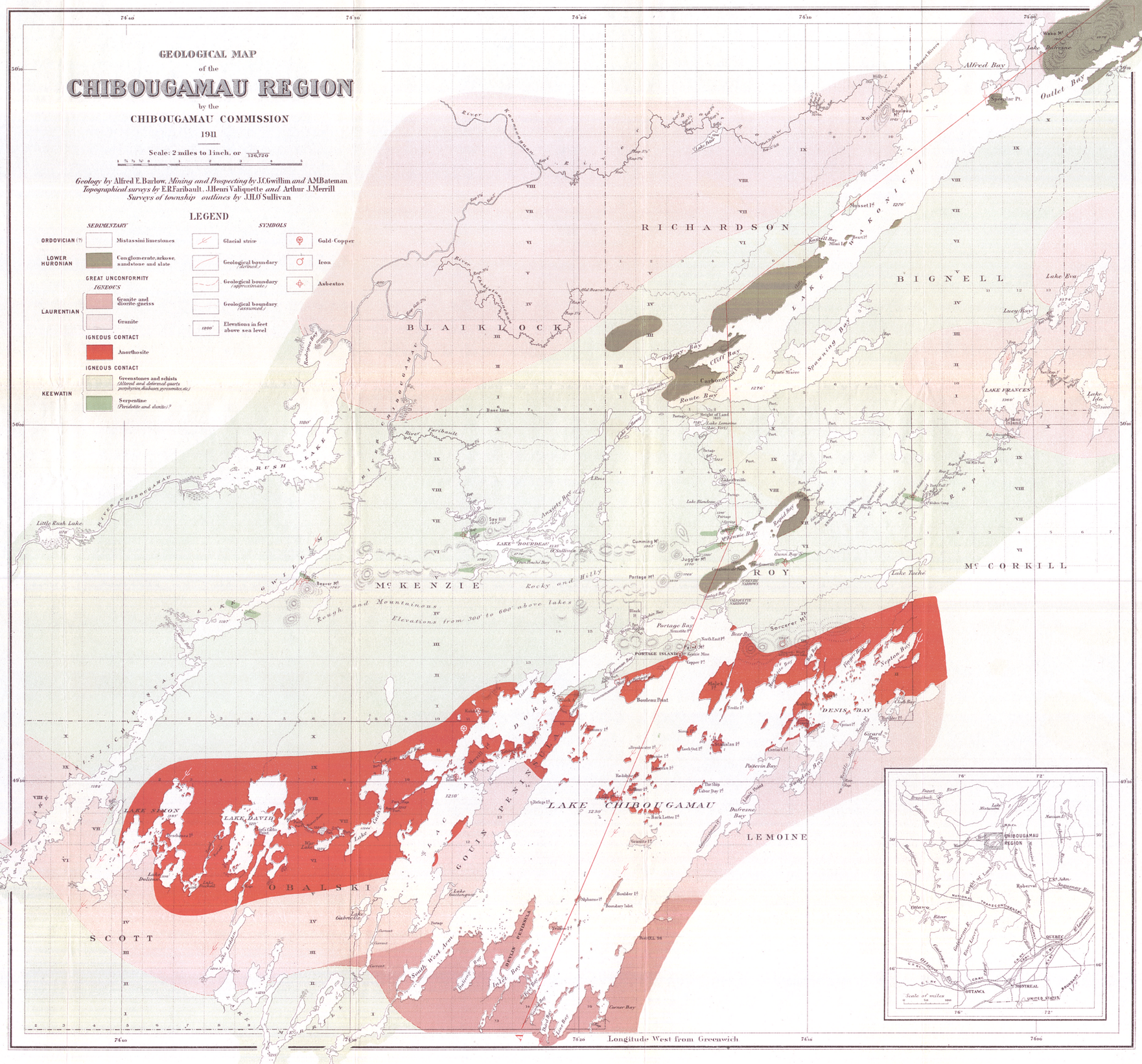
by the

CHIBOUGAMAU COMMISSION

1911

Scale: 2 miles to 1 inch, or $\frac{1}{126,720}$

Geology by Alfred E. Barlow, *Mining and Prospecting by* J.C.Gwillim *and* A.M.Bateman
Topographical surveys by E.R.Faribault, J.Henri Valiquette *and* Arthur J.Merrill
Surveys of township outlines by J.H.O'Sullivan



