FRONTISPIECE. PLATE I.

(*Photo by Wilson*)

Cavern worn in an amygdaloidal bed beneath a more massive bed. The lakeward dip of the beds near Mamainse is well shown.

CANADA
DEPARTMENT OF MINES
MINES BRANCH
HON. W. B. NANTEL, MINISTER; A. P. LOW, LL.D., DEPUTY MINISTER;
EUGENE HAANEL, Ph.D., DIRECTOR.

BULLETIN No. 6

Diamond Drilling at Point Mamainse Province of Ontario

BY

ALFRED C. LANE, PH.D.

INTRODUCTORY

BY

Alfred W. G. Wilson, Ph.D.

OTTAWA
GOVERNMENT PRINTING BUREAU.

No. 111.

LETTER OF TRANSMITTAL.

Dr. Eugene Haanel,
Director of Mines Branch,
Department of Mines,
Ottawa.

Sir :—

I have the honour to submit, herewith, a record of diamond drilling, which was carried on near Point Mamainse, on the east shore of Lake Superior, during portions of the years 1907 and 1908. This work was performed by the Calumet & Hecla Mining Company, and Dr. Alfred C. Lane, who prepared this bulletin, was engaged to report upon the work. Through the kindness of the Manager of the Calumet & Hecla Mining Company, Dr. Lane has been permitted to make this record public.

It is very desirable that all records of this character relating to Canadian localities should be preserved, because of their value to future investigators and operators. I recommend, therefore, that Dr. Lane's record be published by the Mines Branch in the form of a bulletin. As the data collected by Dr. Lane have a direct bearing upon the investigations into our present knowledge of the copper resources of Canada, I have prepared a preface outlining the general investigation that is now under way, and of which it forms a part. A short introduction, relating specially to the copper bearing amygdaloids of the north and east shores of Lake Superior, has also been included.

I have the honour to be, Sir,

Your obedient servant,

(Signed) **Alfred W. G. Wilson.**

Ottawa, April 12, 1911.

TABLE OF CONTENTS

ILLUSTRATIONS.

PHOTOGRAPHS.

DRAWING.

MAP.

PREFACE.

Copper probably ranks next in importance to iron among those metals which are utilized in our industries. During the year 1909—the latest for which we have statistics—the world's production of copper was valued at $244,470,770; and Canada's proportion of this total was valued at $6,188,432, or about 2·53 per cent of the whole. According to statistics furnished by Mr. John McLeish, Canada's copper production has increased from 3,505,000 pounds in 1886—the first year for which data have been compiled—to 56,598,074 pounds in 1910.

Minerals containing copper are found in numerous localities throughout Canada. Explorations for copper ores have been carried on in all the eastern Provinces, and in British Columbia. Almost the whole of the production, however, comes from Ontario, (where it occurs in association with the Sudbury nickel ores) and British Columbia. The output from the Maritime Provinces and from Quebec has not been very great, though there is one mine, the Eustis, located near Sherbrooke, Quebec, which has been practically in continuous operation for about thirty years.

In all the provinces in which copper minerals have been found, exploration work has been carried on; in some it is still being pushed forward successfully. The records of these explorations are not readily accessible; in many instances they have been completely lost.

It may be that under new conditions, and by employing new and improved methods, prospects which could not be operated profitably at one time may become available in the future. It is, therefore, both desirable and important that the records of exploration work in the different localities be made as complete as possible. It is equally desirable that these records be readily accessible to all those who are directly interested in the industry. At present such information as we have is largely to be found scattered through various government and private reports and other publications.

Acting under the instructions of Dr. Eugene Haanel, Director of the Mines Branch of the Department of Mines, the writer has, for some time, been engaged in collecting all available information relating to the copper resources of Canada. During the past two field seasons, he has personally visited all the more important mines, abandoned mines, and prospects in the eastern part of Canada. It is planned to extend this work to British Columbia during the season of 1911. Subsequently, a special monograph will be prepared, containing the best available information relative to our present knowledge of the copper resources of Canada; including not only the operating mines, but also those abandoned mines and prospects, which, so far as one can judge, may be worthy of further investigation, under improved conditions. Incidentally, the proposed monograph will discuss methods of prospecting, and the methods of mining copper ores as practised in Canada. The essential purpose of the report, however, will be to furnish as accurate and reliable a statement as possible of the status of the copper mining industry in Canada in 1911.

Inasmuch as changing conditions, improved methods of mining and extracting ores, better market facilities, and the exhaustion of other sources of supply, will tend to make increasingly valuable, prospects which, under other conditions, could not be utilized, it becomes desirable to preserve as complete records as possible of all exploratory work. Such records may prevent serious mistakes in the future, and will certainly be of value in guiding future explorers. In the past this has not been done; and at the present time is being done only in a few localities.

The occurrence, on the northeast shores of Lake Superior, of amygdaloids, carrying native copper, has been a matter of common knowledge for many years. A number of mining companies have explored portions of these deposits, but no property has ever been successfully developed. For the most part, the records of this exploratory work have been lost, though in many cases thousands of dollars were expended on the investigations. It is true that no large deposits of ore, that could be economically worked, have been discovered, but only a very small portion of the district has been explored, and that only imperfectly. In the future, the exhaustion of other sources of supply may make this district of more importance.

The present bulletin contains very detailed descriptions of the results of the diamond drilling carried on by the Calumet & Hecla Mining Company at the old Pancake Bay location near Point Mamainse. This record has been placed at the disposal of the Mines Branch, through the kindness of the Calumet & Hecla Mining Company and Dr. Alfred C. Lane—at one time State Geologist of Michigan. Dr. Lane has spent about twenty years in geological work in Michigan. Many years of study and practical work have given him a most intimate personal knowledge of the copper bearing amygdaloids of the Keweenawan peninsula and Isle Royal. Hence a report of this character from his pen is particularly valuable. Dr. Lane explains in the introductory chapter of the bulletin, the character of the work of the Calumet & Hecla Company at the Pancake Bay location, and the nature of his connexion with that work. In the event of further explorations being carried on in this district, these records will be valuable both for comparison and for guidance. In consenting to their publication, the manager of the Calumet & Hecla Mining Company has done a public service, which should be appreciated by those who may utilize this record in the future.

Alfred W. G. Wilson.

INTRODUCTORY.

Alfred W. G. Wilson.

Native copper appears to have been obtained by the Indians near the shores of Lake Superior long prior to the advent of European explorers. Reports by the early Jesuit missionaries—the first white men to visit the region—refer to the mining operations of the aborigines, and give the first recorded account of the finding of native copper. A little more than a century later (August, 1765), Alexander Henry, while on a fur-trading venture, found native copper near the mouth of the Ontonagan river.[1] He writes: "I found this river chiefly remarkable for the abundance of virgin copper, which is on its banks and in its neighbourhood." He makes mention of a particularly large mass of copper, which he found near the mouth of the river. This copper boulder was subsequently removed to the Smithsonian Institution, at Washington, where it is still preserved. It was also seen in place by David Thompson in 1798, when he was surveying the shores of Lake Superior.

Two years later (1767) when on his way to winter quarters on Michipicoten island, Henry discovered copper on the east shore of Lake Superior. He writes:[2] "At Point Mamance, the beach appeared to abound in mineral substances; and I met with a vein of lead-ore, where the metal abounded in the form of cubical crystals. Still coasting along the lake, I found several veins of copper-ore of that kind which the miners call grey ore." Some 45 miles farther north, he found several pieces of native copper, which he states were remarkable for their form. "Some resembled leaves of vegetables, and others, animals. Their weight was from an ounce to three pounds."

Between the years 1771-4, Henry carried on mining operations at several points around the shores of the lake.

David Thompson appears to have been the next white man to record the occurrence of native copper in Canadian territory on the east shore of Lake Superior. He writes: "The same year (1798) on the survey, about 52 miles northward of the Falls of St. Maries, near Mahmaize, there were five or six canoes of Indians, who informed me they were then at the old path of their grandfathers, who used to come here for pure copper for heads to their lances, arrows, axes, knives, and other necessaries; by their description, the place was about five miles in the interior. I requested to be shown the place, but they said they did not exactly know it, and dreaded the mosquitoes. It appears that in those days, the first settlement of this country, the ornaments of the Churches of Rome came from these two mines, in pieces of pure copper."[3]

Thompson also refers to the prospecting for copper ores along the north shores of Lake Superior, east of Thunder cape, during the years 1845-6.

In the year 1847, Sir William Logan was despatched by the Government of Canada to examine the north shores of lakes Huron and Superior, to delineate the boundaries of a number of mining locations in this territory, and to report on the copper occurrences. In the following years a number of exploration companies were organized in Montreal and elsewhere for the purpose of exploiting these copper discoveries.

At times, the operations of some of these organizations were temporarily successful; but owing to inherent difficulties of exploration in a district so far removed from civilization, from markets, and from a base of supplies, all operations were eventually abandoned.

---

1 Travels and Adventures in Canada, 1809, p. 194.
2 Travels p. 211.
3 David Thompson's Journals and Surveys in the Crown Lands Department, Toronto, Appendix, pp.7-10; quoted by A. Blue, Ont., Bur. Mines Report, Vol. III, 1893, p. 63.

During the last thirty or forty years, some of these old locations have been occasionally re-examined, but no permanent industry has ever been developed.

No systematic detailed geological study has been made of the Keweenawan copper bearing amygdaloids in Canadian territory. Various localities where these rocks are exposed have been visited by different geologists from time to time, and special localities have been described. Our general knowledge of the district is derived largely from the early reports of Logan and Dawson, supplemented by occasional reports of the other writers, who deal with smaller areas.

The copper bearing amygdaloids are known to occur on the north shore of Lake Superior, forming a narrow fringe along the shore, and outcropping on many of the coastal islands. Some excellent exposures are found on St. Ignace island. Michipicoten island is wholly underlain by them; the dense vegetation and the soil cover on this island makes their exploration particularly difficult. They also outcrop along the east shore of Lake Superior, between Cape Gargantua and Batchawana bay. The inner margin of the area underlain by these rocks has never been fully delineated. It is altogether probable that, in the vicinity of Cape Mamainse it lies at least five miles inland. Dr. Lane, in the accompanying bulletin, makes references to all the principal reports which have appeared, and describes with much detail the local geology in the vicinity of Point Mamainse.

RECORD OF DIAMOND DRILLING

AT

POINT MAMAINSE, ONT.

BY

Alfred C. Lane, Ph.D.

HISTORICAL.

The writers on the geology of Point Mamainse, which lies at the east end of Lake Superior, in latitude 47° N., longitude 84° 50′ W. of Greenwich, have been mainly connected with the Ontario Bureau of Mines, or the Canadian Geological Survey. The testimony of the witnesses before the Royal Commission of Mines in 1891 (5), is also of interest, and Irving's Copper-bearing Rocks of Lake Superior (8) gives a valuable discussion of the general relations: the region was visited for him by A. C. Campbell.

Logan, W. E. (1); Macfarlane, T. (3); Bell, R. (4); Blue, A. (6); and Coleman, A. P. (7) are the chief geologists who have visited the region, mainly skirting the shore and making observations along it, or examining the mine workings, mainly on veins 10 and 11 near Sand Bay.

Mining or exploration seems to have been done first in 1847, on islands close to Point Mamainse from which the miners were driven by the Indians; again in 1856-8 by the Montreal Mining Company working on the recommendation of E. B. Borron[1], probably in part on veins 10 and 11; again by the Lake Superior Copper and Native Copper Companies in 1882-1884, under Capt. H. Trethewey, who did more than any other one in detailed development.

In 1891 operations were renewed for ten months, with a diamond drill, but no records have been found, and though I found some pieces of core showing a good deal of copper, the cores were all at random in boxes. Further work was also done on the "Copper Creek" in No. 10 vein. A shaft was sunk 300 feet and drifting done, as described later. This was done under the Canadian Land Purchase Co., with Capt. Trethewey, under Mr. Sibley, in charge.

In 1906, Mr. Sibley offered the Calumet & Hecla Mining Company an option.[2] On September 12-19, Mr. E. S. Grierson and the writer visited the island and made a preliminary report. The Company agreed to put in a small amount of money in preliminary testing, and finally did about $25,000 worth of diamond drilling. The writer visited the point once more, July 12-16, 1908, mainly to examine drill cores, but there was time for some supplementary notes while awaiting a boat. I am also much obliged to Moses Brown, Jr., resident engineer of the Calumet & Hecla Mining Company, during the work, for various surveys, and to Mr. E. S. Grierson, chief engineer, and to Mr. James MacNaughton, under whose charge the work was done, who readily agreed that the results should be accessible in due time to the scientific world.

The work of the Calumet & Hecla Mining Company was almost entirely confined to diamond drilling, and ceased in 1908. It cannot be said that this work showed that copper does not exist in commercial quantities, though it

---

1 His reports to the Company are quoted by Blue.

2 Terms of option are given on page 143 of the Osceola trial testimony. The Nipigon Mining Company, which Mr. Sibley represented, gave an option on about 11,000 acres of land from November 20, 1906 to 1907 (this was afterward extended) and the Calumet & Hecla Mining Company agreed to expend $25,000 for an option on a three year extension. If the Calumet & Hecla Mining Company chose to exercise this further option a new company was to be formed in which the Calumet would have 60,000 shares at $50,000 and would put in $100,000 to be in whole or part a debt of the new company as well as $50,000 for the shares, and would agree to advance money as necessary to put the mine on a producing basis. The second option was never exercised.

indicated that the region was less promising than some others, and that exploration would be relatively difficult and expensive.[1]

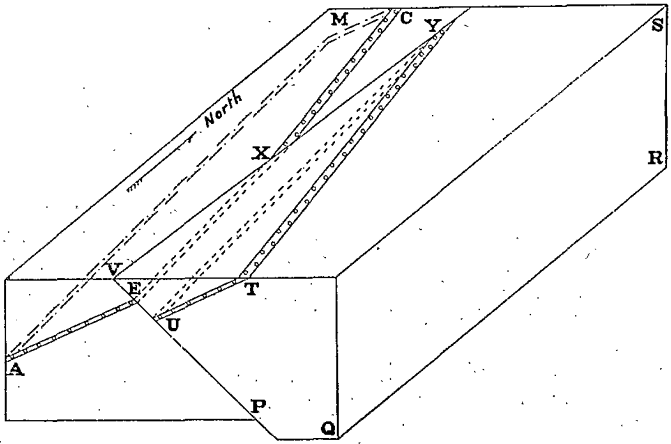


FIG. 1—Sketch showing possible shoot at vein 10, and troughs made by faults intersecting beds.

BIBLIOGRAPHY.

(1) Remarks on the Mining Region of Lake Superior and Report on Mining Locations claimed on the Canadian shores of this lake, by W. E. Logan, Montreal, Lovell and Gibson, 1847, (pp. 28-30).

(2) W. Dawson, Nat. Hist. Soc. of Montreal, 1856, Canadian Naturalist and Geologist, March 1857, pp. 3-9.

(3) Geological Survey of Canada, Report of Progress 1863-1866. Report of Thomas Macfarlane, French edition, pp. 136-140, Ottawa, Desbarats, 1866.

(4) Geological Survey of Canada, Report of Progress for 1876-77. Robert Bell's report, pp. 213-244. By authority of Parliament, 1898.

(5) Report of the Royal Commissioner on the Mineral Resources of Ontario, Toronto, Warwick and Sons, 1890, p. 197, 97 (Quebec Company) 98-102. Evidence of Borron and Trethewey.

(6) Report of the Bureau of Mines for 1893, Toronto, Canada, pp. 62-79, by A. Blue.

---

[1] In my report before the Calumet & Hecla Mining Company did any work, I suggested, among other things, the following lines of exploration:

To do further surface geologic work. As will appear, the very lowest part of the Keweenawan formation has not yet been tested, on the properties under option.

To test further the intersections of amygdaloids and conglomerates with the cross-fissures. (See Fig. 1.)

The last of my suggestions was to make a diamond drill section starting between Rousseauville and Whisky point and running north 55° east or thereabouts; incline of holes 65°. This last was all that was undertaken.

I called attention in this preliminary report to certain difficulties in and objections to this region in comparison with others under consideration, as a site for mining operations. One of them is the disturbance due to faulting. Another is the relatively flat dips which would make handling the rocks from the stopes much more expensive. The dips are flatter than in any mine at present paying on Keweenaw point.

Fig. 1 illustrates the trough or shoot which may be produced by a fault such as that occupied by Vein 10 which has a strike of N. 5° E. magnetic (indicated by the line VXY) and dips to the east about 45° (as shown by the line VEUP). It has dropped the right hand block down as shown by the displacement of the bottom lines. The top of the block is supposed to be planed or eroded to a smooth level surface to show how it displaces the bed UTY to the position XEA and produces a trough or shoot pitching from Y to U. The strike of the bed YTU is assumed to be N. 15° W. and its dip 24° to the west.

PLATE II.

(Photo by Wilson)

(a) Amygdaloidal beds dipping southward on the north side of Michipicoten island, Bonner location.

PLATE II.

(Photo by Wilson)

(b) Amygdaloidal beds dipping southward on the north side of Michipicoten island, Bonner location.

(7) Report of the Bureau of Mines for 1899, Toronto, Canada, pp. 129, 168, 170, 171, by A. P. Coleman.
(8) Copper-bearing Rocks of Lake Superior, Monograph V, U.S. Geological Survey, by R. D. Irving, pp. 148, 160, 348, 415.

GENERAL GEOLOGICAL STRUCTURE.

The general structure may be easily grasped (see Map). The point is made up of a series of beds of the Keweenawan or copper-bearing series dipping toward the lake, (Plate II, a and b) and veering in strike from S. 10° E. south of Mica bay, where they begin, to S. 45° E. or even more easterly as they approach Batchawana bay.

The series is mainly made up of traps and amygdaloids, (melaphyres or diabases of other writers, auvergnoses and hessoses of the Quantitative classification) such as everywhere make the bulk of the Keweenawan formation. But there are also beds of conglomerates, and intrusive felsites or quartz porphyries, much like those that occur on Keweenaw point. There are the following notable differences:—

The conglomerates here contain more green pebbles of the Keewatin series, and also granite pebbles. We have only to go a few miles north or inland to seek the source of these rocks. In the Keweenawan conglomerates just north of the Gogebic range, we similarly find many granite pebbles. The intrusive felsites seem to be charged with pyrite in minute particles near the contact, just as in the Mendota mine near the felsites of Mt. Bohemia and Houghton we find sulphides. The lowest part of the formation (yet explored, some 1375 feet, underlain by about 5000 feet unexplored) contains few conglomerates and some intrusive trap dykes and it is exposed on the shore, down to the Elephant Arch, (Plate V), and is mainly composed of small agatiferous melaphyric flows. The middle section (2200) feet begins with a very heavy conglomerate, contains five or six conglomerates at least, and winds up with some felsite beds near Sand Bay.

The upper part (5035 feet) began with a very heavy flood of ophite—the "Carlson ophite"[1] (mottled trap) but it is also cut with felsites. Pancake point is largely felsite.

I did not recognize the "Ashbed group" of sodic melaphyres, which are prominent in the upper part of the series on Isle Royale as well as Keweenaw point, and I think also on Michipicoten.

The total column which we know in some detail is about (8,510) feet, to which perhaps (5,000) feet should be added at the base to get the total thickness of the Keweenawan here. A summary of the geological column is found at the end.

There is one question concerning which a few words may be said at this point and that is the possibility of correlation of these beds with those of Michipicoten island. I have only been upon Michipicoten island a few minutes while the steamer stopped. My knowledge, therefore, is derived from the descriptions of Burwash[2] and Herrick, Tight and Jones[3] and those in Irving's

[1] There has been some debate as to the proper use of the term ophite. (See article by Winchell, A. N. Bull, G.S.A., 20, pp. 661-667, and Lane, Science, Vol. XXXII, No 824, Oct. 14, 1910, P. 513). These papers give the earlier references. As here used it is applied to the Keweenawan basaltic rocks in which the cement is augite in areas which act as a mould or matrix for feldspar laths. As soon as the augite is coarse enough to be recognized by the naked eye, a "luster mottled" effect is produced on a fresh fracture of the rock. Patches each representing a cleavage plane of an augite crystal here and there reflect the light. A characteristic mottling is also developed on dull flat surfaces such as pebbles and drill cores, and a pock marked appearance on some weathered surfaces. See also Bull. G.S.A. (1908) pp. 644-648. So far as I know, all the Keweenawan ophites have about 10 per cent of CaO) with 45 to 48 per cent of SiO_2.

[2] University of Toronto Studies, Geological Series, No. 3, 1905; The Geology of Michipicoten Island, by E. M. Burwash.

[3] Bulletin of Scientific Laboratories of Denison University, Granville, Ohio, May 1887, Vol. II, Pt. II, pp. 119-143, Geology and Lithology of Michipicoten Bay, Lake Superior, by C. L. Herrick, W. G. Tight and H. L. Jones.

