North shore Lake Superior: [specimens 42024-42135]. No. 339 1900

Van Hise, Charles Richard, 1857-1918
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U. S. GEOLOGICAL SURVEY

FIELD SECTION BOOK

9-891

LAKE SUPERIOR DIVISION.

INSTRUCTIONS.

1. Ordinarily at least two pages of this book will be devoted to one section. On the left-hand page, place a map of as much of the section as has *actually been seen*. Denote rivers, lakes, marshes, etc., by the usual topographical signs. Denote the ledges of rock, when no structure is made out, by cross-hatching, making the cross-hatching cover as nearly as possible the areas occupied by the exposures. If the rock is a massive one, but still more or less plainly bedded, use the same sign with a dip arrow and number attached, showing the direction and amount of the dip. Denote a shaly or other very plainly bedded ledge by right parallel lines, and a ledge having a secondary structure by wavy parallel lines running in the direction of the strike, with dip arrow and number attached as before. The greatest care must be taken to avoid confusing slaty or schistose structure with bedding, and in all cases where there is the least doubt about the true bedding direction, indicate it by a query. To each exposure on the face of the map attach the number of the specimen representing it. In mapping the section count each of the spaces between the blue lines as 100 paces, and twenty of these spaces to one mile, or 2,000 paces. Usually the southeast corner will be placed at the bottom of the page, or at the first black line above the bottom of the page, and at the right-hand side. If, however, for any reason, it is desirable to show portions of an adjoining section, the southeast corner may be shifted up, or the map may be turned around and the north placed at the left-hand side of the page. The ruling of the left-hand pages is also arranged so that, if desirable, a larger or a smaller scale can be used, eight inches, two inches, one inch, or one-half inch to the mile. With the two-inch scale, the squares outlined in black represent sections, and those in red, quarter sections and "forties," while the space between the blue lines is 200 paces.

2. On the right-hand page place the notes descriptive of the exposures. Begin in each case with the number of the specimen, placing the number on the left-hand side of the red line, after which give in order on the right of the same red line the position of the ledges as reckoned in paces from the southeast corner of the section and the dip and strike when observable, the latter always being expressed from the north; for instance 4025, 250 *N.*, 300 *W.*, *Strike*, *N.* 78° *E.*, *Dip* 50° *S.* Then follow with a full description of the ledge. When topographical maps are used for locations this paragraph applies only in part.

3. Collect a specimen from every ledge, or wherever there is a change of rock on any one ledge, taking care to get fresh material, unless for a special purpose the weathered surface is desired. In case of trips made on foot or in canoes, for long distances, neighboring ledges, unquestionably of one kind of rock, need not be specimened. The position and extent of the ledges not specimened should be marked on the map, with notes that each is of a rock identical with specimen so-and-so. Under the same conditions small-sized specimens, trimmed to a uniform size of 2 x 2½ x ¾ inches will be allowed, but in all other cases *large-sized specimens*, trimmed to a size of 3 x 4 x 1 inches, must be selected, in accordance with section 3, chapter IV, p. 44, Regulations of the U. S. Geological Survey. Specimens should not be placed together without protection in the collecting bag, as the fresh surfaces, important in determining the character of rocks, are thus destroyed. They should be damaged by no temporary mark, but the numbers should be at once marked in at least two places upon the inclosing paper or cloth bags. Specimens may be permanently marked in camp by painting the numbers upon them in white upon a black background, using Silver White and Ivory Black oil tubes for color, with turpentine as a diluent.

4. On the last twenty-five pages of the book give, as may seem desirable, a general account of the examination of the region mapped in the previous pages, correlation of observations, sketches, cross sections, etc.