HISTORICAL

The Chibougamau District first came into public notice as a probable mining field soon after the two expeditions of Peter McKenzie, of the McKenzie Trading Company in the summer of 1903. The discoveries of asbestos and magnetite made at that time created an interest in this region, which was followed up by an official visit, made in the year 1904, by Mr. J. Obalski, then Superintendent of Mines for the Province of Quebec. His report, made after a short examination of the principal discoveries, during September of that year, was sufficiently favorable to encourage further exploration and development.

In June 1905, the same district was visited by Mr. John E. Hardman of Montreal. He examined, especially, the asbestos and gold bearing quartz discoveries of Mr. McKenzie. His report, although made less publicly, confirmed the impression of this being a valuable field for mining development, especially as regards the asbestos of Asbestos island, and the gold bearing quartz of Portage island, whenever suitable transportation facilities should be supplied. A month after Mr. Hardman's inspection, Mr. A. P. Low, of the Geological Survey of Canada, was charged with an examination of the Chibougamau District. His work was directed towards a closer mapping and study of the geological relations of the rocks and mineral occurrences. A little over six weeks was occupied in this work and the ground covered was considerably in excess of that examined by the Commission. His report, was sufficiently optimistic to add to the inducements already attracting prospectors and exploration companies.

These reports, considered to be authoritative and favorable caused many parties to be sent into this district and into Northern Quebec generally.

In 1906-07, Capt. H. A. C. Mackin began the development of blocks A and H on Lac Doré. In 1907 there appears to have been especial activity in development of discoveries already made and in a general prospecting of the whole district covered by this report, as evidenced by old camps, abandoned tools, and surface work upon obscure mineral in remote places.

In 1908, Prof. Dulieux of Laval Polytechnic School, Montreal, made a somewhat extensive examination of the discoveries which had been made up to that time. His report is distinctly less favorable than those, which preceded it, and is by far the most comprehensive, embracing most of the discoveries made up to that time.

Since the date of the last official report (by Professor Dulieux) little has been done in further prospecting or mining development work, the general attitude of all concerned being that nothing further could be done without railway facilities.

SCOPE OF WORK

The Commission's examination like all those preceding it could only be made upon superficial evidence as with the exception of the one shaft at the McKenzie Gold Mine (which is 35 feet deep) no workings had extended beyond a depth of 10 or 12 feet. Indeed many of the prospects consist of rock excavations, the result of a single blast.

APPRECIATION OF DISTRICT

The region is difficult to prospect, much of the area being of low relief, usually densely covered with a thick forest growth principally of small and often closely packed black spruce. The greater part of the area is covered by drift, while a thick mantle of moss and peat often from 2 to 3 feet in depth usually hides even the steeper slopes. Rock exposures are by no means plentiful so that a small proportion only of this region is available for ordinary methods of prospecting, nor can this condition be improved unless by repeated forest fires.

Such conditions, combined with the cost of provisions and equipment, the necessity of employing voyageurs or canoemen, who are altogether unaccustomed to mining activities, the time and trouble of getting into and out of the district naturally discourage prospectors as well as development. Only an extraordinary richness or magnitude of its mineral deposits would keep up a condition of progress. The region appears to have been as thoroughly prospected as conditions justified and the mining development work in some cases has been carried as far as is reasonable in these circumstances.

Considering therefore the limitations of the prospecting surface and the excessive cost of mining development the district can only be examined and reported upon to a limited extent. This, however, constituted the field of our enquiry and upon its merits the following judgment has been given.

There should be no mistake or misrepresentation regarding the scope of this investigation—"Our duty" as the Canadian Mining Journal has very well represented it "was to determine the general geological character of the country, and to discover how true were current tales of spectacular wealth. The findings of the Commission must be accepted as they are offered—as an appraisal of the present results of prospecting in one section of northern Quebec. It must not be misconstrued into a sweeping condemnation of a region that may yet prove entirely worth while."

GEOLOGICAL SUMMARY.