"Copper-bearing Rocks of Lake Superior" together with a few private notes of conversations with A. C. Burrage and G. L. Michael and examination of specimens. Burrage's specimens were a copper-bearing conglomerate. G. L. Michael was working a prehnitic copper vein.

The difficulties of close geologic work on Michipicoten island are, I understand, very great, owing to a very dense growth of small trees. My impression is that not only may the island be cut by faults running with the strike as suggested by Burwash, but also by faults and fissures running across the strike. I should be tempted to believe too, that some of the numerous porphyries described were intrusive. On the whole, the rocks of Michipicoten island appear to me to belong to the upper part of the Keweenawan series—that of the Ashbed group of Keweenaw point or of the rocks forming the Porcupine mountains. Typical lustre mottled melaphyres or ophites which occur among the uppermost beds at Mamainse are among the lower beds on Michipicoten island. It would seem to me, therefore, probable that the beds of Point Mamainse here described are lower and belong more in the lower part of the series, as indicated by the intrusive dykes as well as other features and as also indicated on Irving's map (Plate 28). The points which appear to me especially worthy of investigation at Michipicoten, after the detailed work of Mr. Burwash's thesis, are the possibility of intrusive felsites and of cross-faults. This would require a kind of work which he did not have the time to do, namely following certain horizons rather closely along the strike.

TOPOGRAPHICAL OR SUPERFICIAL GEOLOGY.

For the purposes of the present paper we need only dwell upon those points of the surface geology, into which Coleman has gone, which have a bearing upon the availability of the region for mining. All but the very highest points have been covered by the waters of the Great Lake system when their eastern outlets were dammed. The present topography is, therefore, due to a combination of the following factors:

(1) The ridges due to harder and softer beds of the original series of Keweenawan rocks. (See Plate III, a and b).

(2) A series of faults of which the most topographically prominent group seems to run more nearly north than the strike of the formation. These features seem to have been brought out in relief quite largely before the last ice age.

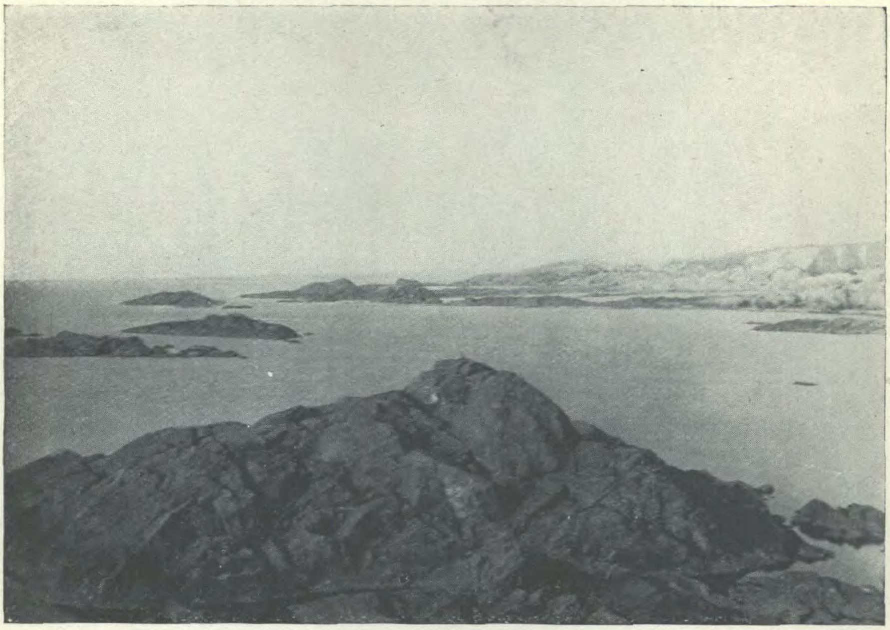
(3) The distribution of glacial till itself from the receding ice sheet does not seem to be a very important factor in the topography, as in many other regions, while the distance to bed-rock is not anything like as deep as it is, for instance, in that part of Keweenaw point which has been undergoing exploration recently. Here depths of over 200 feet drilling before striking bed-rock are not uncommonly recorded in the recent drilling around the Lake and Indiana properties. Such depths make exploration much more expensive and need not be expected at Mamainse.

(4) The scarping of the surface by a series of nearly horizontal lines of beaches, due to the erosion of the waters of the Great Lake system when standing at different levels. These strands have been described by Coleman, Lawson[1], Taylor and Leverett.[2] Lawson gives at the "deserted mining village of Mamainse," (that is, the old Quebec mine workings about 2 miles north of Mamainse point) (Plate III, b), three beaches as follows, "a gravel and shingle beach which skirts the back of the old stamp mill. Its crest, where crossed by our levels, is 122·1 feet (XI). The second is a distinct terrace

[1] Sketch of the Coastal Topography of the north side of Lake Superior, by Andrew C. Lawson, 20th Annual Report of The Minnesota Geological Survey, Pt. V.

[2] Presidential address before the Michigan Academy of Science, 12th Annual Report, 1910, pp. 26-27 and 34-37.

PLATE III.



(*Photo by Wilson*)

(a) Lakeward dipping beds forming ledges and shoals near Point Mamainse.

PLATE III.

(*Photo by Wilson*)

(b) Edges of lakeward dipping beds forming partly submerged ridges, Mamainse. Old dressing works in the background.

which at its rear was found to be 156·8 (XIII). The third is also a terrace, but a somewhat extensive one, the rear of which was not observed. It is an apparently flat gravel plain thickly timbered, the surface of which, near its brink, is 191 feet above the lake. (XVI)."

There are, however, well-marked terraces below these levels. There was much building between 27 and 32 feet above Lake Superior which may be traced more or less all around Lake Superior and appears in the lee of Pancake point. This may be to some extent the off-shore accumulation of a lake with a considerable range of height which has made a heavy cut into the felsite cliffs back of Carlson's over 53 feet above Lake Superior. I should put the water level as probably 57 feet above Lake Superior. This is pretty clearly the Nipissing of Leverett, Taylor and Goldthwait, which is 49 feet above the lake at Sault Ste. Marie, and rises to about 100 at the northeast corner of Lake Superior. Just above this strand, then, outcrops may be expected to be relatively frequent, and below it the grades are rather flat and suitable for railways or other sites. A spit crosses the geological cross-section made by the drill holes near hole 6 at this level.

Somewhat more than 90 feet above the lake there was pronounced building and well-marked terraces. From 190 to 230 feet above the lake again the slopes are relatively gentle and Lawson's gravel plain XVI evidently forms its front. At 340 feet was a very sharp and well-marked bench which crossed the line of geologic section at stations 147+60 to 70, 156+, 192+, and 203 (hundred feet from the lake). At 418 and 419 feet above the lake crossed by the line of section at stations 209+, 90, and 213 hundred feet from Lake Superior is perhaps the highest beach of Lake Algonquin. Along all these shore lines one is rather more likely to have exposures, especially just a little above them. The Pancake location is very largely below the Nipissing and, therefore, very largely covered with sand. Only a small corner next the Sand Bay location rises much but there are low hills of the Copper Point ophite and one of similar height near Pancake point. The elevation of 900 feet which is given on some of the charts is surely due to some blunder.

In the Sand Bay location the main divide is made by the heaviest conglomerate and the crest is a little over 400 feet above the lake. This is practically the limit of abundant outcrops, and of any exploration which amounts to much. Back of this divide the government road runs in rather gentle grade from 200 to 260 feet above the lake. On the south side of this divide streams have to a good extent cut down to rock surface, following ravines made by the faults which cut the range obliquely.

PHENOMENA OF VEIN AND COPPER DEPOSITION.

In describing the veins I will for convenience keep Trethewey's numbers, which are placed on the map.

It may be said that in general the mineralization is of precisely the same type as on Keweenaw point, and having been well described by previous writers, (most fully by Dawson and Macfarlane), I need not enlarge on it here. I have found[1] fluorite in the veins in felsite.

The native copper occurs with prehnite or with calcite either disseminated in bedded lodes, or in fissures. Some of the fissures probably contain an iron carbonate.

The sulphides (chalcocite especially) seem to be confined more to the fissures. Chalcopyrite does occur in amygdules (Sp. No. 06.9.31), and if so near the centre. The pyrite along the felsite contacts seems not to carry copper. The fissures may have 5 to 7 or more feet disturbed, but the values

[1] Cf. drill hole 3 at 187 feet and 14 at 89 feet.

seem to be concentrated in a narrow pay shoot of a few inches and are most noticeable when a conglomerate forms one wall of the vein (at vein 10 and 11 shafts, the upper wall.)

An easterly hade is universal. The strike generally is nearly north. It would be interesting to see more of what happens along a strong northeast fault like No. 4.

There are quite likely northwesterly or strike faults too, but they cannot be recognized, except that it is possible the fault cutting Conglomerate point is displaced by a northwest fault and is really the same as No. 4.

Dawson correctly describes the veins as crustified, filled with successive deposits from their sides; in several cases agatiform quartz, then quartz, then calcite, the latter on the quartz (and also he says vice versa); the copper contemporaneous or often later, also later than some zeolite. The sulphides have similar relations, the copper carbonates are later still.

He attributed the deposition of the copper to the electro-chemical decomposition of some soluble salt, probably the sulphate, as an aqueous deposit both in true veins and in vesicular cavities. We know now[1] it is more likely to have been a chloride.

Veins 1 and 2 near Rousseau's are described as a conglomerate bed carrying native copper.

This is where the Pancake felsite disturbs the conglomerates and the ophites (specimens 06-9-40 to 42). The shafts were full of water, little of promise was seen. Compare drill holes 3 and 4.

They are said to have been sunk 65 and 87 feet but the ore "yielded less than 1 per cent of copper."

Vein 4. At Mineral point, strike S. 45° W., dip 63° to S.E. May be traced under water. As shown by map a large displacement occurs. A blast put in it for me (see p. 104) where a stringer of it crossed the trail about 1850 paces N.W. Carlson to Cape Mamainse, showed copper carbonate.

It is said that it showed a trace of strontia, and that the vein was about 15″ wide and carried "copper and sulphide." A shaft 40 feet deep probably was on the contact of the conglomerate under the Carlson ophite and the trap on the other side of the fault, and would soon run out of the shoot. This was probably one of Borron's shafts.

It might be well to follow up this vein and see what happened when it and No. 11 or 10 met, a point which would be outside the Sand Bay location.

Veins 5, 7, and 8 are probably continuations of No. 10 vein at vein 5, the wall rock said to be trap, copper stained. The exact pit of those visited I did not identify.

Vein 6 is mapped as a fissure near Rousseau. I found nothing worthy of mention.

Veins 7 and 8 are presumably parts and stringers of the same fault as vein 10; 8 being reported as in conglomerate.

We followed the general course of No. 10 toward 7 and 8 up to above 340 feet above Lake Superior, and found in one place a piece of copper 1 foot long and 1″ wide; in another pit chalcocite with some carbonate and native copper. These pits may, however, be those between 7 and 10 shown on the largest map. While the strike was normal N. 5° W. the dip here appeared steep 65° E. In other pits we found amygdaloid and trap with chalcocite in a narrow seam. In a massive trap there was nothing on the same vein. The mineralization did not appear to be over a few inches broad at most, but was quite persistent along this belt.

---

1 Proceedings Lake Superior Mining Institute, XII (1906) pp. 154-163.

Vein 8 is a little farther east than 7 and is supposed to unite with or be a stringer of 7 and 10. It is said to have been traced for 1000 feet.

Vein 9 was not visited by me but was tested by holes 13 and 14 and examined by Brown.

It is described as containing native copper in fine grains lying with a conglomerate hanging and trap foot dipping to the east. This can only be a fault with a thrown back conglomerate on its east side. We found indications of a similar break and throw on the location line. The chances are that like all other faults it hades east. Thus, hole 13 would not hit it; but drill hole 14 cut it perhaps at 14 ft. or 35 ft. where a speck of chalcocite was seen.

36-57 chains N. 80° E. of No. 10 shaft are pits which may well be on a continuation of No. 9 vein. The strike was N. 20° E. Pits are respectively 40, 112, 165, and 495 paces north of the trail. No. 2 was the only one that showed any sign of copper.

Vein 10—Copper Creek vein—at shaft house.

The elevation of the shaft[1] at No. 10 vein, measured about 240 feet above the lake. The vein strikes north nearly N. 5° E. and dips 42°-45° to the east. The rock on the dump carries much copper. On the east side is a conglomerate with red matrix and containing many cobbles and boulders of granite, 2″ diameter and upwards. The native copper (often crystallized) comes mainly from this conglomerate.

On the other hand, on clearing the bed of the creek near the shaft we found a 4″ seam of almost solid chalcocite. This really seems to be the whole width of the main lode of rich material though the vein is said to be 6′-6″ wide. The conglomerate to the east is about 45 feet thick with a lot of 2″ granite cobbles in a red sandy matrix. The opposite side is amygdaloid, being on the other side of the fault as shown in the map. The conglomerate strikes N. 15°-20° W.

In the vein material two kinds of calcite, an older pressure twinned, and a younger not so twinned, may be noted.

The shaft is said to go 308 feet down on the vein to a vertical depth a little over 200 feet, and is dry from 80 to 270 feet, at which depth much water was struck.

At 80 feet a drift was extended 49 feet south and 20 feet north, all in trap.

The chances are that the shoot went off to the south following the conglomerate. (See Fig. 1).

The strike of vein 10 would carry it toward drill hole 12, and to it may be charged perhaps the numerous seams in that hole at 22° to the core, for instance that at 12·359[2]. The pyritic impregnation of the felsite may be connected with nearness to this fissure.

Vein 11 does not seem exactly parallel to 10, being on a strike of N. 20° E. and dipipng 65° to S.E. Perhaps there are two veins crossing. It has much more chalcopyrite than No. 10, some chalcocite, and some carbonate; bornite is rare The foot amygdaloid contains chalcopyrite in the amygdules. Native copper and silver are said to have been found, some ore running thousands of dollars per ton in the latter.

The foot on the west side is a massive ophite and an amygdaloid; the hanging a conglomerate ridge over the vein which strikes N. 25° W., dips 37° to 30° to S.W. and contains pebbles of granite, jasper, iron ore, greenstone schists, and rhyolitic felsite. This is not less than 40 feet thick, probably 138 feet long or so.

---

1 A view of the buildings, labelled the Copper Creek mine, is given by Blue, p. 73. The machinery and buildings had been well taken care of and were in about the same condition in 1906-8.

2 The writer designates drill cores by the number of the hole as shown on the map, followed by the depth in the hole as a decimal.

The throw in a direction S. 65° W. at right angles to the strike is about 1250 feet, or at any rate in that direction in from a conglomerate ridge with felsite 200 feet south. About 220 feet down to the trail a fissure seems to cut across streaks of conglomerate with trap on the south.

Along the main road to No. 10 on the north side of the road are a number of pits which may show continuations of vein 11 or others parallel to it. One strikes N. 9° E., dips 70°, and shows a little carbonate of copper and chalcocite.

Another fissure vein of calcite on an old trail, strikes N. 25° E. and dips steeply to the east and might be one of the fissures passing through drill hole 9.

It was reported that No. 11 is 5 to 7 feet wide (I doubt if the pay chute is that width), that it was exposed by five pits for 54 chains with (besides the minerals already mentioned) red and black oxides of copper. The vein is a breccia cemented by a red zeolite, perhaps in part chabazite (the microscope shows a mixture) on which comes quartz, calcite, barite or celestite, and copper oxide and kaolinite among the last things formed (Sp. 06.9.31).

Dawson's description of the work he visited in 1856 seems to refer to the No. 11 vein.

If its strikes were like vein No. 10, nearly north and south, it would pass between drill holes 10, 9, or 12, but if its strike continues N. 20° E., it will pass down toward the beginning of section.

Vein 12 was not identified.

Veins 13 and 15 appear to be the same, and are close to the location line and just below the heaviest conglomerate. Vein 13 is on the Ryan location with walls copper stained. Float chalcocite is said to have been found near.

Vein 14 is near where the picket line and trail from No. 10 strikes the old Rousseau trail. It is close to or under the heaviest conglomerate, perhaps 200 steps under it. We saw nothing of value, but an old map indicates pits all along the location, in three of which within a thousand feet of the north line copper and copper glance are noted. These we did not see.

Vein 11 is said to have shown chalcocite. We visited the pit and found nothing.

A few other veins not bearing any copper are indicated on the map.

Vein 15 would be a continuation of No. 13 on the section line and not far from No. 15 hole.

Both hole 16 (near Station 198) and hole 17 (near Station 203) probably cut an amygdaloid which was opened by old pits on the section line opposite. But except a few amygdules of copper carbonate in hole 17 there was little in it, although a little copper was found here and there all along the outcrop through the pit on the line of the location to the cross-section line of the drill holes. There was another amygdaloid at station 214 of the drill hole cross-section in which there was a little copper carbonate at the surface.

So much for the veins which were actually worked upon, more or less, by Capt. Trethewey, and visited by us. It must be remembered that at present no successful mines in Michigan are working fissure veins and it seemed to the management of the Calumet & Hecla Mining Company a good plan to see what the bedded lodes looked like apart from any fissures. It is only fair to say, however, that in many cases the bedded deposits are richer on one side of the fissure, and conversely, in mining the Central mine, which was the last fissure to be abandoned, a good deal of available rock was found in the more pervious beds adjacent to the vein, which were mined out laterally for many feet. It seems to me very possible that in this region of flat dips ore bodies are more like those around the Central mine than like those around Portage lake, and the bulk of the copper might be found near the fissures, since if the beds were relatively flat, circulation would more naturally follow the pervious features with greater inclinations.

Accordingly, it might be well to try and follow up the shoots which would be formed by the intersection of the veins and pervious beds, looking for copper either in the vein or in the fissure. For instance, if vein 10 were unwatered and a drift south extended, it might be found to strike into a shoot of copper again. (See Fig. 1).

The amount of copper disseminated is not dissimilar to that found generally in the Keweenawan rocks, as shown in analyses of Keweenawan traps, or in a series of sludge analyses.

The following is a summary of the tests of the sludges for copper made by the Calumet & Hecla Mining Company.

Hole 1.

From 192-210 feet	0·04 per cent	0·72
210-226	0·03	0·48
226-244	0·06	1·08
244-258	0·05	0·70
272-282	0·04	0·40
332-353	0·04	0·84
353-373	0·04	0·80
411-435	0·05	1·20
430-448	0·04	0·72
470-490	0·05	1·00
rest between 1-530	0·00	7·94

Average..........0·0149 per cent for 530 feet.

It will be noticed that in hole 1 the largest amount of copper occurs in the Rousseau conglomerate in streaks on the whole in the upper part, though not specially or exclusively just at the top. A large fragment of trap included seems to have had some copper around it and the lower part of the conglomerate seems to be distinctly free.

Hole 2.

52- 72 feet	0·08 per cent	1·60
72- 86	0·04	0·56
86-103	0·04	0·68
155-164	0·03	0·27
164-180	0·05	0·80
180-191	0·07	0·77
191-216	0·04	1·00
216-223	0·15	1·05
223-233	0·05	0·50
233-246	0·05	0·65
350-375	0·04	1·00
375-393	0·05	0·90
393-410	0.02	0·34
410-450	0·03	1·20
450-464	0·02	0·28
464-486	0·03	0·66
486-496	0·05	0·50
rest between 52-496	0·00	12·76

For 444 feet average 0·0287

Average 1.0-530 and 2.180-496=(846) feet 0.0199 per cent copper.

In hole 2 the greatest concentration of copper seems to be in and below the amygdaloid of Bed 12, but whether this copper really belongs in the amygdaloid, or whether it may have been derived from a cross seam does not appear. It will be noticed that at 256 feet minute copper crystals were visible in a prehnite seam.

These two holes were all for which the sludges were systematically tested. The amount of copper is the same as that found in similar tests on Keweenaw point, and also by Grout in Minnesota[1].

Other work prevented systematic testing of all the sludges especially as there was nothing particularly attractive. Specks of copper at holes[2] 5.52, 5.85, 5.248 (prehnite), 6.323 (just above the conglomerate), 7.240, 7.292, 7.295, 7.432, 8.262, and 11.262 were not at all promising, but were enough to illustrate the wide dissemination of native copper in the formation.

Hole 9 shows similar traces rather more frequently—at 229, 309, 353-58, and 437 feet. The last seam may be connected with No. 10 vein. There was also a speck in an amygdule at 437 feet.

At 10.174-9 there is prehnite and rarely copper, also at 257 and 375.

Tests of the disseminated pyrite and iron oxides along the contacts in hole 12 showed no copper values. The pyrite was in minute cubes.