5. Forward this note book as soon as filled as registered mail matter to C. R. Van Hise, U. S. Geologist, Madison, Wis.

Sec 23
Sec 26 beach cut 6
bet 80 feet
40
a screen mine
Beach face 3 feet
high 130 above low
Brg. (70) Sec diff (60)
Sty face (150) Boulder
Spit from bound feet
Cut mid Bull Creek
~~Cut Ant~~ Ant cut
terrace mile small
beach 200 feet

S ~ N S
Loop 5 7 6 6 0 2

Corry is 70 W Mag by

Chest Whitish Catarrh
1 Lancelin Sister Pat
Fitted 30th & Thos Neil
Pt 4
Dr Pg section engraved
& Lucid Type for
Scripture Study

Carlos
Peter
Ruth
Methodist
Presbyterian
Episcopal
Baptist
Disciples

Typed by Smith
Cyril & Methodius Pb
Lenten Mill Melchizedek
Amyd.
Cong. Evangelical Friends
School & not
Shaw & 30th dist 20th

Bold angular rocks on
west point of Bay of
Conception

Strike NW. S.E.
dip 25° S.W.
Strike Joint N 65° W
[illegible]

Strike N 50° W
dip 40° S.W. Conglomerate
in part

Strike N.W. S.E.
dip 60° to 70° S.W.

Aug. 2nd and 4th.

Went from Nipigon to Pt. Alexander. In Lake Mary and up the river found old hornblende gneisses and schist cut by various granites. Had indeed all the aspect of Archean. This true both in a structural and geological sense. On trip to Nipigon and up the river could see very well the escarpment which separates the Keweenawan and the Archean. This is made by the gently southward dipping sandstones of the Keweenawan and the crowning trap. These break off steeply to the north and dip gently to the south.

Aug. 5th and 6th.

Examined the Keweenawan rocks of Nipigon Bay. Along west shore up the Nipigon river to Nipigon and down to Cascade river. The principle Keweenawan sediment is red sandstone. This is very conspicuous on the cliffs of the Nipigon river below Nipigon station, and at various places along the north side of the bay. While in general the dip is flat, there are many minor rolls with brecciation. In some places the dips are 30° or 60° to 70° or even vertical, but these are all local. Often find these at places where are the basic igneous rocks, and I feel inclined to connect these local irregularities with the latter.

In general the sandstone is red, but the strata for a few feet below the trap seems usually, if not always to be gray or often laminated white and gray. Clements collected specimens of this rock at the east side of the mouth of the Nipigon. 42024 and 42025 are from the cliff about 3 miles east of Jack Pine river.

42024
42025

All of the eminences are of the peculiar topographic type exhibited in Thunder Bay, and the cause is the same. Flat-lying sediments capped by diabase or gabbro or dolerite, as

one chooses to call it. In general these are fine grained at the contact At various places these cut across the bedding in a minor way. One of the bestplaces to observe this is where specimens above were collected. Here the strata dip 30° or more and an interlaminated mass of dolerite cuts diagonally across the beds for 5 or 20 feet. This mass is only about 10 feet across, but it appears to join on a larger mass. Diagonal cutting also noted at mouth of Nipigon; but was not able to be sure that Lawson is right in connecting the dike with the cap? In various places it is certain that igneous rock not only caps but is interleaved with the sediments. At contacts the igneous rocks are fine grained. Have no question that same is intrusive. This is evidenced not only by the nature of the contacts, but by the character of the sediments. If interbedded, sediments would be likely to have characters of the sediments in other parts of Keweenawan limestones? Graywackes, etc. absent after lavas appeared. While the igneous rocks make a great show, have little doubt the Nipigon rocks are properly placed at the base of the Keweenawan; for the igneous rocks are subsequent intrusives.

The great area and conspicuous topography of the lower division of the Keweenawan are interesting, and especially so because the sediments which make the display are so thin. The explanation lies of course in the flat dips and the great masses of hard intrusives.

Aug. 7th.

Moved on to mainland northwest of island about 2 miles S. W. of Pays Plat river. The little island off the point 2 miles east of Cypress
42026 river is composed of red sandstone. The rocks of the point west of Pays Plat river were examined. While these are mainly composed of granite, the granite is not all of the same kind and subordinate amounts of schist are found. The schists are coarse hornblende schists, which may have originally been a massive igneous rock. Next to the granite it contains much red feldspar, apparently as a consequence of the granite injections. The granite gneiss itself is cut by later granite veins. In short, the whole has an exceedingly complex character which I have usually correlated with the Archean, but which may be an unsafe proceeding since the injections of the greenstone conglomerate by granite at Snowbank Lake give almost as complex an appearance. However the granite is not gneissic, but injection gneisses with the schists are produced. At the point on which we camped the rock is red massive granite. This however is cut by dikes of another red granite. The small island south of camp to my surprise is underlain by