The geological formations represented in the Chibougamau Region belong to the Archæozoic (Archean) Proterozoic, Palæozoic and Cenozoic Eras.

The sedimentary rocks belong to the Cenozoic, Palæozoic and Proterozoic Eras, and are divisible into four formations: A. Post-Glacial; B. Pleistocene; C. Lower Ordovician and D. Lower Huronian. It will thus be seen at a glance that the geological record is very incomplete, great lapses in geological time being altogether unrepresented in the sequence of formations.

The Archean or Archæozoic formations are all of igneous origin and are separable into three distinct groups, readily distinguished from one another and each of which underlies a considerable area of country. These groups are (E.) Granites and gneisses usually classified as Laurentian, (F.) Anorthosite, and (G.) Keewatin greenstones and schists.

The Post-Glacial deposits of stratified sand and gravels with some alluvium found in certain of the valleys and flats between the mountains and in the vicinity of the various lakes and rivers are the complementary or modified portions of the underlying boulder clay or till from which they have been mainly derived. These areas of drift as well as others made up of the bare glaciated rocks are usually covered with a thick carpet of sphagnum moss passing beneath by progressive stages of decay into peat.

The Pleistocene deposits in the Chibougamau Region proper are made up of the unmodified boulder clay with a large proportion of intermixed sand and gravel, and accumulations of boulders of morainic and drumlin formation. Most of this loose material is of local origin, being due to the degradation of the underlying rock formations, but a considerable proportion of the erratics have travelled comparatively long distances from their source to the northeast. Boulders of Mistassini limestone, outcropping over 40 miles distant are found on certain of the shores and islands of lake Chibougamau. The movement of the ice during the Glacial Period has been in a general direction of South-southwest, there being a gradual shifting from a southerly to a more westerly direction as exemplified by the divergence in the two sets of striæ (S. 30° W. to S. 40° W.) impressed and preserved upon some of the rock surfaces. Very narrow and comparatively long points running in the direction of the earlier set of striæ (S. 30° W.) and made up principally if not altogether of coarse gravel and boulders are doubtless of drumlin formation.

The Mistassini limestones were first included as Cambrian by Low because of their resemblance to the Cambrian rocks of the east side of James Bay (1). Later in 1906 he considered them as resembling the Upper Huronian limestones about Lake Superior and so classified them (2). Richardson who examined them first made no attempt to fix their geological position being content to refer to them as "fossiliferous limestone" remarking at the same time that "the only fossils observed were an orthoceratite and an obscure coral neither of which could be determined" (3). The Commission could not make any lengthy examination or detailed study of these rocks but on grounds of lithological similarity, their uninterrupted stratigraphical succession and their general undisturbed condition, as well as the practically unaltered character of the component limestones, dolomites and sandy shales seem to them to furnish very strong presumptive evidence of their being considerably younger than Cambrian. They would refer them possibly to the Lower Ordovician. Certain supposed fossils of stromatoporoid appearance were collected and submitted to Dr. W. A. Parks of Toronto University, the recognized authority. After carefully examining the thin sections under the microscope he found that there was "no trace of true stromatoporoid structure but the form might easily be ascribed to Cryptozoon."

The Keewatin formation is made up of a series of decomposed and deformed basic magnesian rocks which may in general be described as greenstones and green schists. These are the oldest rocks of the district. They are penetrated by the batholithic mass of the anorthosite and which as shown in the map extends in a west southwest direction from Denis Bay (Baie des Iles) across Chibougamau, Doré, Cachi, David and Simon lakes where it seems to end abruptly, being replaced in this direction by granite and granite-schist breccia.

Both the Keewatin schists and anorthosite are intruded by certain granites and diorites, some portions of which especially near the junctions with the older rocks are very plainly foliated. From their general composition, appearance and geological relations these rocks have been classified as Laurentian. Both the anorthosite and the granite in certain areas intrude the Keewatin in the most intricate manner forming a breccia which in certain localities underlies a comparatively large area as on Asimitchikabastt lake in the vicinity of and opposite to the inlet (Chibougamau river).