Holes 13 and 14 also showed no copper, except that in hole 14 at 34 feet was a speck of chalcocite, which may represent vein 9.

Hole 15 gave the following results:—

198-215, 0·10
216-222, 0·17
223-232, 0·00
43-353, 0·00 (except as otherwise reported)

This, however, is mostly from a felsite margin charged with pyrite like that in hole 12.

From hole 16 no copper was reported.

Hole 17 gave a minute speck of copper carbonate in the first amygdaloid just below the surface, and specks of copper were also seen, on the coast at about this horizon. Samples ran as follows: 0·02, 0·08, 0·02, 0·07, and 0·04 per cent.

DIAMOND DRILL SECTION.

The Calumet & Hecla Mining Company, accordingly, prepared a geologic cross-section by a series of drill holes, the record of which is the chief object of this report. It follows in detail.

It will be noticed that the record runs along fairly smoothly through the first seven holes, interrupted only by a body of felsite which appears to be intrusive in holes 3 and 4. Holes 7, 9, and 11 on the other hand seem to show a good deal of repetition. Hole 12 shows once more a good deal of felsite which is more or less comparable in horizon with that north of Sand Bay. There is then an interval which is at least in part filled up by exposures of the heavy Carlson ophite and various conglomerates. Holes 13 and 14 were to test the conditions of vein 9. Holes 15, 16, and 17 were to see if the formation under the heaviest conglomerate looked any more promising, but, of course, they have by no means exhausted the possibilities in that direction. It will be noticed that except close to the faults or other disturbances the beds are in almost all cases quite flat, but on the whole flatter near the upper part of the section. The total thickness developed (including that part of the section

---

1 Science, Sept. 2, 1910, p. 313.

2 The writer designates drill cores by the number of the hole as shown on the map, followed by the depth in the hole.

PLATE IV.

(*Photo by Grierson*)

(a) Rousseauville, showing the lakeward dip of the beds.

PLATE IV.

(*Photo by Wilson*)

(b) Trap sheet at Copper Mine Point light.

which was not developed by drill holes but where the outcrops are pretty thick and making allowance for faulting) may be something like 8,510 feet. To this, for the thickness of the formation may be added something less than 5000 feet to obtain a minimum.

Copper Mine rock trap, not visited. A sheet of copper is said to have been found in a joint fissure 200 feet horizontal, say (70)[1]

Covered under the lake, 1400 feet horizontal, say (495)

Copper Mine Point (Light House) trap, base exposed in hole 1 to 45 feet, at 8 feet ½mm mottles, at 37-45 feet basal amygdaloid. This bed makes the bluff on which the lighthouse stands (Plate IV, b) and is probably about fifty feet thick, allowing for the part above the drill hole. (50)

Hole 1 is at an angle of 59°, elevation 28 feet above Lake Superior, at Station 0+66 on a line starting from the water near it.

Light House conglomerate.

Hole 1.45-55, more distinctly a conglomerate and sandstone; amygdaloidal to 121 (75)

The dip as measured at the surface was 22° to S. 44° W. In the hole there was much dark sandstone matrix with felsite pebbles, also amygdaloid conglomerate. A red shale band makes an angle of 78° with core, implying a dip of about 20°. The inclination of the hole was 59°, elevation (23) 605 above tide, position (0+66). The 0 of elevation was the level of Lake Superior on July 12, 1907.

View Rock Trap. Hole 1.121-183. (60)

The amygdaloid merges in the base of the conglomerate above. Seams at (24°, 22°, 20°, 14°) with the core are probably at right angles to the dip. Though it seems to get finer toward the base there is no apparent mottling.

It makes the first rock exposures south of Rousseau's dock at the harbour, and probably also the islands off it, Rousseau island, etc. (Plate IV, a).

Rousseau Harbour Conglomerate. Hole 1.183-302. (116)

(Not exposed at the harbour) to 199 feet many basic fragments, and at 199-203 feet, all trap probably a large rock fragment as there is no amygdaloid; down to 225 many felsite pebbles, below at 230 feet much calcite cement with felsite and dark fine grained trap pebbles mainly, occasionally coarse amygdaloid. This conglomerate sludge contained copper as follows: 192-210, 0·04 per cent; 210-226, 0·03 per cent; -244, 0·06 per cent; -258, 0·05 per cent, the rest none, that is, the copper was in the upper part only about 0·04 per cent.

This reminds one of the concentration of copper in the Nonesuch, just under an impervious bed. Heavy conglomerates like this and the Kearsarge rarely carry large values throughout. The tendency seems to be for the values to lie close under the impervious bed, that is toward the hanging of the conglomerate.

Feldspathic Melaphyre (26)

Amygdaloidal 1.302-306
Trap -329

The traps at the top of (2) are of the same type as those on the north side of Rousseau harbour.

Feldspathic melaphyre, ophite, 44. (43)

Amygdaloid 1.329-333.

White amygdules and small green feldspar phenocrysts on red ground.

---

1 Numbers in parenthesis always refer to the thickness, in distinction from horizontal and vertical measurements.

Trap 1.333-373, a tholeyitic[1] (ophite) melaphyre. Feldspathic, decomposed, with pink and green flecks and 1 mm feldspar, like some of the trap above the Isle Royale lode.

From 332-373 was 0·04 per cent copper, and on the north side of Rousseau harbour, prehnitic cupriferous amygdaloids and trap occur, the amygdaloid was purple and quartzose. Dip 24° to S. 55° W. I estimated five feet amygdaloid and 30 feet trap for the uppermost trap flow seen on the shore of the harbour.

---

(69)

Feldspathic melophyre. 57 (or 47) (56)

Amygdaloid 1.373-395 cf. 2.57-73. Fine grained, porphyritic with contact to 380 feet, part of the flow above perhaps, then decomposed coarse amygdaloid to 395 (compare hole 2, 57-73 16), probably the one exposed with copper and prehnite in a small point over against the end of the pier, specimen 46.

Trap 1.395-430, cf. 2.73-104. The trap is somewhat amygdaloidal, with coarse plagioclase laths (2 mm long) at 411; a seam at 40° to the core, at 417 feet, may be nearly north and nearly vertical; by 417 feet it is finer.

At hole 2.52-72, the sludge ran 0·08 per cent copper and at 72-103 0·04 per cent.

Hole 1. 411-435 ran 0·05 per cent and from 430 to 448, 0·04 per cent.

Feldspathic melaphyre. 29 or (47 or 35) (29)

Amygdaloid 1. 430-435; 2. (57-73), cf. 2. 103-106. Coarse. No. 2 at 57 feet has glomeroporphyritic[2] contact. No. 1 at 430-448 feet has 0·04 per cent copper

Trap 1. 435-459 (cf. 2. 73-104) and 2. (106-138). Coarse and feldspathic; like hole 2 at 104 is hole 1 at 459. On the shore this bed dips 23° to S. 50° W.

Feldspathic melaphyre. 61 (or 35 or 46)

Amygdaloid 1. 459-467, 2. 103-106 or 2. 138-148. Coarse, seems to make a cave on the shore, calcite there.

Trap 1. 467-520 (cf. 2. 106-138) or (2. 148-184). Coarse, feldspathic.

In hole 1 are seams at 50° to core, in hole 2 at 22° respectively 78° to the core.

In hole 2 the sludges from 155-164 ran 0·03 per cent copper; 164-180, 0·05 per cent.

In hole 1 from 470-490 ran 0·05 per cent copper. Hole 1 averages 0·0149, hole 2 0·0287. Copper was also noted with prehnite in the outcrop of three amygdaloids on the north side of Rousseau harbour.

No. 2 hole is at 1000 feet on the line, elevation 634, above tide. (Adding 602 to elevation above local datum). At 65° inclination from horizontal. The correlation of 1.459 and 2.103 implies a dip of about 23½° which is close to that measured on the outcrop and in the cores. If we match 1.459 and 2.138 we get 21° which is a little closer, and the size of the beds fits a little better.

---

1 Tholeyitic (German tholeiit) is a term used by Rosenbusch (Volume II, 1908, pp. 1207 and 1224) after the town of Tholey, not far from Bingen on the Rhine, for basaltic rocks in which the last part to solidify, which occurs in polygonal or wedge shaped interstices and only in small quantity, is a glass often filled with microscopic fibres of feldspar. It is thus nearly wholly crystalline, all the crystallization being subsequent to the eruption.

2 The terms glomeroporphyrite and —itic borrowed from Tate are herein applied to certain of the Keweenawan basaltic rocks in which larger feldspars were formed and seem to have clotted together before the final consolidation, from the feldspar of which they are, however, not always sharply separate. While they have, so far as I know, about the same amount of silica as the ophites they have more soda. The same flow may be much more glomeroporphyritic at top than at bottom, the feldspar having risen.

Moreover, three different amygdaloids opposite Rousseau island give dips of 18° respectively to S. 53°, 55°, 52° W. There were 52 feet of drift in No. 2.

Feldspathic melaphyre 35 (35) (490)

Amygdaloid 2. 184-191 1. 520-524.
Coarse with laumontite and calcite.
Trap 2. 191-219 1. 524-530.
From 2.180-191 the sludge gave 0·07 copper.
191-216 the sludge gave 0·04 copper.

Feldspathic melaphyre 70 (70)

Amygdaloid 2.219-228. Grey ground, marked calcite amygdules above, chlorite below.

Trap 2. 228-289.

The feldspar is up to 2-3 mm. long. Toward the base from 252 feet down it is darker fine grained chloritic; at 256 feet are copper crystals in a prehnite seam. Seams, perhaps vertical, cross the core at 31° and 18°.

From 216-223 the sludge gave 0·15 per cent copper.
223-246 the sludge gave 0·05 per cent copper.

An amygdaloid on the shore of the harbour, estimated 170 feet below the top of the series, also showed copper with prehnite and is probably the amygdaloid 12.

Feldspathic melaphyre 61 (61)

Amygdaloid 2. 289-314. Marked.
Trap 2. 314-350.
Feldspathic to 334, then growing finer to 344 or 350.

Feldspathic melaphyre 20 (20)

Amygdaloid 2. 350-355, with prehnite partly changed to chlorite.
Trap 2.355-370. Fine grained, feldspathic, glomeroporphyritic.
From 350 to 375 ran 0·04 per cent copper.

Feldspathic melaphyre 60 (60)

Amygdaloid 2. 370-375.
Poorly marked, with laumontite, chlorite, and calcite.
Trap 2. 374-430.
Chlorite with 1 mm feldspar, and at 415 very faintly ophitic.
2.42 is like 3.43 and 2.430 like 359.

From 375 to 393 ran 0·05 per cent copper, from 393 to 410 ran 0·02, from 410 to 450 ran 0·03. It will be noted that the main body of the trap ran lower than the top and bottom. Quite possibly the values are more closely confined to the amygdaloids.

Melaphyre.

Amygdaloid 2. 430-436, 3. 59-64. (15)
Poor.
Trap 2. 430-445, 3. 64-94.
From 410-450 is 0·03 per cent copper.

Feldspathic ophite. (52) (278) (461)

Amygdaloid 2. 445-453, 3, 94-99.
Marked at first, poor chloritic 450-453.
Trap 2. 453-497, 3. 99-155.

A streak of amygdaloid at 2.464-8, and veined at 3.124-150 at an angle of about 1 : 2 with the core. This is probably nearly vertical and very likely involves faulting; since at 3. 124-150 it is faintly mottled, while at 3. 135 feet the augite is 5 to 6 mm across, then finer and fainter to the end.

This ophite is low in copper; from 450 to 464 0·02 per cent.
464 to 486 0·03 per cent.
486 to 496 0·05 per cent.

This rise at the bottom may be due to copper spread in from adjacent amygdaloid.

Bed No. 10 of the section north from Whisky Rock has about the same coarseness. There is also an ophite on the east side of Cottrell cove[1] that may correspond.

Ophite. (30)

2.497, 3.155-185.

Amygdaloid at 3.155, reddish chloritic.

This is close to a fault I think. I do not think the transition to the felsite is an intrusive contact though it is possible. The mottling gets to be 3 to 5 mm in the trap, but it is much veined, at an angle of 36° with the core (which may be nearly vertical), and at about 3.185, has a white chalky look. Hardness 1. This is probably kaolin derived from felsite.

There seems to be no object in trying to add together detailed thicknesses for a geological column, beyond this, for the felsite suddenly comes in, in the middle of a coarse trap, and whether faulted on one side or the other, or simply intrusive, there is surely no normal succession of beds.

Felsite—Quartz porphyry. (76)

3.185-261.

White and chalky (kaolin) at first with banding and seaming at 19½° to the core. At about 201 has a reddish sandy appearance but is probably still porphyry, and continues porphyry with banding from 19½° to 32° against the core. At 253 it begins to get greyish white and greenish again approaching the contact. The phenocrysts of porphyritic quartz are distinct.

This ophite 18 and felsite 19 are shown without doubt in the shafts 1 and 2, in the 1895 blue print, near Rousseau in the pits, but not on the shore. The felsite was not recognized between Rousseau and the Pancake boundary line. But about an equal number of flows was noted around the first point north of Roussain to the first covered beach, next to which was a conglomerate.

A number of sections were made, all indicating that it is porphyry. 3.187 is a quartz porphyry (misnumbered 1.187) with phenocrysts of quartz, in corroded dihexahedra (brotocrysts 0·55 mm) and a ground mass now coarse, now fine, in bands with calcite.

The specimen is in places greenish pinitic[2], in others reddish and frequently has a spherulitic or perlitic appearance on a minute 0·02 mm scale, something like the augen or ellipsoidal greenstone effect.

This may also be seen with a low magnifying power in the thin section.

One opaque corroded isotropic aggregate with refraction less than quartz may be fluorite.

A little yellowish iron stain, some black mineral which might be chalcocite and one speck of copper occurs.

Section 3. 188.

Shows quartz phenocrysts, much sericite or pinite and kaolinite.

---

1 Whisky bay of the Map No. 112.

2 The term pinite is here used in a number of cases where no accurate microscopic determination has been made, but where rocks that look like altered felsite are light greenish with a feeble waxy luster and diminished hardness, and I think, mica is developed in the rock. Cf. Dana's Mineralogy, p. 621, pinite as general term.

This has more red iron oxide and more pinite, but is apparently the same as 3.187 with more shearing.

The dihexahedral form of the quartz is plain, and their size about as in 3.187 (0·3 mm).

Calcite seams show pressure trimming.

It also contains small fragments of the melaphyre which seems to have been fairly coarse ophite; though the feldspar is all changed to a white pinitic mineral and the augite likewise, the original texture remains. This would indicate an intrusive felsite rather than an effusive one. The fragment is angular, and there seems to be a little difference in grain in the ground mass just around it, which is quite different from a fragment in a conglomerate which has a sharp border. The specimen is generally reddish, and the trap fragments enclosed, in which the lath structure may be seen with a lens, are greenish. An open porous texture (almost granular) in streaks, appears to be perlitic.

Section 3.240 is a quartz porphyry much like 3.205 but distinctly coarser both in ground-mass and phenocrysts which have the secondary additions (kaolinite and pinite).

Both in hand specimen and under the lens and in section it seems to be saturated with secondary poikilitic quartz, which occurs in halos around the quartz phenocrysts. These are more cloudy, and judging by the amount of cloudiness there was a lot of secondary chalcedony silicification now changed into coarser structure.

One interesting section is an octagon now a fine grained aggregate. Another similar aggregate has a form which might be that of porphyritic feldspar.

Some of the quartz appears to be secondary vein quartz in amygdaloid cavities upon which the quartz has afterward been added secondarily in what was originally a quite open texture. This is the one that looks most like a tuff, but I do not see conchoidal ash forms and the secondary silicification seems to be toward the center from rounded elongated amygdule forms.

The general conviction which comes from these sections is that all this matter is a quartz porphyry, probably intrusive, but certainly not very deep seated.

Ophite.

Trap 3.261-363.

This may be a repetition of the beds 3.99-185.

At 269, 282, 290 feet the augite mottles are 1-2, 2-3, 4-5 mm across.

At 300 it seems coarsest. There are many calcite seams about parallel to the core. At 3.308 feet the seam is at 50° to the core, and then from 3.360 to 3.340 feet there are numerous seams, and while not fine grained the rock is uniform in colour so that the mottling is not clear. At 3.340 to 358 feet the mottling is apparent and it becomes blanched like 3.185, and the fault contact line is at 40 to 36° to the core. This angle of 36° appears to be the dominant one, and may be due to faulting or seaming striking nearly north (say N. 11° W.) and dipping 30° to the east. 3.317 is a feldspathic ophite.

The augite patches are 2-3 mm across, the feldspar in them so abundant that they do not appear physically, only optically continuous.

The iron oxides, and olivine (changed to serpentine, calcite, and iron oxides, which is quite abundant), are crowded out to the edges of these patches.

The feldspar (in an albite and Karlsbad compound twin) is labradorite.

The grain is fairly normal for the distance from the contact beneath.

Felsite-quartz porphyry.

3.363-483.

At 363-366 it is whitened, near the fault line, and may belong to the altered ophite, as no section was made. The contact line between the ophite and the underlying felsite is at 3.366 which resembles 3.188 exactly, that being an altered quartz porphyry. The angle of the contact line is 35° to 40° against the core. Then there is a greenish pinitic breccia, a shattered porphyry with banding, at an angle of less than 15° to the core, whether rhyolitic or fault shearing was not determined.

3.378-427 resembles 12.227-428, being very light coloured, reddish or greenish, with greenish pinitic grains, fragments of trap, breaking easily across the core, with whitened forms like feldspar phenocrysts.

From 3.439-446 was no core.

Section 3.411 shows a sediment, a porphyry tuff; sericite and quartz are dominant. While there is some secondary silicification and calcite also, yet a comparison with 3.240 is instructive. There are no phenocrysts, (brotocrystals) of quartz. There are small irregular granules and with low powers there appear to be conchoidal ash fragments.

Section 3.478 has a curious open texture, the cavities filled with sericite? or pinite? compare 1.188. The ground-mass tends to be poikilitic (or globulitic) with a tendency to micro-felsite and spherulite.

The ground had originally radiating films, in texture botryoidal like chalcedony. This is shown now by radiating streaks of reddish and clearer matter. On passing to polarized light, however, it appears that this original texture is all gone and replaced by patches of quartz.

In between these radiating textures is greenish serpentine (or pinitic material). The agate-like effect of concentric bands is very plain.

So far as I can tell this is simply vein matter in which soluble chalcedonic silica from the felsite plays a large part.

From 3.447-453 on the core is dark and basic with a banding which varies from being at 68° to being at 29° to the core, but is mainly more nearly at right angles; a 2 foot green and green and brown band (chloritic) comes between 453 and 460. A brown and white specked vein comes at 471 feet. It is green and red flecked from 474 to 478 feet—probably vein matter and it is irregularly specked and decomposed to 483 feet.

Ophite. (68)

3.483-551.

With a coarse pattern but faded, not plain.

Compare belt 3.261 to 363 and 3.555-570; at 547 feet, 4 mm mottles.

It would almost seem as though there were a series of fault repetitions, comparing:

Quartz porphyry 185-261 (76), 363-446 (83), 446-483 (37).

5-6 mm ophite 261-363 (102), 483-551 5 mm at 547 (78).

Quartz porphyry 551-557 (6-), 570-608 (38).

6 mm ophite 557-570 (23).

The faded pattern may be due to igneous contact. Fault decomposition generally tends to make the pattern plainer. There is a coarse ophite near the base of the Whisky Rock section that might be the same; also one on the east side of Cottrell (or Whisky) cove about 600 paces from the point (Whisky point).

Felsite (quartz porphyry)

3.551-557.

Contact at angle of 63½° with core at 557 feet and specimen 3.558 there.

Compare No. 4.38

Section 3.555 is a porphyry.

Porphyritic are: biotite
quartz dihexahedra with enclosures
feldspar (orthoclase)?

There is an enclosure of fine grained melaphyre. The ground is red with iron oxides.

There are signs of a current and flow lines around the melaphyre enclosure.

The core apears to be distinctly a porphyry with melaphyre enclosures. Compare 1.188.

These dark reddish specimens with enclosures occurring near the upper contacts are very suggestive of intrusions.

Section 3. 558.

Quartz occurs in sharp dihexahedra.

Orthoclase seems to occur.

There is present as though porphyritic, a mineral—uniaxial, or -2 V small, octagonal apparently enclosing plagioclase, colourless, refraction low, and birefraction like that of quartz. Compare scapolite.

The section was taken as nearly as possible at the exact contact, one part being dark brown, uniform in colour, with apparently occasionally phenocrysts of quartz and specks of some yellow ore (pyrite). The contact of this is very irregular but sharp, reddened, and there seems to have been small irregular shreds of the same stuff in the dark green mass against which is the contact. At the extreme end of the section is a clasolitic[1] mass embedded in which are also fragments with the melaphyre plagioclase diabasic texture. This in the other end of the piece of core is clearly diabasic with plagioclase laths. This might perfectly well be an effusive contact of the felsite on the sediment.