bedded shale, sandstones, and conglomerate. The strike is approximately parallel to the shore, and the dip is lakeward at angles of 10° or 15°. In passing up the cliff from the north side one finds first shales, on these sandstones well indurated, and on top of these conglomerates 10 or 15 feet thick. The sandstone and conglomerate are also interstratified. The conglomerate is rather coarse, pebbles 6 or 8 inches in diameter being common, some indeed a foot in diameter. The common pebbles are those of white quartz and the cherts and jaspers, many of them ferruginous, plainly from the Animikie. A few quartzite pebbles were also seen, but strangely enough almost no granite pebbles were discernible. It is rather curious that so far from the Animikie the predominant pebbles should be from this source. May not the Animikie be nearer at hand than shown by the maps. And it is interesting that so near granite none of it should be found; and it is finally surprising to find the expected order of sediments reversed; i.e., shale, sandstone, and conglomerate, in passing upward.

Wednesday, Aug. 8th.

Found the N. W. part of large island in Rossport Bay (Pays Plat River Bay) to consist of sandstone which was capped with luster mottled
42028 columnar dolerite (42028), the sediments and contact dipping lakeward at an angle of about 5°. The topography of the islands corresponds with the cliffs on the N. W. and S. E. general slope. The point between Rossport Bay and Rossport Harbor consists of schists, granite, and gneiss with the usual complex relatio In places the schists are in great dike-like masses in the granite. These same schists are also often cut by a later granite. At Rossport their relations are very well seen. A great dike-like mass of mica-hornblende-schist appears to cut through
42029 the granite. Just above the dikes a similar schist is seen to be cut with granite veins. The islands just off Rossport Harbor expose on the N. W. Sides black shales and sandstones, and then are capped by the usual columnar trap, both dipping lakeward at gnetle angles, 5°, but locally steeper dips up to 10 or 15° were seen. A little nearer the shore the trap was seen also to cut the slate. At one place a flat thrust fault in the sediments was noted, but this evidently very local.

The islands show the usual topography corresponding, - steep N. W. slopes and gentle slopes to the S. E.

The mainland beyond for a long way is composed of the granite-gneiss-schist complex, with the exception of the first little point just beyond the island out of Rossport, which gives a narrow shallow channel between the same and the main land. Here is seen a flat-lying
42030 pyritiferous chert (42030) with a gentle lakeward dip which I take to be a remaining scale of Animikie, and the presence of which confirms my conjecture of yesterday that the Animikie was not far distant because of the abundance of chert fragments in the conglomerate on the island of Rossport Bay.

The character of the material and the manner in which it must be a mere skim above the granite, all correspond with the occurrence of the Animikie skim on the old granite-schist complex in the N. W. part of Thunder Bay. Apparently throughout the district the iron formation occurs with a very thin skim of conglomerate on the Archean.

In the afternoon coasted to island half way between the point below Magnet river and opposite Schreiber station. At the point east of Magnet river, and for some distance toward Schreiber Bay, the Anim-

ikie rocks were found in extensive exposures dipping lakeward with flat dips 5° or less for the most part. In no case was any great thickness exposed, but the Animikie character of the strata is unmistakeable. The rocks comprise many of the typical varieties of the iron-bearing formation, comprising chert, siderite-slate, magnetitic and sideritic slate, jasper, etc. Where the thickest exposures were noted the rock at the
42031 bottom is a gray siderite (42031). Perhaps the most abundant rock noted was banded magnetitic and cherty
42032 siderite; but chert is abundant, and
42033 also jasper is plentiful. At various places the iron formation is interlaminated with or capped by
42034 finely textured diabase, showing the usual columnar structure; but this [illegible] of the Animikie.

At various places the Animikie was found only a few feet from granite; but a conglomerate was noted at its base, and at one place the skin of Animikie had been pealed off from an oval area some feet in width, and
42035 here the granite (42035) was noted in sharp contact with the Animikie without any trace of conglomerate, so far as I could see. At one place the Animikie strata abutted against the granite, and here was seen a breccia containing many fragments of granite and Animikie rocks.

It was also cut by great veins of calcite. I had no doubt that the breccia which was 20 feet wide or more is a fault breccia. This occurrence looks like a fault of some magnitude more than anything I have yet seen. Strike of same is parallel to the strike of strata approximately.