The Lower Huronian is represented by certain conglomerates, arkoses, sandstones and slates which either in horizontal position or in low broad anticlinal and synclinal troughs rest unconformably upon the upturned edges of the Keewatin and the uneven or the hummocky surfaces of all the older rocks which have already been described.

(1) *Ann. Rep. Geol. Surv. Can.* 1885, *Part D. p.* 31; 1895, *Part L, pp.* 266-268.

(2) *Geol. Rep. Chibougamau Min. Reg.*, 1906, *p.* 31.

(3) *Ann. Rep. Geol. Surv. Can.* 1870-71, *p.* 295.

ECONOMIC GEOLOGY.

From an economic standpoint the junction between the anorthosite and Keewatin schists is perhaps the most important geological feature in the district, for it is at or in the immediate vicinity of this line of structural weakness that the copper-bearing quartz veins, in which gold has been discovered, occur. Both in the gabbro itself and in the Keewatin green stones and schists, veins and patches of quartz with smaller quantities of calcite, dolomite and ankerite often occur, either with or occasionally without sulphides of copper and iron. It has been established almost beyond a doubt that the intrusion of the anorthosite has been the direct cause of the formation of these quartz veins in which gold as well as copper has been found. Such quartz veins as well as certain dikes containing these same sulphides are deposits which are their presence to the differentiation of the same magma from which the anorthosite has solidified.

In addition to these veins, other deposits of chalcopyrite and pyrrhotite with low values in gold and nickel occur at Cooper point on Portage island. These appear to be similar in origin though much smaller in volume than the nickel and copper deposits of the Sudbury district. They are thus a direct differentiate of the anorthosite, and occur close to the line of junction between this rock and the Keewatin green schists. These primary segregations of sulphide material, occurring at this place and under such conditions seem to have puzzled some of the mining engineers who first examined them, but as they apparently lacked any analogy to veins received but scant attention. They were worthy of more serious development.

As already mentioned the rocks underlying the whole area examined by the Commission are of Archean or Pre-Cambrian Age. The presence of these rocks as in other similar areas of the Quebec hinterland is very promising from a mining standpoint. The large areas of Keewatin schists in the Chibougamau district present precisely similar rock types as have been found associated with the gold of the Porcupine and Larder Lake districts in Ontario, while the geological relations are not altogether dissimilar. In addition the almost invariable presence of gold in the quartz and its occurrence over such a wide area although usually in small amount is distinctly encouraging and should stimulate prospecting. Most of the outcrops, however, are deeply covered with peat and moss, while the region is remote and only accessible with much expense and difficulty. None of the discoveries of copper and gold as already developed are in deposits of such magnitude or promise as would enable your Commission to state without a considerable degree of hesitation that they would with further development become "mines" in the strict meaning of this term.

The anorthosite is also an economically valuable rock formation because it is to the intrusion of certain feldspathic dykes, which cut the serpentines on the shores of McKenzie bay and Asbestos island, and which are believed to be the surface expression or upward extension of the anorthosite batholith, that has contributed to the formation of the silky asbestos at Pits, 3, 4 and 7, while the presence at the surface of a small dike of similar material a short distance northeast of No. 6 Pit, may be an indication that the main body of the anorthosite is not very deeply buried in the vicinity of Pits 1, 2 and 6.

The serpentines of Rapid river, McKenzie bay, lakes Bourbeau and Asimitchibastt result from the alteration or decomposition of peridotites and probably dunites which are integral portions of the Keewatin greenstone complex. These serpentines are very dark green in color, sometimes almost black, and have a distinctly harsh rather than an unctuous feeling characteristic of pure serpentine except in the vicinity of the feldspathic dykes already mentioned and other favored localities where most of the iron has been leached out and removed to other places, leaving a comparatively small band (3-6 inches in width on either side of the dyke) of very pure pale green serpentine. In certain places usually in the immediate (3 to 6 inches) vicinity of the feldspathic dykes small veins of silky asbestos have been formed, many of which are of high grade material but these do not constitute a large percentage of any considerable bulk of the rock nor are they continuous for any great distance, as they are subject to frequent dislocation and faulting and very often thin out altogether in every direction. Most of these veins vary from the thickness of a knife blade up to a quarter of an inch and the widest are not more than three-quarters of an inch.