Ophite.

3.557-570 mottles 6 mm. (13)

Felsite (quartz porphyry).

3.570-608. (38) (453)

Begins red mixed with white in a brecciated appearance, at 580 whiter, and remains a banded decomposed quartz porphyry with a sugary ground to the end.

No. 3 from 185 to the end is alternately felsite and coarse ophite. If there were effusive sheets of felsite, we should have had above or below them some amygdaloids and fine grained traps. We may conclude that the contacts are either fault contacts or intrusive contacts.

There is no doubt that we see something of this felsite and ophite in the shafts marked 2 and 1 (Map) as well as on Pancake point. But it was not noticed on the shore.

Section 3.604 is a quartz porphyry.

Quartz dihexahedra show plainly.

Calcite is very abundant.

[1] Clasolite is a term introduced by M. E. Wadsworth in the report of the Michigan Survey for 1892, p. 130, for sedimentary material (red mud, or clay, or sand sometimes bleached to yellowish grey or white) occurring in fissured cracks or irregular stringers in lava flows.

The mosaic of the ground is rather coarse (0·03 to 0·20 mm).

All through hole 3 is an alteration of coarse ophite and porphyry that is evidently the same as the country rock of veins 1 and 2. How much is added to the real thickness of the section must be uncertain.

The correlation with the felsite of Pancake point and the heavier ophites of the base of the Whisky Rock section seems reasonable. But the correlation with the beds on the coast from Rousseau to Sand Bay is very poor and may be cut off by a fault.

Hole 4 of the Mamainse section is inclined at angle of 68° (practically perpendicular to the dip).

Elevation 50·09 or 652 A.T. at station 31 and at a dip of about 22°; the top should about correspond to 3.376. But it begins in a well marked conglomerate not found in 3, though it may be replaced by some of the felsites.

There was drift for the first 24 feet 4·0-24.

Conglomerate.

Hole 4.24 to 37.

Many green pebbles, (greenstone schist, etc.). This should correspond to one of the conglomerates in the bay where the line between the Sand Bay or Pancake locations comes out.

Hole 4. 24 to 179 (conglomerate, felsite, and conglomerate) might be compared with hole 3 from 185 to the bottom at 608 feet. But in this hole there are not the ophites, and in that not the distinct conglomerates. It looks decidedly as though the felsite were intrusive, or else there is much faulting. Compare, however, the association of conglomerates and felsite in Pancake point.

Felsite.

4. 37 to 154.

Begins with a red mixed or brecciated porphyry or tuff like 3.571, then felsite; after 50 feet, sugary white decomposed or light brownish and mottled brown with small green enclosures, (probably of the melaphyres judging from sections of similar things in hole 3). At 145 feet there is a banding at an angle of 73½° with the core; at 152 feet the phenocrysts of quartz are plain, about half a mm across.

Conglomerate and sandstone.

4. 154-179. (25)

For the upper 11 feet there are numerous round green pebbles with a white ground of smaller grains. Then it passes into sandstone with a dip of only 22° against the core. These may be cross-bedding lines or near a fault. Finally near the bottom is a shaly band at 80° to the core which is probably close to the dip.

Feldspathic melaphyre. (47)

Amygdaloid 4. 179-184.

Marked.

Trap, 4. 184-226.

Very feldspathic; at 189 a seam nearly parallel to the core but with numerous displacements.

Feldspathic melaphyre.

Amygdaloid 4. 226-242. (16)

Clasolitic and porphyritic with green 1 mm feldspars on red ground. Beds like this occur around the Isle Royale lode.

Conglomerate.

4.242-286, 5·0 to 39. (44) 275

This includes granite pebbles and grey and green pebbles. Toward the base it gets shaly.

The correlation of this with 5. to 39 is one of the best correlations and implies a dip of 24° which is close to those noted along shore. This conglomerate appears to be one of those of Conglomerate point, the first point in the Sand Bay location.

We struck it also on the Rousseau trail about 520 paces from shafts 1 and 2.

(38)

Amygdaloid 4. 286-306, 5.39 to ?, 44 to 48.

Trap 4. 306-330, 5. ? to 77.

Feldspathic reddish grey, a speck of copper at 5.52.

(50)

Amygdaloid 4. 330 to 333, 5. 77 to 88, 42 to 50.

Scattered large amygdules. At 1.85 a copper speck.

Trap 4. 333 to 372, 5.88 to 127?

Feldspathic, in No. 4, variously seamed at high and small angles with the core.

(111) or (33)

Amygdaloid 4. 372 to 395, 5.127 to 140.

Fine grained belt in No. 4, but the amygdaloid is not marked, nor is it in No. 5.

Trap 4.395-483, 5.140 to 160 (160 to 175) to 248; specked in No. 4 with green and white granular aggregates and at 4.449 is a seam nearly parallel to the core, then massive green and feldspathic. Near No. 4.400 there is a seam at 8-10° with core perhaps near vertical.

In No. 5 is a marked amygdaloid at 5.160-175. Below that the trap is reddish feldspathic to 5.193, then greenish and pink and greenish and specked at 5.225 to 228 and 5.230, remaining dark, coarse, feldspathic to 248. No. 5 seems to have more beds here. Perhaps the seams in No. 4 cut out something. The correlation of 4 and 5 below seems to be out of harmony.

4.286	4.372	4.483-489	4.505 to 509	
5. 39	5.127	248	290	
247	245	235	215	Differences

4.483-489 is a brown and white amygdaloid underlain by specked trap and 4.505 to 509 is a well marked amygdaloid.

This rather heavy bed may be classed as an amygdaloidal ophite and seems likely to be the bed which outcrops on the Rousseau trail facing north about 750 feet east of a conglomerate outcrop corresponding to that at the top of 5 and about 900 feet N.W. of the line of section.

It may be the trap of Norway Pine point (south of Agate harbour).

Hole 5 of the Mamainse section is at an angle of 60°, probably 5 to 10° off from being at right angles to the dip, but not enough to be worth correcting the thicknesses, elevation about 50 at station 37—on the transit lines—and the correlations assumed with No. 4 imply a dip of about 24°. We have the following section lapping No. 4:

Drift 5.0-5.

Conglomerate 30-35

Amygdaloid and trap 42-77

Amygdaloid and trap 50-127, with a speck of copper at 52 and 85 feet, with scattered large amygdules.

Amygdaloid and trap 33-160. Then we go on—

(88)

Amygdaloid 5.160-175.

Marked.

Trap 5.175-248.

Reddish feldspathic to 5.193, then greenish and pink and greenish to 200 feet. Specked at 5.225-228 feet and at 5.230 feet, then dark and rather coarse, feldspathic.

Amygdaloidal melaphyre. (42)

Amygdaloid 5.248-270.

This one has pink prehnite suggestive of copper veins.

Trap 5.270-290.

Amygdaloidal.

(48)

Amygdaloid 5.290-295.

Trap 5.295-338.

Feldspathic, chloritic, specked, and often seamed (both nearly parallel to the core and at 45° thereto. Basal amygdaloid over conglomerate 5.338-340.

Sandstone and conglomerate. (13)

Red shaly sandstone 5.340-344.

Dip well marked and not far from right angles to hole.

Conglomerate.

Largely white granitic pebbles 5.344-353.

Ophite. (40)

Trap 5.353-364.

Specked and fine grained.

Trap 5.364-393.

The augite mottles at 366, 370, 375 feet are 2, 2-3, 3 mm across.

There are streaks plainly ophitic, others not so. The mottling grows finer and disappears at about 390 feet.

(46)

Amygdaloid 5.393-414.

Coarse, with occasional amygdules, feldspathic, reddish perhaps merely a streak in the flow.

Trap 5.414-439.

Conglomerate. (33) (531)

5.439-472, 6.44-78.

With felsite and coarse grained syenitic and granitic pebbles, also amygdaloidal pebbles.

The bed beneath is much seamed as though with slides at an angle of 76° to the core, and lower down at 68°.

These would mean a dip of 44° or 16°, probably neither right, and probably the correlation above given is correct. In that case the dip, if there is no faulting, would be 22½°, which would agree with other observations.

In such case this seaming is probably at an angle to the bedding and due to the crushing that goes with the sliding.

The remaining beds in hole 5 may be matched as follows:

6. 78- 86 Specked porphyritic amygdule = 5.472 = 4.492.

6. 86-130 *Not* ophitic trap, more or less cut in 5 perhaps.

6. 130-140 Marked amygdaloid = (spot) 5.536?
6. 140-153 Trap.
6. 153-162 Coarse amygdaloid = 5.563-569.
6. 162-210 Trap.

Hole 6 is inclined at an angle of 64° 30′ at station 46 + 79.
Elevations 57.71 or about 660 above tide.
Drift was 0-44.
Conglomerate 5.439-472 at 6.44-78.

Feldspathic melaphyre. (52)

Amygdaloid 6. 78-86, 5. 472- 4. 492.
Specked almost like a porphyrite.
Trap 6. 86-130, 5. 492-536?
Reddish, feldspathic, not mottled.

(23)

Amygdaloid 6.130-140, 5.536?
Marked.
Trap 6. 140-153, 5. to 563?

(57)

Amygdaloid 6. 153-? or 162, 5. 563-569?
Continues coarsely amygdaloidal to 162. In a broad way the whole belt from 130 to 180 may be classed as amygdaloid in these small flows.
Trap 6.162-210, 5.569-578.

(39)

Amygdaloid 6.210-218.
With calcite and laumontite.
Trap 6.218-249.

(33)

Amygdaloid 6.249-259.
Trap 6.259-282.

(41)

Amygdaloid 6.282-292.
Trap 6.292-323.
Specks of *copper* in it at the base just above the conglomerates.

Conglomerate.

6.323-332-? 7. at 168. (9)
In hole No. 6 this is well marked and the thickness at least this much. In No. 7 it is but 2″, if this correlation is right, and the other correlations will be
6.332-349 (17), 7.168-185 (17) (17)

Amygdaloid 6.354, 6.349-354.
Trap, 6.354-380.

Amygdaloid 6.380-388. 31
(44) 346

Trap 6.385 to 424 (44) 7.185-226 (41).
6.424 (clasolitic *faults* and seams) to 455 (31) clasolitic at 7.240.
Trap -460 (5).
This is not a very good correlation.

Melaphyre. (17)

Trap 6.332-6.349.
The amygdaloid seems to have been removed, by erosion or perhaps by slide faulting.

(31)

Amygdaloid 6.349-354.
Amygdaloid and specked trap.
Trap 6.354-380.

(44)

Amygdaloid 6.380-388.
Slightly amygdaloid and specked.
Trap 6.388-424.
Fine grained, prehnitic, amygdaloid.

Amygdaloid 6.424-455.
With clasolites and much seamed. Such clasolites suggest the blowing or washing in of dust and mud into minute cracks in the lava.

At 6.444 is a fault at an inclination of 2 : 3 to the core (34°).

Trap 6.455-460.
Fine grained.

Hole 7 of the Mamainse section, inclined at an angle of 65° is at station 54+50. Elevation 64·5 or 666 above tide. It is characterized by a coarse olivinitic ophite at the bottom which seems also to occur in 8 and 11. This hole contains specks of copper at 240, 295, 432 feet, not suggesting a well defined lode.

There is a heavy overburden—146 feet of drift.

A trap, coarse, feldspathic, laumontitic, veined directly beneath to 168 feet may be the same as hole 6 to 323 feet and there are 2″ of conglomerate beneath.

Melaphyre. (58) (not added)

Amygdaloid 7-168-185.
Very well marked at the top.
Trap 7-185-226, 8.80-117.
Fine grained and peculiarly even; at about 7.200 feet like the Minong trap of Isle Royale.

Amygdaloid conglomerate. 7.226-240? 8.117-121-131? (14)

From 226 down is clasolitic and the passage to amygdaloid conglomerate is gradual. Also the base is uncertain. At 240 there is a speck of copper in a seam.

In No. 8 it is a grey sandy, hardened mud to 121, then an amygdaloid with clasolites, (mud seams) down to 131. In a broad way it seems clear that 7.226-244 corresponds to 8.117-131. In No. 8 there are 8 feet of trap, feldspathic and much seamed, 8.131-139 coming underneath, which may be compared to 7.244-260. A slight discrepancy between 7 and 8 as to the number of flows between this and the large ophite about 210 feet below may be due to minor faulting or irregularities of lava flow.

Feldspathic melaphyre. (9) and (18) or (20)

Amygdaloid 7.240-244, 8.139-146 or 8.121-131.
The transition to amygdaloid conglomerate above is as ill-defined as usual.
Trap 7.244-260, 8.146-148 or 8.131-139. Coarsely feldspathic.
In 8 the amygdaloid is much whitened and much seamed.

Feldspathic melaphyre, (slightly cupriferous) (37) or (39)

Amygdaloid 7.260-264, 8.148-151.
Trap 7.264-299, 8.151-185.

Feldspathic with coarse scattered amygdules, at 7.292 ft. and 7.295 ft. containing specks of copper.

In 8 it is much seamed and at 11.173 also at about 45° to core, at 178 ft. at 11°, at 182 ft. at 22° to the core.

Feldspathic melaphyre (ophite). (86) (92)

Amygdaloid 7.299-317, 8.185-193.

Reddish grey, coarse grained, feldspathic, with white amygdules.

Trap 7.317-391; 8.193-271; 11.69-103.

At 7.322 the feldspars are 3 mm long; it is grey and green blotched. At 7.342-345 is a speck of amygdaloid, but it remains massive feldspathic. Then toward the base it grows finer, seams parallel to the hole grow more chloritic and there is a faint ophitic mottling.

At 11.69-84 it is coarse feldspathic red and green, then finer, clasolitic at 104.

In 8. from 185-197 is a genuine green amygdaloid, then at 8.198 feet heavy seams and to 8.215 feet heavy seams of calcite, mainly at small angles to hole (vertical?) and very barren, again from 230-241. At 11.258 a small seam at 35° to the hole was crossed, and thereafter it was ophitic. There is a bare trace of copper in it at 262 feet.

Amygdaloid 7.391-398, 11.123-129? or 11.109-119.

Trap 7.398-410 (19), 11.119-123.

Fault seam angle 18½° at 7.400. This might be a vertical fault or disturb the series shown in 11.

11.109-119 is a fine grained red amygdaloid, and that seems to be the true top, the thickness being then 59 feet in No. 11, 41 in No. 7.

Feldspathic melaphyre (22) or (58) or (45). Total from hole 6. (206)

Amygdaloid 7.410-414, 8.271-283, 11.123-129.

Fine grained to 7.412 then coarse.

Trap 7.414-432, 8.283-329, 11.129-168.

Chloritic and spotted. It is in a way proper to include this and the flows above and below as one amygdaloidal belt perhaps. There is a trace of copper at 7.432.

8.271-283 has forms suggesting large porphyritic crystals. Compare the beds on the shore east of Copper point and 9.520.

Copper Point ophite (15 mm.) (300 feet?) (228)

Amygdaloid 7.432-446, 8.329-334, 11.168-175.

A fine grained streak has copper and is slightly amygdaloid in spots; an irregular cavity has chlorite on its upper border and calcite center.

Trap 7.446-660, 8.334-373, 11.175-347.

The variation of augite grain is as follows:—

At 7.	454	470	499[1]	509	525[2]	535[3]	543	565	577	585
	2	5	7-8	7-10	10, 12	7x15	13	9	10	15
	617[4]	630	639-644	646						
	5	3-4	3-4	1 mm across.						

At 8.	(329)	348[5]	354	370 feet the grain is
		2-3	3 mm coarser.	

At 11. (168)	192	209	229	249	255	294	302	328	335	338 ft.
the grain is	3-4	5	7-8	9-10	10[6] ·	10	8	4-5		7 mm.

In 11 there seems to be some disturbance. But the grain in the other holes all lies if plotted within a line representing an increase of 1 mm in 9·3 feet, starting from a central zone 10 feet outside the contact, and another line representing an increase of 1 mm in 11 feet starting from the margin.

---

1 Joints are at 22° with core.
2 Other grains beside augite (olivine?) are coarse too.
3 As coarse as the Carlson ophite which lines the north side of Sand Bay.
4 Finer than above, with rings of augite twins. There may be a fault between this and 7.585.
5 Decomposed; red with a slip and sudden change of grain. The sudden changes suggest that the hole is crossed by some displacement.
6 Faint pattern.

This is practically the same grain as the grain of the Greenstone in the Manitou section of Keweenaw point and is (1 mm in 2·85 to 3·37 meters) just about 1 mm in 3 meters. This is A. The marginal rate of increase C′ is higher[1].

11.338 is an olivinitic ophite quite coarse. The augite patches vary from 0·3 mm to 1 mm and are badly cut up by the feldspar (20, 16, 14, 13, 14) all 0·4 mm, rather long. There is much corroded olivine altered to serpentine, with grains from 0·4 to 1·0 mm.

There is much secondary iron oxide. The primary is not over 0·1 mm across.

The labradorite feldspar runs 0·5 mm × 0·1.

Section 7.577 is a quite olivinitic ophite.

The ophitic augite patches relatively free from iron oxides and altered olivine are two of them 10 and 11 mm across, therefore the grain is not less than this.

The iron oxide, magnetite and hematite, is in large part secondary after the altered olivine, but grains 0·3 mm and tending to be octahedral, though later than the feldspar, occur.

The olivine was up to 0·4 to 0·6 mm.

Occasionally in the same interstitial areas where the iron oxide and olivine occur there are interstices filled and coated with chlorite which seem to have been original miarolitic pores.

The feldspar is labradorite and is 0·3 to 0·6 × 1 mm.

The occurrence of this trap in No. 11 hole is fairly in the line of strike of the ophites near Carlson's house, Sand Bay. But its occurrence in the No. 7 hole would fall more into line with the massive ophite that makes Copper point at the south side of Sand Bay. The dip if one should correlate the base in 7, 8 and 11 would be practically flat.

All this may be accounted for by faults like the fault at the shaft on vein 10 running from the interval between holes 7 and 11 toward Sand Bay.

Conglomerate.

7.660-669—11.347-379.

The pebbles are largely felsitic, but with some coarse granitic rocks.

In 11 are round pebbles of felsite and other knobs of rocks and plenty of matrix. There is no sign of copper in the conglomerate, but a little in the amygdaloid beneath. If the bed above were the Greenstone this would be the Allouez conglomerate.

As 11 and 7 are 2643 feet apart, the correlation of these two would, except for the faulting, indicate an almost flat dip.

Mamainse hole 8 is inclined at an angle of 68°.

Elevation 70 above datum. 682 above tide at 65 + ·00 of section.

As here understood it exposes no new bed, the faulting causing the beds in No. 7 to reappear.

Drift is 80 feet.

Inclination	of seam	35°	from	core at	139
"	"	45	"	"	173
"	"	15	"	"	178
"	"	22	"	"	182 and at 215-236
"	"	35	"	"	258
"	"	23	"	"	348

[1] See my report for 1903, Michigan Geological Survey, pp. 215-217.

Copper visible (a trace merely) at 262 feet.

Hole 11 is the next in order, preceding 9 and 10. Inclined at 66° 30′. Elevation about 90 (692 above tide).

At 80+93 feet. This too, seems to be a duplicate of hole 7; for instance:
The amygdaloid conglomerate 7.226=11.109 and associated feldspathic traps;
The copper 7.295=11.125-129;
The ophite 7.432-660=11.168-347;
The conglomerate 7.660-669=11.347-379 =9.105.

All these make a more or less parallel series, but the intervals between are much less in No. 11. No difference in dip is likely to explain this by the varying angle at which the beds are cut, but it might possibly be due to distributed duplication in 7 or cutting out of beds in No. 11. The ophite in 11 is not as thick as one would expect from its grain.

A recapitulation of 11 to the base of the conglomerate is:

Drift	69	
Feldspathic melaphyre with clasolitic base	40	to 109
Amygdaloid and trap	18	to 127
Amygdaloid with speck of copper and trap	39	to 168
Ophite 10 mm	179	to 347
Conglomerate	32	to 379

Then follows:—

Porphyrite (24)

Amygdaloid 11.379-398 with a trace of copper.
Trap 11.398-403.
Fine grained; base an igneous contact without amygdaloid, but a little sediment.

Porphyrite. (29)

Trap 11.403-432.
Very fine grained, felsitic in habit. Intrusive?

Feldspathic melaphyre. (19) or (12) 104

Amygdaloid 11.432-441, 9.136-145.
Trap 11.441-451, 9.145-148.

Mamainse hole No. 9 at an inclination of 86°. Elevation 92·95, (695 feet above tide), is at station 89+03, only 810 feet from No. 11. If it does not lap on 11 the dip must be over 26°. Now as a matter of fact in the bottom of 11 and top of 9 is a peculiarly red fine grained porphyrite, a "red trap." A similar bed comes under the Carlson ophites, as well as under the Copper Point ophite, and there is said to be a little conglomerate at the beginning of 9, though I did not see it. This would imply a dip of 19° to 20° or according to a better correlation 20° to 21½°.

In hole No. 9 the thicknesses along the hole should be reduced to give true thicknesses by about 1-30 (cos (86°-70°)).

While there is nothing at all promising in copper, it is seen in specks in this hole more often than in some, to wit at 229, 309, 353-358, 437 feet.

Feldspathic melaphyre. (40)

Amygdaloid 9.148-156, 11.445-451.
Trap 9.156-188.

Specked and coarse feldspathic, slightly amygdaloid at 168 (with a speck of copper) to 170, and again at 173-175. Compare No. 6.78-180; at 178-183 is the coarsest feldspar 2-3 mm.

Feldspathic melaphyre. (49)

Amygdaloid 9.188-200.

Not very bubbly.

Trap 9.200-237; feldspathic with pink seams at 216 feet and 222 to 229 feet; at 229 copper.

(57)

Amygdaloid 9.237-241.

Marked pink and brown, with crystals of laumontite in cavities.

Trap 9.241-294.

Fairly coarse, flecked from 271-280.

(39)

Amygdaloid 9.294-313.

Pinkish with conspicuous brown specks of iddingsite, altered olivine, copper at 9.309.

Trap 9.313-333.

Somewhat amygdaloidal.

Feldspathic ophite. (76)

Amygdaloid 9.333-338.

Trap 9.338-409.

At 353 to 358 is a very narrow streak with a white and yellow seam containing copper, quite a little very fine copper all along it.

The rest of the way it is greenish mottled becoming coarser perhaps but very vague.

The seam at 9.353 might be connected with No. 10 vein. It is nearly in line with it.

Amygdaloid 9.409-419. (84)

Red marked.

Trap 9.419-493.

Fine grained a little copper in a large yellow and white amygdule at 437 feet, green at the base.

Amygdaloid 9.493-497. (22)

Marked, with a clasolite[1].

Trap 9.497-515.

Greenish fine grained as above, seams near parallel to bed but as a whole this hole is relatively little cut by seams, especially as compared with 8.

Porphyrite.

Amygdaloid 9.515-520. (20) (387)

Coarse feldspathic

Trap 9.520-535. (3070)

Feldspathic with 15 mm phenocrysts.

Compare with Sp. 06 9.492, also 8.271, and 7.414.

Compare 11 and 9 with the Copper Point section.

The above 3070 feet are the upper group. The column is much more reliable than below.

Mamainse hole 10 at an inclination of 85° (90) 692 above tide is near 98+40 of the section line, 263 feet N.W. of it.

The surface drift is 139 feet.

---

[1]See page 27, footnote.

Feldspathic ophite.

Trap 10.139-174 cf. 9.333-409.

At 160-165 ft. the mottles appear to be 3 to 4 mm.

Feldspathic melaphyre. (41)

Amygdaloid 10.174-179.

White and yellow with prehnite and rarely copper.

(Compare 9.437).

Trap 10.179-218.

At 10.200 a seam nearly parallel to core.

(19)

Amygdaloid 10.218-223.

Red with greenish prehnite.

Trap 10.223-238.

Amygdaloid 10.238-248.

Slightly amygdaloid perhaps part of flow above.

Trap 10.248-295.

Copper at 10.257. A reddish alteration brings out the altered olivine, iddingsite; coarsely and vaguely mottled like 10.139-174 and 9.333-409.

(77)

Amygdaloid 10.295-302.

Trap 10.302-375.

Fine grained to 326 then fissured and somewhat amygdaloid and at 330 a big vein white and yellow, of calcite, etc. barren.

It continues trap, somewhat veined and amygdaloid to 375.

This vein at 330 is not at all unlikely to be vein No. 10 or to be parallel and not far from it.

Ophite.

Amygdaloid 10.375-381.

Quite a little copper in a 1″ seam also in amygdaloid below.

Trap 10.381-409.

Mottles at 386 399 feet are
2 4 mm across.

From the grain this must be closely associated with the next belt, the amygdaloid which is coarse, being only a streak in the trap.

Amygdaloid 10.409-416.

Coarse yellow and brown.

Trap 10.416-448 fine mottles.

Porphyrite? (89)

Amygdaloid 10.448-468.

Trap 10.468-540.

Fine grained like 11.432 to 11.473, coarser to 497, but all fine grained.

Trap 5.40.

Mamainse hole 12. is inclined 65° once more. Elevation about 90 (692 above tide). Location 200 feet off on the south side from station 112.

The depth of surface drift overburden was heavy.

Drift 1-166.

The rest of the way it seems to be running in and out of a contact between a quartz porphyry and trap. The porphyry has scattered through it minute specks of pyrite, etc., but I understand assays show no values.

The trap is a fine grained blue trap which might be the same as the lowest bed in 10.

Trap is 12.174[1] to 197[2], 343-354[2], 364, 513-529[2], 534-537.

Then from 10.572-579 is amygdaloid, and under that 10.593 is ophite.

Felsite or quartz porphyry is 12.197-343[3], 354[4], 513, 529-534, 537-567.

At 359 is a seam at 22° to the core, faulting a seam running nearly across core and throwing, if it is vertical, the lower part of the core up. The thrown seam across the core is thrown into the acute angle between core and fault plane. Compare vein 10. At 364 the contact comes in again, and is charged with ore (pyrite). There are rhyolite bands and the contact is at 31° with the core.

From 380 on not only the quartz phenocrysts but greenish altered (propylitized) feldspar phenocrysts occur.

At 480 there is probably a fault line at 45° to the core under which the porphyry looks like a red sandstone, though I think it is but an altered reddened rhyolite. At 513 the contact with the trap is very plain at 31° with the core as before.

At 529 the contact is at 59° with the core. At 560 the flow lines are at 22°, the rhyolitic banding at 31° with the core.

Hole 12 is then mainly porphyry, and the contact seems to be distinctly that of an intrusive. It is not likely that they could occur so frequently for effusives. Moreover they look like welded intrusive contacts. Again the occurrence of pyrite and chalcopyrite disseminated is, according to my experience, very characteristic of intrusives.

The beds in which it is intruded are not unlike those at the bottom of 10.

The following notes are on the thin sections studied under the microscope.

12.197.

Mosaic of quartz and feldspar coarse, much calcite and sericite (0·04 mm grains).

Phenocrysts rare, but sometimes show the clear dihexahedral rhombs of quartz (0·5 mm) with a narrow border of secondary quartz.

Feldspar with irregular rectangular forms very much clouded also occur of similar size.

There is a spherulitic or perlitic ocellar texture vaguely present, about 2 mm across.

Fluorite occurs; in one place next to a quartz phenocryst it is irregularly purple, in other places colourless? In one little vein one can see indications of crystal form.

Quartz porphyry 12.212.

Quartz brotocrysts? up to 1·5 mm.

Flecked mosaic 0·02 mm in size.

White mica more or less parallel is much more abundant than in 12.197. Calcite is abundant, occasionally in rhombs. 1 mm foreign enclosures, and minute highly refractive needles occur. It is studded with minute specks of pyrite (0·06 to 0·13 mm).

In oblique illumination is brought out a curious texture (the grain of which is about 0·3 to 1·0 mm, small sharp rectangular feldspar forms). In direct illumination, however, there is little visible. One porphyritic grain was 3 mm.

---

1 Blue, seams at 22° to core and otherwise.
2 Fine grained.
3 Disseminated ores 197-205, 210-280, 364.-380.
4 Spherulitic felsite.

Quartz porphyry 12.222.

Quartz brotocrysts, corrosive action far gone, very round, like (12.212) 1·4 mm.

Much mica.

Iron ores, pyrite and something black, pyrite cubes about 3 mm on edge with a secondary halo.

White rhombs of carbonate.

Calcite is abundant.

The section shows a structure of former feldspar like 12.212 0·3 to 0·6 mm in grain but not so marked, and one phenocryst would seem to have been 6-8 mm long.

The ground-mass mosaic is so clouded with mica and calcite that it is hard to make out, but is not over 0·1 mm in grain.

12.257.

Quartz brotocrysts, with very conspicuous secondary additions of halo quartz that extinguish with them, corroded, abundant about 1 mm in diameter.

There is generally a slightly darker halo around the quartz brotocrysts and they contain cavities with bubbles not movable.

The ground-mass mosaic is rather coarse 0·1 to 0·2 mm (0·17 rhombs of carbonate are very abundant).

Octahedra of fluorite and irregular shapes occur sometimes with violet stains.

12.265 quartz porphyry.

Quartz brotocrysts (0·8 mm) with aureoles as before but broader.

Rhombohedra of dolomite, negative crystals inclusions with bubbles 0·1 to 1·0 mm.

Orthoclase phenocrysts too. Karlsbad twins clouded about 0·6 mm. Muscovite abundant.

Ground-mass 0·02 to 0·10 mm largely feldspar.

More full of little opaque 0·1 mm round specks than 12.257.

12.310, All ground-mass felsite?

Ground-mass 0·03 to 0·12 mm largely feldspar.

Much muscovite in small folia.

General effect like 12.265 without the phenocrysts; a little seam of calcite runs through it.

12.343 is at contact.

With coarse vein-like streaks of quartz, carbonates, brown specks, 1 to 2 mm and areas of secondary quartz.

Elongate streaks of secondary quartz might be later filled pores.

12.348.

Much decomposed with secondary quartz, calcite, sericite. Narrow seams have been recently mended with quartz, round specks surrounded with green, then brown borders might be due to microfelsitic or spilositic alteration. Compare 12.355 which seems to have the same texture in fresher condition.

12.355.

Coarse with many balls spherulitic.

Large areas of secondary quartz are 0·4 to 1·0 mm across and interlock.

Reddish microfelsitic balls (0·1 mm to 0·2 mm) are embedded in them.

Carbonates are abundant.

12.368.

Still coarser than 12.355, but it has a somewhat similar spherulitic texture. There is a quartz dihexahedron 1 mm with a secondary halo. The secondary quartz patches are about 1 mm.

The microfelsite, spherulitic original texture is plain.

A pyrite cube is 1 mm.

Calcite and mica are abundant.

12.380. Quartz porphyry.

Quartz dihexahedra large, 1·1 (with negative crystals and motionless bubbles) inside and all rounded, secondary additions from ground-mass.

Feldspar (probably oliogoclase) phenocrysts all changed to sericite, which must be a general prophylitic action as these are from a drill core. They are 10 mm long. Feldspar phenocrysts are outlined all over the ground-mass in oblique light just like 12, 212 and 222.

There is also pyrite disseminated (0·6 to 0·7 mm).

While holes 10 and 12 are in no sense a normal section, we must assign something to the interval covered by them. I assign (540) + (537) feet say (1100) feet down to the Carlson ophite. The beds off Mamainse point suggest more than this.

Beyond hole 12 N. 70° E. comes a beaver meadow to about Station 123 for 1100 feet of which one cannot say whether it would be felsite or trap. Then on the east side at 12.730 feet rises a slope of trap which appears to be the coarse Carlson ophite replaced by faulting and continuing and exposed nearly to the fault of vein 10.

This might conceivably be the heavy bed of holes 7 to 11 repeated by a series of faults, but the surface exposures are such that it is pretty plain that it is the same as the Carlson ophite, and that means some faulting, and there are plain indications of repetition by faulting in the section. The section along shore from Mamainse point to the Quebec mine shows only one very heavy ophite, above a group of conglomerates, near the mine location and just north, corresponding to those found on the section between the 140 and the 180 stations, with which it must be identified. The grain of 15 mm indicates probably 300 to 500 feet thickness or a horizontal breadth of 1300-2000 feet if not faulted.

Hole 13 was 69·2 feet to S.E. of Station 133 + 41·5 (elevation 152·6 feet above Lake Superior) at an interval from hole 12 in order to avoid wasting money in drilling a heavy trap (coarse ophite), the Carlson ophite, a repetition of 7.436-660?) which came on the line of section. It dipped at an angle of 68° 30′ against the dip of the beds to N. 57° E., consequently vertical fissures would make angles of from 0° to 21° 30′ (tan. 42). It is not far from the old No. 9 vein of the 1895 map. And if that varies from the strike of the drill hole by 64°, striking nearly north (N. 7° W.), and is vertical the vein would cut it at 19½°, but if the dip is 45°, it will cut it at something like 24°, and there are seams at 16° to 20° to the core which may be parallel to the No. 9 fissure.

The indications are that the beds make an angle of 74° with the core, so that about 3 per cent should be taken off for the thickness. But I have not bothered in view of the uncertainty, and have assigned it a thickness of (209)

Porphyrite (Minong type).

Trap 13.22-47. Compare 11.379-403.

At 13.30 feet red bands and white veins at 66° and 71½° to the core.

Sp. 13.40. Under a lens shows magnetite perhaps 0·15 mm in diameter and feldspar laths but reminds one of 13.70 and the castile-soap-like beds in the Central mine section, No. 95-1573 feet below the Wolverine sandstone, chlorite and calcite joints at 20½° to the core. Specific gravity (by Jolly balance) 2·63 in spite of a small calcite seam.

Porphyrite.

Amygdaloid 13.47-52.

A couple of feet of amygdaloid conglomerate (?) with sediment on top, then poor small amygdules. Compare 11.403.

Trap 13.52-85. Compare 11.403-432.

These two beds do not seem to vary in grain and are fine grained.

Sp. 13.70 is like 13.40 with a jointing at right angles to each other and at 15° and 64° to 74° to the core.

Although these beds come so close under the Carlson ophite, I do not think they represent the felsite beneath, which seems to be intrusive.

These are probably the shingly, chippy, felsitic beds in outcrop, found 1800 feet N.E. of Carlson's north to Point Mamainse.

Similar beds occur under the Mt. Houghton felsite[1].

Sandstone.

13.85-102.

The banding at 73° 20′ to the core is well marked and seems to represent pretty closely the dip, being represented also at 30 feet. If so the true dip of the formation would then be 38° which is not steeper than *might* occur, for I noted dips of 40° and 42° myself near by.

Sp. 13.92 shows the banding well, also calcitic cement, and 2 to 3 mm granules of altered basic rock, deep red.

This seems not to have been noticed in exposure, being soft and eroded away.

Melaphyre.

Amygdaloid 13.102-104. Compare 11.432-441, 136-? 145.

Well marked white amygdules 4-10 mm on a grey ground trap 104-187?

Spots of green and white amygdaloid, probably bombs or inclusions, at 157 and 166 feet.

Feldspathic melaphyre.

Amygdaloid 13.187-192? Well marked epidotic, with quartz and calcite amygdules on grey base.

Sp. 13.187 has specific gravity 2.71.

Trap 13.192-209.

Coarse, feldspathic, epidotic, with calcite blotches 5 mm, and feldspars 2 mm × 0·4 and glomeroporphyritic. In general type this occurs at various points in the Ashbed group around the Pewabic lode, but more especially lower down, not far from the Isle Royale lode above conglomerate 8.

Hole 14 was a vertical hole put down 29·2 feet N.W. of Sta. 137.26 to prove up vein No. 9. The dip of the bed is near 45° perhaps, and for true thickness about 0·7 of that along the hole should be taken. I assign a thickness of (140)

The occurrence of felsite was not expected and it seems to be intrusive.

Overburden 10 feet.

---

1 Geol. Survey. Mich. VI., Part II., pp. 21-28.

1. Melaphyre.
Trap 14.10-14.
Dark weathered decomposed.
2. Fault contact, at 34° to core possibly a slide contact parallel to bedding, perhaps No. 9 vein dipping to E.
3. Melaphyre.
Amygdaloid 14.14-34.
Trap 14.34-49.
At 34 feet another seam at 34° to core with a *speck* of chalcocite and kaoline, *which may represent* vein 9, then much decomposed, fine grained, black.
4. Melaphyre 14.49-81, 99-110. (59)
With iron oxides and chlorite and a coarse green and red flaking and seams at 32° to core (vein 9). Compare bottom bed in 13.99-103, which is a similar dark decomposed trap, specked and fine grained.
5. Felsite (intrusive).
14.81-99.
Crushed, banding at 45° to core, with white mica exactly at contact, then a transition, a dark trap like that on the other side. This may be an intrusive felsite. The banding of the felsite is at about 45° to the core, but this is faulted by a red seam at about 26½° with core.
Sp. 14.89 has a vein at an angle of about 21° with core lined with comby quartz crystals with some violet fluorite at the centre.
Then comes the melaphyre again 14.99-110, like that above from which the felsite seems to split it, and again each side of 14.125 to 140 are similar beds.
It is conceivable that this is near the horizon of the felsites back of Carlson's, much faulted to the north.
6. Melaphyre.
Amygdaloid 14.110-125, again 140-160.
5. Felsite.
14.125 to 140.
Pinitic, banded at 24½° to core about like the vein at 14.89.
6. Amygdaloid, 14.140-160.
Trap. 160-226.
Faint 2 to 5 mm mottling, not ophitic, fairly compact.
7. Sandstone and conglomerate (27)
Basic sandstone 14.226-252.
Conglomerate 14.252-264.
Green Huronian or Keewatin trap pebbles 2″ to 3″ across.
Sp. 14.233 to 235 shows a nearly vertical calcite fissure. The dip may be about 22° (68° with core) but it is not clear.

This conglomerate is that at 145+85 to 149+60? of the section. It was also struck by us on the Sand Bay location line and is, I think, that which occurs at the shaft on No. 10 vein. Just close to the location line it is perhaps displaced a little by a fault running along the stream valley crossed at station 137, also on the road. This stream valley strikes about N. 10° W. which is that of prevailing faults. We followed the conglomerate S.E. from No. 10 vein to about 100 feet from the location corners, then following the S.E. location line of Sand Bay crossed a seam at 77 feet and in 300 feet came to conglomerate again about 500 feet broad. This seems to be a displacement. It is displaced again at No. 10 shaft and again at No. 11 vein, I think, and perhaps is found 28,250 feet N.E. of Carlson's and near the old powder house of the Quebec location. (Plate III, b).

Hole 15, at 61° dip and at stations 193+25 of the section, elevation (322.85) 925 above tide, was at an interval about 2,855 feet below No. 14, largely filled (e.g. between stations 172 and 179) with a heavy conglomerate. It was started just under an exposed trap to prove up an amygdaloid shown in a pit which looked hopeful, and unfortunately struck beneath a conglomerate a felsite probably intrusive, which we did not notice.

"Overburden" 81.

1. Conglomerate.

15.81-195.

At the beginning a very epidotic and calcitic conglomerate with occasional larger trap and amygdaloid pebbles, but mainly the fragments are small (2 to 5 mm). Sp. 15.90 shows a large pebble. Sp. 15.91 is more like felsite. Sp. 15.122 shows a variety of grains in a calcareous matrix, some of them porphyritic quartz from felsite.

This I take to be the base of the heaviest conglomerate traceable to the shore north of the Quebec mine, past the point where the N.W. line of the location crosses the Government road.

2. Felsite—feldspar porphyry.

15.195-233.

At the margin is charged with pyrite just as it was in 12.197-205, but it seems a little more granular.

From 198-215 gave 0·10 copper.
216-223 " 0·17 copper.
223-232 " 0·

Sp. 15.195 seems finer than Sp. 15.208 or 232 and has more quartz.

Sp. 15.208 shows small 1 to 3 mm feldspar (orthoclase) phenocrysts, white or yellowish green on a reddish ground, and also ⅓ mm quartz dihexahedra.

Sp. 15.232 appears coarser owing to more abundant phenocrysts.

Hole 16 at 197·91 of the cross-section at 61° 30′ inclination.

Overburden 38 feet......unconsolidated deposit.

1. Conglomerate 16.38-256.

Much like No. 15 at 179 feet—green pebbles that look half melted, on a cement that is yellow epidotic. Below 16.177 it becomes darker and more of an amygdaloid conglomerate with much epidote; white pure kaolinite occurs in seams. Between 220 and 239 it is rebrecciated, faulted, and disturbed, the direction being apparently at 21° with the core.

No copper.

Possibly this is just a faulted repetition of the heaviest conglomerate as we did not notice exposures of it N.

2. Melaphyre.

Trap 16.256-324.

Dark fine grained, brown.

3. Amygdaloid 16.324-336.

Epidotic.

Trap 16.336-350.

Fine grained.

Hole 17. at 54° dip, at 203.31 of the section.

This is in the series (below the heaviest conglomerate at 179 of the section) in which the arches shown in the views of Plate V, b, were cut north of the old Quebec mine, in which we also saw specks of carbonate.

Overburden, 9 feet.

1. Feldspathic melaphyre.

Amygdaloid 17.9-19.