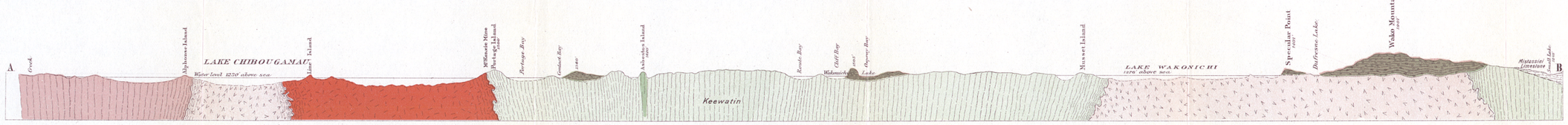
Although the possibilities of the Chibougamau serpentine as an asbestos producer has neither been exhausted by the mining development work, as far undertaken, the results so far are decidedly disappointing. The amount of asbestos noticed in the working faces of the various opencuts and workings as well as in the dumps, is insignificant and altogether insufficient for their successful exploitation as mines. The precious reports on the occurrences of this mineral are, to say the least, unduly optimistic and misleading. Not only does the serpentine of Chibougamau cover a much less area than was described and outlined in previous reports and maps, but the serpentine itself is much less pure except in very restricted outcrops, and as a consequence is very much less in area than that of Thetford and Black lake in the Eastern Townships with which it has been compared. In addition the geological relations are essentially different from Thetford and Black Lake, for whereas at these places the differentiation in the magma as shown by the various rock types extends to the most acid phases and is therefore very complete, the most acid rock type noticed at lake Chibougamau is only of most of intermediate composition as exemplified by the feldspathic dykes already mentioned as cutting the serpentine.

The titaniferous magnetite deposits found at Sorcerer mountain, on Portage island north of Copper point and also on the islets near the southern or main outlet of lake Chibougamau are also largely of magmatic origin, and occur at or in the immediate neighbourhood of the line of junction between the anorthosite and Keewatin green schists. This magnetite is perhaps more largely and typically developed on the southern face of Sorcerer mountain that elsewhere in the region. It is not, however, of any great importance at the present time.

The chief occurrences of pyrite are on Portage island near the northern end of Paint mountain. The mineral occurs as abundant disseminations in chlorite schist and decomposed diabase. No large body of pure pyrite capable of economic development as a source for sulphur was however noticed. Outcrops resembling these on one of the western summits of Sorcerer mountain may be a continuation of this belt, but here likewise no massive deposit was found. Similar occurrences some richer and some leaner are by no means uncommonly met with in the Keewatin formation of Northern Ontario and Quebec, in fact their frequency seems to be a characteristic of this formation. It is possible that a large and pure body of pyrite might be discovered, but the expense of prospecting and the remoteness of the district are in this case also sufficient deterrents to further prospecting under existing conditions.

The conglomerates of McKenzie narrows, McKenzie and Rapid bays on lake Chibougamau, as well as those on Wakonichi lake are regarded as Lower Huronian and thus presumably of the same geological age as the conglomerates of the Cobalt District, in which most of the silver veins of that famous region have been found. The newer diabase however which is the real "silver bringer" in the Cobalt area and to whose intrusion the silver-bearing veins owe their presence, was not found, although careful search was made for it. It is not likely therefore that any similar deposits will be found in the Chibougamau Region and the reputed "finds" of silver, smaltite and cobalt bloom must be treated as mere fictions. It is possible, although unnoticed by any member of the Commission, that cobalt bloom may occur in small amount but an examination of the localities where it was reported as occurring failed to show any sign of this mineral, while the rocks themselves at one of these places was not at all favorable to its presence.

Galena and zinc blende are both present in small amount in the flat lying limestones occurring at the narrows about two miles north of the Hudson's Bay Company post at Mistassini. Although the deposits there examined are not economically valuable the presence of these minerals even in small quantities and in such geological association is of somewhat more than scientific interest as it is under precisely similar conditions that the great deposits of the Mississippi valley occur.



Ideal cross section along line A-B

Scales { Horizontal, 2 miles to 1 inch. Vertical, 2000 feet to 1 inch.