Dark with calcite, datolite, epidote, agate, and a minute speck of copper carbonate. Samples gave only 0·02 to 0·08 copper.

Trap 17-33.

Feldspar almost as distinct as in intrusive diabase.

2. Amygdaloidal melaphyre.

Amygdaloid 17.33-45.

Epidotic.

Trap 45-50.

3. Doleritic melaphyre.

Amygdaloid 17.50-68.

Yellow epidotic, with altered clasolite at 66 feet, fine grained specked, at 17.58 seam at 26½° with core, perhaps nearly vertical.

Trap 17.68-356.

From 17.142-155 doleritic coarse streaks. (3 mm feldspar) at 17.180 epidotic. There can be seen also the augite lustre mottles 17.218, and in such cases the augite may also be seen to have a good deal of its own form, in short prisms (4 × 2 mm) with oblique terminations. A specimen at 170 feet has specific gravity 3·06.

This is the same type of bed as the doleritic melaphyres and ophites under the Wolverine sandstone, not the Carlson ophite or the ophite of No. 7. It does not seem to be as coarse as we would expect from the thickness. I should suspect that it was cut quite obliquely.

4. Amygdaloid 17.356-359.

Trap 17.359-367.

5. Amygdaloid 17.367-374.

Trap 374-376.

It may be only a gush of another flow, 17.367-374 is the better marked amygdaloid. There is a trace of copper (0·04 to 0·07).

6. Surface sections in detail. A.—Pancake Location Sections.

1. Pancake point to Whisky Rock.

The hill that makes Pancake point is all felsite, which is well exposed along the shore (the 30 ft. Nipissing terrace being cut back), from the first exposures, where the coast runs N. 65° to 70° E. to a point 700 to 800 paces west of the range for soundings at the extreme south end of the point. It is fine grained, the porphyritic crystals hardly visible but with open quartz lined hollows, lithophyses and spherulites. In patches along shore, for instance, from 550 to 600 paces west and also east is a fringe of conglomerate dipping to the south which may belong to the Lake Superior sandstone.

The exact contact of the felsite with the next rocks east is not exposed, and whether it is a fault, intrusive or superficial contact, cannot be said, but the rock appears to be of a very effusive type of felsite.

On the whole it resembles a little more the felsites of hole 3 and 4 than that of hole 12, for instance, and the ophites are not as coarse as the Carlson ophites. Moreover, if we assume that the formations are thrown north on the east side of veins which like No. 10 strike north, or if we assume a curving of strike to the east, in either case the felsites of holes 1 and 2 and 3 and Pancake point are more in line.

The amygdaloids and traps next succeeding appear to strike about east and west and dip 30° or so to the south.

2. Whisky Rock.

Whisky Rock appears to be the uppermost of a series of melaphyre flows striking east and west, dipping south; with joints, for instance N. 23° E. dipping 70° to the west, and N. 75° E. dipping 45° to N. A clasolite N. 23° E. is normally faulted by one N. 75° E.

The amygdaloids are well marked, with calcite, but not with epidote, prehnite, laumontite, or copper. The series seems to be as follows:—

1. Whisky Rock (20) feet thick?
2. Front flow on south exposure of point (20) thick.
3. Point at end near Whisky Rock. Coast turns N.W. ophitic (30) thick.
4. 100 feet broad.
5. 160 feet broad plus 100 feet covered beach?
6. 100 feet broad a (9) foot amygdaloid.
7. 100 feet broad marked fine grained.
8. 100 feet broad.
9. 100 feet broad plus extensive beach.
10. 6 mm ophite, 140 feet breadth exposed plus beach 300 above, 100 below (180?).
11. Well marked amygdaloid (30) feet thick?
12. Well marked amygdaloid.
13. Pink and white amygdaloid and marked ophite (6 mm?).
14. Pink and white amygdaloid and marked ophite (6 mm).
    Coarse amygdules, breadth of these two 361 feet?
15. Trap 180 feet broad.
16. Trap fine grained (30).
17. Trap fine grained.
18. Trap fine grained.
19. Trap fine grained. Total thickness about 1060 feet.

End of outcrop about 100 steps from a trail directly across the point to Pancake bay. The last traps much fissured and with clasolite and brecciated with agate.

This trail seems to pass by No. 12 vein of the 1895 map, but outcrops are not abundant on it and I did not see the vein nor the felsite as I expected. The slopes are gentle and drift covered, the land not very high. The total breadth of this Whisky Rock section at right angles to the strike is 3000 feet about, and its thickness probably 1000 to 1500 feet. Sandstones and conglomerates, if present, must have been covered by the beaches and could not have been abundant. It must correspond to the Rousseau Harbour beds or higher.

3. Pancake bay to Rousseauville.

No continuous sections can be made. The shore is largely beach and probably largely parallel to the strike of the beds, while numerous points are made probably by faults and veins running nearly north. About 325 paces N.E. is a point of coarse amygdaloidal and ophitic trap with amygdaloids. Then after a long beach and a creek where the outcrop of conglomerate might be concealed, about a mile from Cottrell cove[1] is a marked amygdaloid; then 300 paces on is a sandstone which strikes N. 37° E. and dips 80° to S.E. and shows a contact with a trap overlying it on the S.E. which also has a steep dip.

This is abnormal surely. The No. 10 vein may be not far off, and the faulting connected with it may cause the dip. The sandstone itself is in line of normal strike with the sandstones and felsites of holes 3 to 5.

---

[1]Whisky bay of the Map No. 112.

Another point of trap occurs 200 paces farther on, and all along are points of trap which seem to dip to N.W. for the next 400 paces. There is a little copper. In the next 200 paces, about half a mile from the sandstone, is an ophite much seamed (N. 17° E. and N. 30° W.) which makes one side of a cove where are no exposures for 400 paces. This might correspond to the cove of Rousseau harbour, and like it be underlain with conglomerate. Then there is amygdaloid and trap and the section at the point (Whisky point) is apparently a block of beds dipping toward the lake, cut off by fissures that strike north.

4. Section from Rousseauville and Copper Mine Point Light House to the line between Sand Bay and Pancake locations.

This is covered by holes, 1, 2, and 3, and the conglomerates are much better exposed in them.

In the same section are Trethewey shafts 1 and 2 and vein No. 6; shaft No. 2 is N. 15° W. from No. 1 and shows a tuff and a felsite and a trap. In the conglomerates felsite is very common, also dark green and chloritic pebbles. Thirty feet from shaft No. 2 and a little above it in strike, is a pit in ophite. West of No. 2 is an amygdaloid and a ravine running N. 85° W. and quite a knob 25 feet above the shore.

The rocks of these shafts evidently resemble those in hole 3 most strongly. Specimens 06-9-41 a and b, 06-9-40, and 06-9-42 were taken here.

Copper Mine point light toward which Plate IV, a, was taken stands on trap, but a conglomerate exposed at the base (belts 2 and 3 of the diamond drill section) strikes apparently N. 45° to 30° W. The View Rock and Rousseau island are in range N. 30° W. dip 22°, belt 4.

The Rousseau Harbour conglomerate of hole 1 was not exposed, belt 5.

It is possible belts 6 and 7 may also not be exposed, and on the N.E. side of Rousseau harbour is a fissure striking N. 45° E.

But there is a purple quartzose amygdaloid (Sp. 06.9.45) with an ordinary ophitic trap beneath. I estimated the thickness at 50 feet. There was a trace of copper, and in all these respects it agrees with flow 7.

Sp. 06.9.46 represents another amygdaloid about opposite the end of the pier, which contains copper and prehnite and has a 30 ft. trap beneath. (35) Another is a heavier possibly double amygdaloid 15 ft.-20 ft. trap, strike N. 40° W. dip 23° to S.W.

The next amygdaloid forms caves, being full of calcite but with no prehnite. A vein with datolite N. 5° W. dipping steeply to the east represents the cross-fissure. This might be the top of flow 10, hole 1 at 459 feet, 2 to 103 feet.

The resultant strike would be about N. 32° W.

This carries us to the first headland, 40 feet high, opposite Rousseau island. Behind this there is a beach and amygdaloidal trap and amygdaloid, and an amygdaloid with prehnite and copper striking N. 35° W. and dipping 18°. Compare 2 at 180 to 246. I estimated a thickness of (50)

There is a pit on a fissure striking N. 13° E. toward Rousseau island. Then (10) feet trap, 15 amygdaloid, 5 amygdaloid trap, 15 amygdaloid. (30)

Then (15) feet amygdaloid and a covered gap for 24 steps to a marked amygdaloid (8) which may be the top of flow 12 (23)

This would be near (220) feet thickness below the Rousseau conglomerate. The marked red amygdaloid is calcitic, strikes N. 35° W. and dips 18° and the trap beneath is coarse chloritic and amygdaloidal for 40 feet with a 10 ft. base, first main reef. (50)

A quartz laumontite and prehnite fissure strikes north and may have displaced this. The next amygdaloid is marked, red, dips 24° to S. 55° W. and shows copper. (8)

The trap beneath is an ophite, cut by north a trending laumontite seam. (40)

Then succeed another red and white, marked amygdaloid (10) and trap (20) (30)

And another similar amygdaloid (12) and trap (30) (42)

And another dipping 18° and an ophite with thomsonite (Sp. 06.9.48). (50)

The next amygdaloid? is covered. The ophite beneath may be that at shafts 1 and 2. (50)

Then comes conglomerate with pebbles not over 3″, thickness unknown as the next 43 steps are covered.

Total top of this conglomerate from base of Rousseau conglomerate (491)

After 114 ft. covered is a point of trap apparently striking N. 40° W. and dipping 22° (45), then about 230 feet covered again, which brings us to the Sand Bay location line just beyond it. A point juts out N.W. which should repeat the section. Fifty feet, S. 25° E. of the Location point (witness post) between the Sand Bay and Pancake locations is a witness birch and a conglomerate.

The 400 feet or so covered is in line with shafts 1 and 2 and perhaps with the outcrops of the beds exposed in drill hole 3. The coarse ophite is also found along shore on this point that it formed. There are about (552) feet of amygdaloids and trap below the Roussain conglomerate before reaching the felsite horizon as against (491) feet here (1700 to 1200 feet in breadth with some feet covered).

This block of beds then appears to be reasonably undisturbed. They might be the uppermost beds of Pancake point, but there are no signs of copper.

B.—Sand Bay Sections.

5. From the south location line to Sand Bay.

Just at the line post a conglomerate and a coarse (10 mm)? ophite are exposed, but about half way down this conglomerate point, which runs out in an almost straight line for nearly half a mile (2200 feet), the continuity is broken by a fault. This has much the direction of that at Mineral point (Sand Bay) No. 4-N. 40° E. dip 62° to E. Then instead of the westward slope of the point being of trap (ophite) it is conglomerate. The trap ends in a breccia full of fissures.

The rest of the point is conglomerate. Near the fault it is thrown into an anticlinal, but in general it dips 20° to S. 60° W. magnetic. The true strike is N. 35° W. The matrix is like a stamp sand and there are rounded red pebbles of jasper and felsite. A red fine grained sandstone striking N. 15° E. and dipping 50° may be another fault filling.

A 4″ red seam (sp. 06-9-49) which I suspected might be felsite, the microscope proves to be sandstone (a clasolite). The section at the end of this point is 20 feet conglomerate and 10 feet sandstone beneath. (30)

At the extreme end of the point, the strike being N. 32° W., dip 18°, there seem to be patches of amygdaloid resting on disturbed sandstones. This conglomerate contains granite and greenstone (Laurentian and Keewatin) pebbles, and quartz and vein breccia. It is not 200 feet below the conglomerates of the Rousseau shafts 1 and 2.

Twenty feet amygdaloidal trap and 20 feet trap come at the end of the point next beneath and a small island off shore is trap. (40)

Then a siliceous irregular slide (possibly felsite?).

Next a rather heavy bed I nicknamed the "grotesque trap" from its weathering. There tends to be a spheroidal lumpy character, while it is very massive. At least (50) feet thick, but I think probably this is a heavy ophite and much thicker.

This is succeeded by another conglomerate dipping 28° to S. 55° E. (40)
Under this is (10) amygdaloid and (60) trap. (70)

Marked fissures striking N. 20° E. dipping 77° to the east make the trap appear like a dyke and very likely displace it. They are of the same set as No. 4. There is a copper trace in one such seam. There is a well marked prehnite amygdaloid exposed for 260 feet on the N.E. side of the point and for 320 more the coast is made by joint re-entrants.

A 200 ft. covered beach is probably not a gap in the section, but may be where the fault on the other side of the point comes through if its real main strike is N. 70° E. or so, like the No. 10 vein. That there is some considerable disturbance is shown by the peculiar behaviour of the conglomerate that makes up the next point. First it comes in but striking N. 70° E. dipping from 2° to 5° nearly flat but lakeward. Disturbance is shown by a boulder split by fissure running N. 68° W., with the south side moved west.

Another fissure runs N. 25° and dips south.

There are a large number of green Huronian coarse pebbles, with a calcite cement. The conglomerate is 18 feet thick or more, and is probably one of the conglomerates of hole 5.

After letting a little of a grey and white amygdaloid with copper be seen under it, the conglomerate comes in again 200 feet farther on with nearly normal strike N. 15° E. and dips 25-30° to the S. (18)

The copper-bearing amygdaloid with pink prehnite comes in against with trap. (15)
Then another amygdaloid and trap. (30)
Then conglomerates again strike N. 5° E., dip 28° to covered area. Thickness at least—— (30)

Near the head of the bay which is continued by a depression—amygdaloidal trap. (Strike N. 27° W., dip 22 to 26° to S.W.).

Seams N. 70° E. and N. 22° E. with a ravine in that direction.

This is the third conglomerate in rather rapid succession and the three may correspond to those in drill hole 5.

This brings us to the point next to Copper point which we called Norway Pine point. It strikes directly toward Hibbard rock, i.e., N. 30° W., and dips 26° to S.W. The ridge of it continues southeast past a pond cut off from the head of the bay and being filled by vegetation (peat).

There is here at least one heavy trap; cf. drill hole 6.282-323. (50)
One smaller (15)
Agate harbour follows and may represent a conglomerate, as a conglomerate was exposed at about the right position on the trail from Rousseau to Sand Bay, about 700 feet beyond the lake. This might be one of the conglomerates in 6, that at 6.323-332 perhaps. But the head of the bay is covered.

The next point is made up of heavy ophites.

The first ophite makes the wall 20 feet high, with 6 mm. mottles at bottom 100+ . Then there is an amygdaloid N. 30° W. dip 27° (10) then another big (8 mm.) ophite with amygdaloid top and bottom. This makes a marked ridge which can be seen from Carlson's.

This ridge rises high enough to be scarped by the Nipissing fifty-seven ft. shore line and prolonged by it into a sandy ridge not far from drill hole 6. It is crossed by the Sand Bay Rousseau trail through a ravine, about 2050 feet from Sand Bay, and 3000 feet from the pond near Norway point, 6280 feet N. 27° W. from station 67 of the geological section. The gap is about 70 feet above the lake. A hill 100 feet higher rises east, one 40 feet higher west. This hill is on a range from the felsite bluff back of Carlson's right over a point of rocks projecting from the sandy beach of Sand Bay.

This hill lines in well with the large ophites of Copper point and that at the base of drill hole No. 7 (7.432-660), but at the same time compared with the strike of this formation the strike of such a line is more east of south and it seems natural to suppose that there are faults, (through the ravine caused by one of which the trail passes), which are like that of No. 10 and move the east side to the north. I have indicated some on the map, but quite likely the displacement is really due to a number of smaller throws. Similar displacements might make Hibbard rock an outlier of the Copper point ophite. That of vein No. 4 alone would go a good way.

A specimen of this large 8 mm ophite is 06-9-52.

Underneath are marked laumontite amygdaloids with marked ropy upper contact surfaces. Strike N. 29° W. dip 23° S. (14)

The ropy coils are convex to N. 7° W., as though the source were south and the flow northward.

Next is a conglomerate (10) to (12)

The upper contact observations (strike N. 37° W. and dip 25°) are extra good. The pebbles are largely Huronian and Laurentian up to 6″ across, but Keweenawan basic and felsitic rocks also seem to occur.

Beneath come two flows with large red, porphyritic crystals on a dark ground which remind one of the Kearsarge amygdaloids or Huginnin porphyrite; Sp. 06-9-492.

Hole 8.271-283 has not a conglomerate above. Neither has hole 9.520-525, and these are the only ones that show porphyritic crystals. One way to account for its absence in hole 8 is to suppose that holes 7 and 8 do not follow each other consecutively, a fault intervening, passing near 8 and causing it to be much disturbed, as compared, for instance, with 9. A fault with the hade and throw of No. 10 vein and in strike anywhere from that to N. 30° W. would produce the apparent repetition found in hole 8. It is possible that this fault with a hade of 45° crosses hole 8 near where a seam with copper was found in 8 at 262 feet, and that the bed below with porphyritic crystals corresponds to Sp. 06.9.492, while the conglomerate above was just cut out.

I have drawn the map to indicate this, and also a couple of other faults of similar character that might be conceived between 7 and 9.

Under the microscope in 06-9-492, the skedophyric large phenocrysts of labradorite show up well.

The ground-mass feldspar is arranged in andesitic flow lines. There is dendritic iron oxide.

On the shore the phenocrysts of labradorite up to 25 mm long appear, and there are large agate and calcite centered amygdules, up to 100 mm. across. About 10 feet down is an amygdaloid band where the feldspar is as much as 60 mm long; then it is less conspicuous but still up to 10 mm., the total visible thickness of this porphyrite being about (18 feet). The next 150 feet are covered.

The next point shows seams N. 5° W. dipping 80° (Sp. 06-9-51) in a coarse amygdaloid trap. (70)

Then marked amygdaloid with trace of copper (5) and ophite (15) (20)

Then ophite exposed in rock points for 100 feet. (50)

Then strong red and white amygdaloid. Dip 20° to S. 75° W. with laumontite and calcite in the amygdaloidal trap passing into ophite below. There are agates. (30)

Of the bed belows there shows about (15)

Then these are covered 200-300 feet.

Total below Copper Point conglomerate (203)

Compare hole 9.

On the south side of Sand Bay are two converging points, probably part of the one flow.

The western is a fine grained ophite Str. N. 27° W. to Mamainse a massive trap with amygdaloidal bands. (30)

The second point is a doleritic ophite with mottles (100) Then there is covered beach to the Carlson ophite 15 mm. The total breadth represented by the exposure of the points may be 500 feet, the thickness about (215)

But there may be two flows. The section down to the Carlson ophite covered except for them, is 2000 feet, or 800 feet of thickness. To what extent it is covered by the beds of the Cape Mamainse islands, it is, on account of the faulting, difficult to say. The Carlson ophite itself will take up part of the space.

6. Sand Bay, Mineral point and northeast.

A fault (Trethewey's vein No. 4) comes out at the shore just east of the Sand Bay location. It strikes about N. 37 to 45° E. and dips 65° to the S.

There is probably a very considerable throw, as the heavy ophite, Carlson ophite, that occurs at the head of the bay, seems to make the shore beyond. On the N.W. side of this fault a conglomerate occurs over the felsites that does not show, but may exist just over the felsites north of Carlson's between this and the ophite.

We have then, if that is so, this section in descending order :—

Amygdaloid marked near Mineral point.
Doleritic trap.
Amygdaloid.
Trap.
Amygdaloid.
The Carlson ophite. See below.
Conglomerate.
Felsite.
Vein No. 4 can be traced out under water.
Reefs extend out some way.

Ophite, the Carlson ophite.

This occurs on the points both east and west of the Sand Bay dock and in a ridge between the bay and the road to No. 10. The mottles are very distinct and when largest from ½″ to 4/5″ (12-20 mm) across.

It seems to be thrown out so as to make the shore for a short distance beyond Mineral point, or beginning on the west side of No. 4 vein and under the sounding range, about one-fourth mile farther, becoming 15 mm coarse. It is then thrown back again, reappearing along the trail to the Quebec mines and on the shore. There is a fairly coarse ophite at Copper point. But this seems to be coarsest, unique, and to be an identifiable horizon, which can be followed to between holes 12 and 13, with displacements (shown on the map) that appear to be due to faulting.

Dawson (cited by Blue, 1893 report, p. 79) gives the following section from the N.W. extremity of Sand Bay inland, the general strike N. 10°-20° W. the dip 25°-35° (measurements by Mr. Coatsworth of the Bruce mines in 1856).

1. Alternations of trap and tufa with a bed of conglomerate; breadth 1500 feet. Veins of calcspar, quartz, and laumontite, with native copper, native silver. and galena (perhaps really chalcocite?).

2. Argilloarenaceous beds baked into a compact jaspery rock (the felsite) 660 feet. 660

3. Crystalline and amygdaloidal trap with a bed of conglomerate 1320

These rise to 300 feet, with the old Indian workings and excavations of the present (1856-1857) on the summit of this ridge. The lowest rocks of this band are probably tufaceous and have been excavated into the ravine of a small brook.

4. Very coarse syenitic conglomerate with pebbles as large as 2 feet. 480

Total thickness perhaps 2000

The beds included in 3 are those in which the principal indications of copper were observed. From a narrow fissure, greatest thickness 6″, one mass of 600 pounds came, and in a shaft of 27 feet, 3 tons, (horizon of veins 10 and 11). 100 yards north of the shaft mentioned were excavations at the intersection of 2 veins, one N.W. and S.E. (parallel to No. 4 and another north and south). The former was unproductive, the latter has purple copper bornite with a veinstone of quartz and calcspar, and vein crystals of chalcopyrite.

This is apparently vein 11 (which see).

A very similar section to that measured by Coatsworth and reported by Dawson is probably given in one of the mine blueprints, the felsite being called conglomerate, and underneath it 7 bands of conglomerate in a mile from it, the elevation rising to 350 feet.

From Carlson's Brown ran as follows, N.E.:

Distance	Elevation	
0 feet	0 feet	shore line of Lake Superior.
0+73	12.2	flat nearly to
2+30	12.1	first or present terrace and fill
3+0	27.	first of terrace on which are houses
6+57	31.7	nearly flat, highest 32.7 at 6.0
7+0	53.5	Felsite
9+60	55.5 53 by bar	Foot of cliff of felsite and talus Lake Nipissing shore. Compare elevation of hole 6.
10-45	143 (vertical angle)	This was also covered by Mr. Watson and myself who continued to N. 40° E.

By pacing	(140 to 145 bar)	
11 75		(End of felsite exposure and of Dawson's group 2 edge of cedar swamp).
12 24	120	End of cedar swamp.
14 06	120 to 160	Conglomerate bluff rises to 40 ft. and dips 24°.
18 20 to 19 22	120 to 280	Trap and then talus slope of amygdaloid porphyritic type? Sp. 06.9.53 with copper stains at times. These seem to match beds found on the road near Silver Creek bridge. The lake seems to have cut heavily from 120 feet up, the lowest Algonquin beaches.

Distance	A. L.	
28 50	280	Conglomerate bluff faces N.E. This is the end of Dawson's group 3.
31 30	330	Point of amygdaloid trap; descending 40 feet in the next 50 paces.
33 94	300	Trap, and conglomerate dipping to S.W. Dawson's 4.
36 58	325	Fine grained ophite. The rise is notably much flatter from 280 to 325 A.L. Compare the cross-section 152 to 158 stations.
39 30	355	Summit of trap ridge overlooking the valley of Silver creek. If other locations are right this steady up hill pacing is short, probably.
42 00		Headwaters of Silver creek.
42 95	350	Amygdaloid ridge and 92 paces farther a trap.
46 54		Cross-road,—probably that on large old map from No. 11 shaft which would make it only 50 chains from Sand Bay.
52 80	355	17 paces on was trap and at 126 paces farther ravine on the headwaters of Copper creek, I think.
55 30	400?	Conglomerate ridge. This may be exposed at the 418 ft. shore level.

This cannot be the station 175 or heaviest conglomerate, but is the last noted above that, separated from it by 400 paces more or less. It would then be the one which makes the point at the north end of the Quebec Mine location and is exposed on the lower part of the Government road down to that location, which is about 380 to 517 feet above the heaviest conglomerate. On this course there is something like 900 feet between them, which agrees well enough. (Compare the conglomerate at 163-50 of the drill section which is S. 33° E. from it). The highest point of the map run is 87 paces farther on.

6060	380 above lake.	Cedar swamp which continues for over 200 feet with a slow fall.
6670	360	Slight rise before a drop which continues to the Government road.
6975	355	Trap facing west.
7200		Heaviest coarse conglomerate, brink of valley, the bluff seems to run north and south.
7600	295	Cedar swamp for about 200 paces then low knobs.
7640	260	Road near beaver dam at outlet of beaver meadow. Creek 249 above lake.

Following the road east about 300 feet, after it crosses the creek from the beaver meadow, it rises up on to a big hill of conglomerate with numerous exposures which is without question the "heaviest conglomerate" just north of the Mamainse mine. The locations are not accurate enough to tell whether it seems to be displaced in strike or not. The road follows it for 2000 feet or so, then reaching a flat at 290 feet above Lake Superior, we have no more outcrops for about 4400 feet, when we strike conglomerate at an elevation about 225 above Lake Superior, striking N. 25° W. dipping 25°. The road continues winding N.W. on the conglomerate, though not much more than 30 feet thick for 1850 feet more, down to about 55 feet above the lake—that is to the Nipissing terrace, when it runs more west of north, strikes trap, and in about 2460 feet reaches the first houses of the location about 1000 feet from the lake.

Unfortunately, since maps differ materially as to the position of the Government road and our pacing run is not accurate enough to correct them, the mapping must remain approximate, with a possible error of several hundred feet.

This same section was covered in coasting along shore by lake, on the trail between the Quebec Mine location and Carlson's, on the diamond drill section and in the run along the S.E. boundary line of Sand Bay location. It includes the beds in which veins 4, 7, 8, 9, 10, and 11 have been worked upon. But I think this may be a topographic accident, due to being less drift covered, rather than to an extra cupriferous character.

Near the Quebec mine there are a number of conglomerate exposures and one occurs running out in a steep wall at the extreme north of the location. Along the coast there seem to be five important conglomerates between the heavy conglomerate and the Carlson ophite, just as there was in the run N.W. from Carlson's, except that the first just above the felsite was not discovered.

7. The Mamainse Point section and islands off it.

Cape Mamainse ends in a group of islands, rocks and reefs not well figured in any map, but well illustrated in Mr. Grierson's photograph and in Plate III a, characteristically elongate reefs, whose strike is N. 5° to 13° W. The dips seem to be toward the lake and vary from 50° to 37°. Going from island to island, one gets a section as follows:

Outer island—1-5 amygdaloids N. 8° W. dip 50° for a fine well marked amygdaloid flow about 15 feet thick with no conglomerate exposed (100)

Main island—5-15 almost continuous series of small trap flows with no sign of conglomerate.

16. Inner island—a well marked rather doleritic ophite 5 mm or so.

17. There is a plank to a small rock from which is a pier. This and the rocks in line with the pier are medium grained ophite.

18. The shore ridge is a 2-3 mm. amygdaloidal ophite. Strike N. 6° W., dip 45°?

19. Then 200 feet back to the main shore is a 5 mm. ophite. This *may* be continuous to the Sand Bay location line and the outlet of the lake.

Continuing on the trail from the lake outlet about 300 feet, we probably cross a fault as indicated on the map, for we run from a coarse ophite to an amygdaloid. From about 100 feet on we meandered the road back to Carlson's as shown on map running on fine grained traps and felsites.

860 north and 450 west of Carlson's was all on flat sand plain. 1030 north and 900 west of Carlson's a ridge of fine grained amygdaloidal trap or por-

phyrite was west of the trail some 30 feet, the same type of bed that comes just under the conglomerate 1800 feet N.E. of Carlson's and 1166 east of the dock. Allowing for strike, elevation, and dip, this gives roughly the throw of the Mineral Point fault, better shown by throw of Carlson ophite.

1080 north, 1050 west is amygdaloid.

1410 north, 1610 west all along are exposures of fine grained felsitic trap, or felsite porphyrite, breaking to pieces, "chippy," and at one point shattered amygdaloid lies east of the road, the contact (not exposed) running perhaps N. 27° W. See the beds at the top of hole 13, 1290 north, 1440 west was this point nearly. Other sections show that there is a conglomerate at about this horizon.

From Mamainse Point dock a course was run to the inner trail as follows:

East	
209 feet	to amygdaloid.
330	to ridge.
473	to swamp continuing pond?
623	to trail.
S. 30° E.	
120	Along ridge of amygdaloid.
275	Over ridge of amygdaloid.
East	
671	to ridge.
704	15 mm. ophite, the Carlson ophite.
770	Coarse ophite.
902	Coarse ophite.
1122	Amygdaloid.
1166	Conglomerate.
1243	Hollow.
1309	Feldspar porphyry apparently striking N. 12° W.
1529	Up on bluffs of broken amygdaloid.
1595	Inner trail to Quebec mine at a point about
1628	paces from Carlson's.

This locates the felsite and coarse ophite with some definiteness and shows how they are thrown back from Mineral point, and we see that the Cape Mamainse islands must nearly cover the section above the ophite up to the Copper Point ophite.

Finally we have a section along shore from the Mamainse dock north to Quebec mine location as follows:—

North Island section.

Trap	(20)	feet
Sandstone	(3)	feet
Amygdaloid trap	(20)	feet

and amygdaloid with red base and white and green amygdules. I was told by W. W. Pine, official Indian interpreter, that this is the location from which the Indians drove the miners in 1849, not that farther north.

Trap and amygdaloid	(40)	feet
Trap and amygdaloid	(20)	"
Trap and amygdaloid	(20)	"
Harbour gap (5 mm. ophite?)		
Long point, first point back of dock	(100)	"
Strike N. 10° W. dip 39°?		
Trap and amygdaloid	(20)	"

Trap and amygdaloid ... (10) feet
Trap (ophite) ... (50) "
Trap (ophite) ... (50) "
Trap (ophite) ... (50) "

8 + mm. ophite with two sea caves one above the other in it and continued in the hill. This is the Carlson ophite, I suppose (150 + ?), no doubt the same as found 670 to 900 feet east of the point.

From dock (430)

Thick conglomerate dip 45° apparently, thickness (300?). Evidently the conglomerate found 1100 feet east of the point, the first back of Mineral point, the first back of Carlson's, etc., perhaps the Bohemia conglomerate and conglomerate 8 of Keweenaw point. Closely associated with the felsite?

Trap ... from boat (100)
Beach covered ... " "
Trap ... " " (60)
Beach ... 100
Conglomerate at No. 10 vein ... " " (60+)
Trap ... " " (50)
Trap ... " " (50)
Trap point ... " " (50)
Beach ... " " (100)
Trap ... " " (40)
Conglomerate Str. N. 15° W. dip 30°.
Total conglomerate (60) ... (10)
Beach conglomerate? 100.
Powder house conglomerate on point N. 8 W. dip 37° on sandstone layer ... (30)

550

Beach from boat 50
Trap ... (30)
Trap ... (40)
Trap ... (30)
Trap ... (30)
Trap, bluff on rocky point ... (50)
Beach (10) feet conglomerate, then 180 covered to dark green trap then conglomerate or felsite 30- ... (50)
Trap point (about 385 paces N. 20° W. of the Powder-house conglomerate, 40 footwall of 500 deep Str. N. 5° W. dip 34°? ... (50)
Trap ... (10)
Trap ... total ... (10)
Beach, about 800 feet across, (200)
Trap, small traps ... (20)
Trap ... (20)
Trap ... (20)
Trap ... (20)
Beach ... (20)
Trap near horizon of shaft ... (20)
Point crossed by fault near stamp mill. (This fault throws west side to south. The vein is hard siliceous, poor looking, with a little native copper) ... (40)
Beach ... 100

Trap and amygdaloid		(20)
Boarding house beach	100	
Conglomerate at mine location, north end		(20)
Strike N. 5° W., dip 24°, with pebbles granite, amygdaloid, felsite, cement calcite.		
Fissure N. 45° W. dip 80° S. W.		
Total thickness along mine location		(480)

Starting from Mineral point on the other side of vein No. 4 point we have, running N. 40° E. magnetic (really much more N. probably):

The coarse Carlson ophite, 100 steps, 250 feet, full of fissures at 200 steps, 500 feet, we were not far from shore.

An amygdaloid knob was at 330 steps, 825 feet with a conglomerate 25 steps N.W.

There was a conglomerate rising 400-410 at 1000 feet.

A felsite succeeded at 500 steps 1250 feet, feldspar porphyry all shattered.

The road from Carlson's to Mamainse at 600 paces, 1500 feet was near.

Then the point where we blasted on vein 4 was 50 paces N.W. of a point 680 paces, 1700 feet on this course.

The blast showed copper carbonate impregnation close to the fault line and a pit also showed that the amygdaloid underlies the conglomerate with a strike N. 30° E. and also lies over it with strike seemingly N. 60° W.

From the Quebec mine to the heaviest conglomerate the section was estimated on water and land. Just north is a range station for soundings and near by an intrusive trap dyke with a sign of copper carbonate (Sp. 06.9.54) striking N. 10° W. inclining 40° to the east.

I made in a descending section, from above the following beds: (30), (30), (30) to a cove where Macfarlane's sandstone 6, (which I did not find) may be. Compared to first bed in hole 5.

(50), (50), (50), (20), (30), (20), (20), (50). Total ..	(380)
Another estimate by pacing and dip is	(410)

Mr. Brown notes a number of outcrops on the drill core section, but as this was not on the land under option, it was not explored, and I find no record of tests in it. Vein 14 may possibly have been in it.

The heavy conglomerate itself I estimate as about 680 feet thick. A dip of 35° would give a breadth of 1250 feet. Along shore north of the Quebec location there is over 700 paces by a good deal. On the drill core section from station 171 to 178 and more may be covered by it, and its breadth along the trail to the drill holes and S.E. line of the Sand Bay locations, is about 1200 feet. Its breadth on the N.W. line must also be great, but was not determined. Its general course and persistence we may be quite sure of. Its exact course and throw by all the faults is uncertain.

It is very coarse, many of the pebbles are very large. It looks no more promising than the Great Copper Harbour conglomerate. Any testing would be most hopeful near the upper contact.

8. *Section below heaviest conglomerate.*

The only tolerably complete section here is along the shore north of the Quebec location, though it was also traversed in a run to Pancake river and in that part of the diamond drill section beyond station 190 and in a very superficial way there has been some test pitting. Really very little has yet been done in this part of the section.

(*Photo by Grierson*)

(a) Elephant arch, an erosion arch made by sea action on an amygdaloid under a more massive bed.

PLATE V.

(*Photo by Grierson*)

(b) Profile arch worked out by the waves along a small seam which carries a little native copper. The seam passes from the profile view of the man's face down through the arch.

The shore section must be taken as a type:

1. Below heaviest conglomerate, with foot pebbles, a trap . . . . (40)
Then a 300 ft. covered beach, in which more conglomerate may occur for the trap at the north end of the beach shows sandy seams (clasolites) . . . . (30)
2. Trap with clasolite seams . . . . (20)
3. Trap, upper part of arch, with marked sediment at base . . . . (20)
4. Trap of the Elephant Arch (see Mr. Grierson's view, (Plate V, a) strike N. 10° W. dip 32° to lake . . . . (110)

Then, as shown in Plate V, a, and chart, the short trends almost parallel to the strike N. 10° W., the beds shelving west to lake and striking toward Point aux Mines. They are cut by an 8 ft. dyke. From this arch (Plate V, a) to a range for soundings are about 8 flows, six about (10) feet thick each (80)
One heavier, estimated from boat as before . . . . (20)
One heavier still, estimated from boat as before . . . . (50)
Then (with apparent strike N. 70° W. dip to W.) a coarse not mottled trap . . . . (100)
Beach possibly sediment (10) From Elephant Arch . . . . (360)
Fine grained trap? . . . . (40)
Trap (of an uncertain thickness, since here appears to be a fault hading to east and a roll in the formation) . . . . (80)
Trap (estimate from boat) dip about 40° . . . . (50)
Trap " " . . . . (10)
Trap " " . . . . (10)
Trap " " . . . . (20)
Beach 100 feet . . . . (40)

(610)
Trap " " . . . . (20)
Trap " " . . . . (10)
Trap " " . . . . (10)
Well marked amygdaloid trap, about abreast of a range post for a line of soundings Lat. 47° 4′ 40″.

(690)
Trap . . . . (20)
Trap with 5 ft. beach below . . . . (10)
Trap point steep . . . . (20)

(740)

Near this point is a well marked 10 ft. diabase dyke, strike N. 75° W. dip 70° to north. It shows columnar jointing perpendicular to the strike and finer grain at margin. It was 56″ to the centre and specimens were taken at the margin and 8″, 16″, and 56″ from it and examined. The augite increases clear to the center of the dyke, from 8″ in at a fairly uniform rate of 1.2 mm to 1 meter and sections made at 0, 45 204 408 1430 mm.
gave the following grain 0,0.15 0.275 0.48 and 1.6 mm.
This indicates that the dyke was not superheated nor much different from the flows.

The section below was traversed on foot. Coarse amygdaloid (30)
and red fine grained ophite 10 beach (35)

Below this the points are largely cut off by cross fissures parallel to the shore that is striking N. 60° tot 70° E. Then three flows make a point together and are marked by large quartz agates up to 8″ long, of quartz epidote, etc., the amygdaloids being marked. (20) (20) (20)

We are now in the beds of hole 15, 16, and 17 (especially 17) but we do not get the porphyries we got there. The volcanic focus and the felsites are evidently somewhat farther south, nearer Pancake bay.
A marked specked amygdaloid comes next .... (20)
Twenty foot beach.

Feldspathic bed (glomeroporphyritic 3 mm. feldspar) .... (20)
Point; bed appears to dip 45° .... (20)
Trap .... (40)

An amygdaloid trap heavily veined. Veins strike S. 43° W. and dip to east.

There is then a 200 ft. covered beach, possibly a conglomerate concealed thereby.

Trap .... (90)
Amygdaloid and trap 20 feet .... (10)
Amygdaloid with trap 40 feet .... (25)
Amygdaloid conglomerate with a porphyritic amygdaloid feldspars, agates, etc. .... (5)
Trap .... (30)
From Elephant Arch .... (1090)

Strike N. 15° W. dip 38° to west. Also joints and veins N. 15° W. dipping 58° to east and N.E. dipping both northwest and southeast steeply. This brings us to a cove occupied apparently by an unconformable tongue of the Lake Superior sandstone which lies between amygdaloid points but strikes N. 70° E. and dips 18° to the lake N.W. It varies from a fine grained grey green conglomerate with small 2-3 mm. grains of feldspar and felsite as well as quartz to a regular red sandstone. It is S. 13° E. of Point Aux Mines in lat. 47° 5′ 20″. The beach beyond shows the nearness of the Archean by a great variety of large Keewatin boulders, dark mica hornblende rocks with red porphyritic feldspar cut by feldspar seams.

The northeast side of the bay is made by a well marked amygdaloid strike N. 25° W. dip 66° to south. This ends in a rock or islet (we called Profile Rock) in which is weathered a hole, (see Plate V, b), and there are stains of copper carbonate. This is some 500 feet from the last exposure and so perhaps below it, covered by the Lake Superior sandstone.

This is not so very far from the horizon of the copper-bearing amygdaloid found in hole 17. Thus the covered interval may correspond to the conglomerate just above it, which could hardly have a thickness of over (280) feet, probably much less.

It is of interest as showing that copper may occur in these lower beds, but on the whole the signs of copper below the heaviest conglomerate were much less than above.

Total along shore below heaviest conglomerate (1375)

Beside Brown's notes on the diamond drill section this was also visited in a run nearly along the S.W. line of Pancake location, July 14, 1908. It is hardly worth while repeating the notes as they are so near the diamond drill section, but they have been used on the map. The heaviest conglomerate extended to about 2500 feet from the location corner and seemed at the end to strike S. 37° E. dipping 42° to 50° to the west. We found a pit right on the line, with no values exposed, (vein 15 or 16), and conglomerate kept on to 160 steps beyond this pit. 150 steps beyond a tree marked S.E. of 45 alluding to the Ryan township lots, we passed a ridge with amygdaloid and trap and 50 steps on found two trenches in amygdaloid which looked promising. The strike was probably between N. 15° W. and N. 45° W. and from the joints 32° dip. This amygdaloid was located in a number of places by Brown and is tested by hole 17. Its position about 2400 feet from the heaviest conglomerate would bring it nearly in line with Profile rock, where a little carbonate was seen as also here. About 800 feet farther on and about 150 feet from an old blazed post S. XIX, a stream to the north exposes trap at an elevation of about 355 above Lake Superior. About 1200 feet on and 7100 feet from the location corner is the old government road—nothing more than a moose trail. We followed this, with bluffs of trap to the west of us, for half a mile, then struck due east to Pancake river, passing trap at 1100 feet, and at 1800 feet an exposure of quartz porphyry.

There is thus good reason to believe that practically the whole of the Sand Bay location is covered by the Keweenawan.

CANADA

DEPARTMENT OF MINES

MINES BRANCH

HON. ROBERT ROGERS, MINISTER; A. P. LOW, LL.D., DEPUTY MINISTER;
EUGENE HAANEL, PH.D., DIRECTOR.

REPORTS AND MAPS OF ECONOMIC INTEREST.

PUBLISHED BY THE

MINES BRANCH.

REPORTS.

1. Mining Conditions of the Klondike, Yukon. Report on—by Eugene Haanel, Ph.D., 1902.

2. Great Landslide at Frank, Alta. Report on—by R. G. McConnell and R. W. Brock, M.A., 1903. (Out of print.)

3. Investigation of the different electro-thermic processes for the smelting of iron ores, and the making of steel, in operation in Europe. Report of Special Commission—by Dr. Haanel, 1904. (Out of print).

4. Rapport de la Commission nommée pour étudier les divers procédés électro-thermiques pour la réduction des minerais de fer et la fabrication de l'acier employés en Europe—by Dr. Haanel. (French Edition), 1905. (Out of print).

5. On the location and examination of magnetic ore deposits by magnetometric measurements—by Dr. Haanel, 1904.

7. Limestones, and the Lime Industry of Manitoba. Preliminary Report on—by J. W. Wells, 1905. (Out of print).

8. Clays and Shales of Manitoba: Their Industrial Value. Preliminary Report on—by J. W. Wells, 1905. (Out of print).

9. Hydraulic Cements (Raw Materials) in Manitoba: Manufacture and Uses of. Preliminary Report on—by J. W. Wells, 1905. (Out of print).

10. Mica: its Occurrence, Exploitation, and Uses—by Fritz Cirkel, M.E., 1905. (Out of print: see No. 118).

11. Asbestos: Its Occurrence, Exploitation, and Uses—by Fritz Cirkel, 1905. (Out of print: see No. 69).

12. Zinc Resources of British Columbia and the Conditions affecting their Exploitation. Report of the Commission appointed to investigate—by W. R. Ingalls, 1905. (Out of print).

16. *Experiments made at Sault Ste. Marie, under Government auspices, in the smelting of Canadian iron ores by the electro-thermic process. Final Report on—by Dr. Haanel, 1907. (Out of print).

17. Mines of the Silver-Cobalt Ores of the Cobalt district: Their Present and Prospective Output. Report on—by Dr. Haanel, 1907. (Out of print).

18. Graphite: Its Properties, Occurrence, Refining, and Uses—by Fritz Cirkel, 1907. (Out of print).

19. Peat and Lignite: Their Manufacture and Uses in Europe—by Erik Nyström, M.E., 1908. (Out of print).

20. Iron Ore Deposits of Nova Scotia. Report on (Part I)—by Dr. J. E. Woodman.

21. Summary Report of Mines Branch, 1907-8.

22. Iron Ore Deposits of Thunder Bay and Rainy River districts. Report on—by F. Hille, M.E.

23. Iron Ore Deposits, along the Ottawa (Quebec side) and Gatineau rivers. Report on—by Fritz Cirkel. (Out of print).

24. General Report on the Mining and Metallurgical Industries of Canada, 1907-8.

25. The Tungsten Ores of Canada. Report on—by Dr. T. L. Walker.

* A few copies of the Preliminary Report, 1906, are still available.

26. The Mineral Production of Canada, 1906. Annual Report on—by John McLeish, B.A.

27. The Mineral Production of Canada, 1908. Preliminary Report on—by John McLeish.

28. Summary Report of Mines Branch, 1908. (Out of print).

29. Chrome Iron Ore Deposits of the Eastern Townships. Monograph on—by Fritz Cirkel. (Supplementary Section: Experiments with Chromite at McGill University—by Dr. J. B. Porter).

30. Investigation of the Peat Bogs and Peat Fuel Industry of Canada, 1908. Bulletin No. 1—by Erik Nyström, and A. Anrep, Jr., Peat Expert.

31. Production of Cement in Canada, 1908. Bulletin on—by John McLeish.

32. Investigation of Electric Shaft Furnace, Sweden. Report on—by Dr. Haanel.

42. Production of Iron and Steel in Canada during the calendar years 1907 and 1908. Bulletin on—by John McLeish.

43. Production of Chromite in Canada during the calendar years 1907 and 1908. Bulletin on—by John McLeish.

44. Production of Asbestos in Canada during the calendar years 1907 and 1908. Bulletin on—by John McLeish.

45. Production of Coal, Coke, and Peat in Canada during the calendar years 1907 and 1908. Bulletin on—by John McLeish.

46. Production of Natural Gas and Petroleum in Canada during the calendar years 1907 and 1908. Bulletin on—by John McLeish.

47. Iron Ore Deposits of Vancouver and Texada islands. Report on—by Einar Lindeman.

55. Report on the Bituminous, or Oil-shales of New Brunswick and Nova Scotia; also on the Oil-shale Industry of Scotland—by Dr. R. W. Ells.

58. The Mineral Production of Canada, 1907 and 1908. Annual Report on—by John McLeish.

59. Chemical Analyses of Special Economic Importance made in the Laboratories of the Department of Mines, 1906-7-8. Report on—by F. G. Wait, M.A., F.C.S. (With Appendix on the Commercial Methods and Apparatus for the Analysis of Oil-shales—by H. A. Leverin, Ch.E.)

62. Mineral Production of Canada, 1909. Preliminary Report on—by John McLeish.

63. Summary Report of Mines Branch, 1909.

67. Iron Ore Deposits of the Bristol Mine, Pontiac county, Quebec. Bulletin No. 2—by Einar Lindeman, and Geo. C. Mackenzie, B.Sc.

Schedule of Charges for Chemical Analyses and Assays.

68. Recent Advances in the Construction of Electric Furnaces for the Production of Pig Iron, Steel, and Zinc. Bulletin No. 3—by Dr. Haanel. (Out of print).

69. Chrysotile-Asbestos: Its Occurrence, Exploitation, Milling, and Uses. Report on—by Fritz Cirkel, M.E. (Second Edition, enlarged).

71. Investigation of the Peat Bogs, and Peat Industry of Canada, 1909-10; to which is appended Mr. Alf. Larson's Paper on Dr. M. Ekenberg's Wet-Carbonizing Process: from Teknisk Tidskrift, No. 12, December 26, 1908—translation by Mr. A. Anrep, Jr.; also a translation of Lieut. Ekelund's Pamphlet entitled 'A Solution of the Peat Problem,' 1909, describing the Ekelund Process for the Manufacture of Peat Powder, by Harold A. Leverin, Ch.E. Bulletin No. 4—by A. Anrep (Second Edition, enlarged). (Out of print).

79. Production of Iron and Steel in Canada during the calendar year 1909. Bulletin on—by John McLeish.

80. Production of Coal and Coke in Canada during the calendar year 1909. Bulletin on—by John McLeish.

82. Magnetic Concentration Experiments. Bulletin No. 5—by Geo. C. Mackenzie.

83. An investigation of the Coals of Canada with reference to their Economic Qualities: as conducted at McGill University under the authority of the Dominion Government. Report on—by J. B. Porter, E.M., D.Sc., R. J. Durley, Ma.E., and others—,
   Vol. I—Coal Washing and Coking Tests.
   Vol. II—Boiler and Gas Producer Tests.

84. Gypsum Deposits of the Maritime Provinces of Canada—including the Magdalen islands. Report on—by W. F. Jennison, M.E. (Out of print).

85. Production of Cement, Lime, Clay Products, Stone, and other Structural Materials during the calendar year, 1909. Bulletin on—by John McLeish.

88. The Mineral Production of Canada, 1909. Annual Report on—by John McLeish.

89. Reprint of Presidential address delivered before the American Peat Society at Ottawa, July 25, 1910. By Dr. Haanel.

90. Proceedings of Conference on Explosives.

92. Investigation of the Explosives Industry in the Dominion of Canada, 1910. Report on—by Capt. Arthur Desborough. (Second Edition).

93. Molybdenum Ores of Canada. Report on—by Dr. T. L. Walker.

102. Mineral Production of Canada, 1910. Preliminary Report on—by John McLeish.

103. Summary Report of Mines Branch, 1910. (Out of print).

104. Catalogue of Publications of Mines Branch, from 1902 to 1911; containing Tables of Contents and List of Maps, etc.

110. Western Portion of Torbrook Iron Ore Deposits, Annapolis county, N.S. Bulletin No. 7—by Howells Fréchette, M.Sc.

111. Diamond Drilling at Point Mamainse, Ont. Bulletin No. 6—by A. C. Lane, Ph.D., with Introductory by A. W. G. Wilson, Ph.D.

114. Production of Cement, Lime, Clay Products, Stone, and other Structural Materials in Canada, 1910. Bulletin on—by John McLeish.

115. Production of Iron and Steel in Canada during the calendar year 1910. Bulletin on—by John McLeish.

116. Production of Coal and Coke in Canada during the calendar year 1910. Bulletin on—by John McLeish.

117. General Summary of the Mineral Production in Canada during the calendar year 1910. Bulletin on—by John McLeish.

118. Mica: Its Occurrence, Exploitation, and Uses. Report on—by Hugh S. de Schmid, M.E.

143. The Mineral Production of Canada, 1910. Annual Report on—by John McLeish.

150. The Mineral Production of Canada, 1911. Preliminary Report on—by John McLeish.

IN THE PRESS.

81. French Translation: Chrysotile-Asbestos, Its Occurrence, Exploitation, Milling, and Uses. Report on—by Fritz Cirkel.

83. An Investigation of the Coals of Canada with reference to their Economic Qualities: as conducted at McGill University under the authority of the Dominion Government. Report on—by J. B. Porter, R. J. Durley, and others—

Vol. III—
Appendix I
Coal Washing Tests and Diagrams, by J. B. Porter.

Vol. IV—
Appendix II
Boiler Tests and Diagrams, by R. J. Durley.

Vol. V—
Appendix III
Producer Tests and Diagrams, by R. J. Durley.

Vol. VI—
Appendix IV
Coking Tests, by Edgar Stansfield and J. B. Porter.

Appendix V
Chemical Tests, by Edgar Stansfield.

100. The Building and Ornamental Stones of Canada. Report on—by Professor W. A. Parks.

142. Summary Report of Mines Branch, 1911.

151. Investigation of the Peat Bogs and Peat Industry of Canada, 1910-11. Bulletin No. 8—A. Anrep, Jr.

154. The Utilization of Peat Fuel for the Production of Power, being a record of experiments conducted at the Fuel Testing Station, Ottawa, 1910-11. Report on—by B. F. Haanel, B.Sc.

156. French Translation: The Tungsten Ores of Canada. Report on—by Dr. T. L. Walker.

MAPS.

6. Magnetometric Survey, Vertical Intensity: Calabogie mine, Bagot township, Renfrew county, Ontario—by E. Nyström, 1904.

13. Magnetometric Survey of the Belmont Iron Mines, Belmont township, Peterborough county, Ontario—by B. F. Haanel, 1905.

14. Magnetometric Survey of the Wilbur mine, Lavant township, Lanark county, Ontario—by B. F. Haanel, 1905.

15. Magnetometric Survey, Vertical Intensity: Iron Ore Deposits at Austin brook, Bathurst township, Gloucester county, N.B.—by E. Lindeman, 1906.

33. Magnetometric Survey, Vertical Intensity: Lot 1, Concession VI, Mayo township, Hastings county, Ontario—by Howells Fréchette, 1909.

34. Magnetometric Survey, Vertical Intensity: Lots 2 and 3, Concession VI, Mayo township, Hastings county, Ontario—by Howells Fréchette, 1909.

35. Magnetometric Survey, Vertical Intensity: Lots 10, 11, and 12, Concession IX, and Lots 11 and 12, Concession VIII, Mayo township, Hastings county, Ontario—by Howells Fréchette, 1909.

36. Survey of Mer Bleue Peat Bog, Gloucester township, Carleton county, and Cumberland township, Russell county, Ontorio—by Erik Nyström, and A. Anrep.

37. Survey of Alfred Peat Bog, Alfred and Caledonia townships, Prescott county, Ontario—by Erik Nyström, and A. Anrep.

38. Survey of Welland Peat Bog, Wainfleet and Humberstone townships, Welland county, Ontario—by Erik Nyström, and A. Anrep.

39. Survey of Newington Peat Bog, Osnabrook, Roxborough, and Cornwall townships, Stormont county, Ontario—by Erik Nyström, and A. Anrep.

40. Survey of Perth Peat Bog, Drummond township, Lanark county, Ontario—by Erik Nyström, and A. Anrep.

41. Survey of Victoria Road Peat Bog, Bexley and Carden townships, Victoria county, Ontario—by Erik Nyström, and A. Anrep.

48. Magnetometric Map of Iron Crown claim at Klaanch river, Vancouver island, B.C.—by Einar Lindeman.

49. Magnetometric Map of Western Steel Iron claim, at Sechart, Vancouver island, B.C.—by Einar Lindeman.

50. Vancouver island, B.C.—by Einar Lindeman.

51. Iron Mines, Texada island, B.C.—by E. H. Shepherd, C.E.

52. Sketch Map of Bog Iron Ore Deposits, West Arm, Quatsino sound, Vancouver island, B.C.—by L. Frank.

53. Iron Ore Occurrences, Ottawa and Pontiac counties, Quebec, 1908—by J. White, and Fritz Cirkel.

54. Iron Ore Occurrences, Argenteuil county, Quebec, 1908—by Fritz Cirkel.

57. The Productive Chrome Iron Ore District of Quebec—by Fritz Cirkel.

60. Magnetometric Survey of the Bristol mine, Pontiac county, Quebec—by Einar Lindeman.

61. Topographical Map of Bristol mine, Pontiac county, Quebec—by Einar Lindeman.

64. Index Map of Nova Scotia: Gypsum—by W. F. Jennison, M.E.

65. Index Map of New Brunswick: Gypsum—by W. F. Jennison.

66. Map of Magdalen islands: Gypsum—by W. F. Jennison.

70. Magnetometric Survey of Northwest Arm Iron Range, Lake Timagami, Nipissing district, Ontario—by Einar Lindeman.

72. Brunner Peat Bog, Ontario—by A. Anrep.

73. Komoka Peat Bog, Ontario—by A. Anrep.

74. Brockville Peat Bog, Ontario—by A. Anrep.

75. Rondeau Peat Bog, Ontario—by A. Anrep.

76. Alfred Peat Bog, Ontario—by A. Anrep.

77. Alfred Peat Bog, Ontario: Main Ditch profile—by A. Anrep.

78. Map of Asbestos Region, Province of Quebec, 1910—by Fritz Cirkel.

86. Map showing general distribution of Serpentine in the Eastern Townships—by Fritz Cirkel.

94. Map showing Cobalt, Gowganda, Shiningtree, and Porcupine districts—by L. H. Cole, B.Sc.

95. General Map of Canada showing Coal Fields. (Accompanying report No. 83—by Dr. J. B. Porter).

96. General Map of Coal Fields of Nova Scotia and New Brunswick. (Accompanying Report No. 83—by Dr. J. B. Porter).

97. General Map showing Coal Fields in Alberta, Saskatchewan, and Manitoba. (Accompanying Report No. 83—by Dr. J. B. Porter).

98. General Map of Coal Fields in British Columbia. (Accompanying Report No. 83—by Dr. J. B. Porter).

99. General Map of Coal Field in Yukon Territory. (Accompanying Report No. 83—by Dr. J. B. Porter).

112. Sketch plan showing Geology of Point Mamainse, Ont.—by Professor A. C. Lane.

119-137. Mica: Township maps, Ontario and Quebec—by Hugh S. de Schmid.

138. Mica: Showing location of Principal Mines and Occurrences in the Quebec Mica Area—by Hugh S. de Schmid.

139. Mica: Showing Location of Principal Mines and Occurrences in the Ontario Mica Area—by Hugh S. de Schmid.

140. Mica: Showing Distribution of the Principal Mica Occurrences in the Dominion of Canada—by Hugh S. de Schmid.

141. Torbrook Iron Bearing District, Annapolis county, N.S.—by Howells Fréchette, M.Sc.

IN THE PRESS.

106. Austin Brook Iron Bearing district, Bathurst township, Gloucester county, N.B.—by E. Lindeman.

107. Magnetometric Survey, Vertical Intensity: Austin Brook Iron Bearing district—by E. Lindeman.

108. Index Map showing Iron Bearing Area at Austin Brook—by E. Lindeman.

109. Sections of Diamond Drill Holes in Iron Ore Deposits at Austin Brook—by E. Lindeman.

113. Holland Peat Bog, Ontario—by A. Anrep.

146. Distribution of Iron Ore Sands of the Iron Ore Deposits on the North Shore of the River and Gulf of St. Lawrence, Canada—by Geo. C. Mackenzie.

152. Map showing the location of peat bogs investigated in Ontario—by A. Anrep.

153. Map showing the location of peat bogs investigated in Manitoba—by A. Anrep.

157. Lac du Bonnet Peat Bog, Ontario—by A. Anrep.

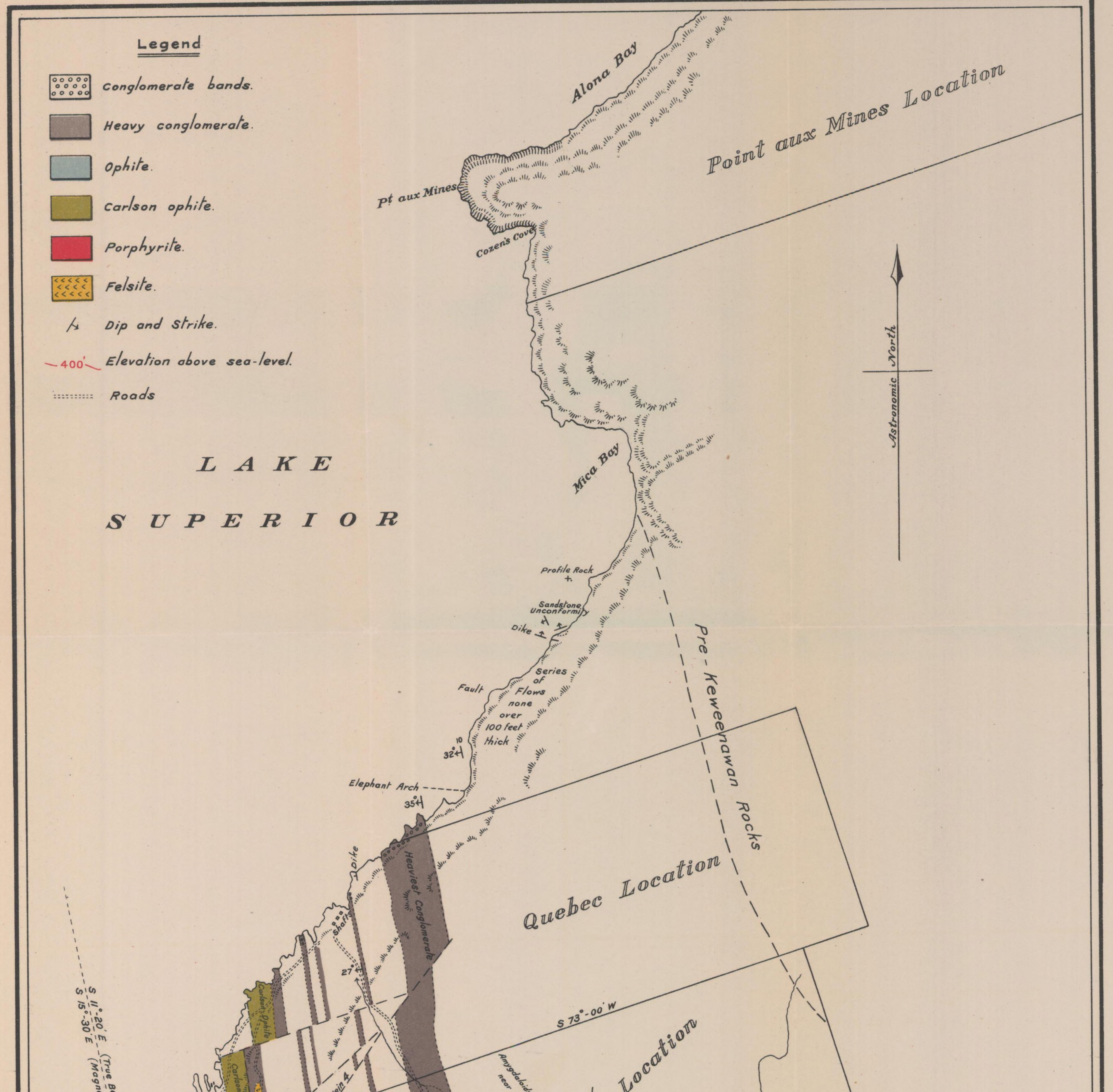
158. Transmission Peat Bog, Manitoba—by A. Anrep.

CANADA

DEPARTMENT OF MINES

MINES BRANCH

HON. W. TEMPLEMAN, MINISTER; A. P. LOW, LL.D., DEPUTY MINISTER;
EUGENE HAANEL, PH.D., DIRECTOR.



L.H.S. Pereira Draughtsman.

No. 112