Of all the interesting phenomena noted, however, was that of a con-
42036 glomerate (42036), in part resting on granite, but to a less extent in a few places resting upon the Animikie. The conglomerate is seen from near the end of the point to a place 1 1/2 miles at least eastward at various places. The conglomerate is also seen below the water. It is a mere skim. Its most plentiful fragments are black, and gray chert, red jasper, white quartz, and other materials plainly derived from the Animikie. At first when I saw the conglomerate I supposed same was basal to the Animikie, but a close examination led me to believe this could not be the case because of the character of the pebbles. After this idea came, a search for the conglomerate directly on the Animikie was successful. Indeed, this relation was found at a number of places In a number of places the conglomerate would be seen at a low place, the granite being on ~~the~~ one side, the

Animikie being on the other. The relation was observed at two other places; and it was plain that the conglomerate was deposited in a minor depression between the two. A pre-Keweenawan depression not large enough to call a valley at the contact of the Animikie and Archean just where one would expect the same. This lower position was what first led me to suppose that the conglomerate was under the Animikie. In the conglomerate there were comparatively few granite pebbles, notwithstanding the near presence of the granite. However the conglom-
42037 erate in places when directly upon the granite was a conglomerate-graywacke or quartzite. It appears that the granite must have disintegrated into its constituent particles to a large extent, and that the resistant Animikie furnished the majority of the pebbles.

At the places where the Animikie
42038 was thickest a black slate was found. At this place the gray rock (42031), the iron formation between, and the slate a l were noted in succession. At the small island half way between
42039 the point and the bay, slate interlaminated with diabase and capped by trap was found. There are at least three interlaminated sills.

The discovery of the black slate of the Animikie above the Animikie iron formation has led me to wonder

whether the slate on the NW side of the islands in Rossport Bay are not Animikie. Indeed I am inclined to think they are. The contact was not seen; and if these be regarded as Animikie the facts here are identical with those seen at Silver Islet; also the anomoly is explained of the slate at the bottom and the conglomerate, which is in every respect like the Silver Islet conglomerate, is on top.

It is rare to find so much of interest at one place as is expressed between the Point and Schreiber Bay The same basal conglomerate in the two systems cutting diagonally across them. No discoverable clastic deposit at the base of the Animikie iron-bearing series here, nor a previous rock which must have been eroded;- in this respect surpassing in interest the Vermilion iron-bearing formation which rests upon the greenstone schist of the Archean. In the case of the Animikie there can be no question, for the rocks are well bedded and flat-lying. If the two were folded intricately the relations would be the same as in the Vermilion district.

Aug. 9th.

Coasted in forenoon from island mentioned in previous notes to Screiber Bay. On mainland opposite island a new set of rocks came in. These are greenstones and greenstone-schists, the latter subordinate and only found in narrow shear zones. They are veined, and present a beautiful illustration of the spheroidal structure as I have anywhere seen in the Ely greenstones. The spheroids also have a porphyritic texture different from that of the matrix. In places apparently amygdaloidal. I did not photograph same because the morning was wet and dark. These greenstones continue all the way to Screiber Bay as the dominant rock. I have no doubt of their equivalence to the ancient greenstones which we have called Archean. They have all their peculiar characteristics in texture,- the peculiar dark green which we have learned to connect with exterior alteration, the schistose structure in places, the veining, etc. By lithology alone I almost immediately classed them with an older series of rocks than the Animikie or Keweenawan.

Resting on this greenstone, almost opposite the island, is a conglomerate about 10 feet thick at its thickest places, the pebbles and boulders of which as well as the matrix are mainly

derived from the subjacent greenstone formation. This conglomerate undoubtedly contains chert fragments of various kinds, some of which are similar to the Animikie cherts (42040), and others of which are quite different. However the conglomerate contrasts strongly with those described yesterday in the relative unimportance of the chert fragments. This conglomerate is overlain, indeed may be said to somewhat suddenly grade into the peculiar granular rock (42041) and the chert of the Animikie, in places rather markedly ferruginous. 1 1/2 or 2 miles farther toward Screiber Bay, about 1/2 mile from the bay, a considerable exposure of exactly similar conglomerate was found resting upon the greenstones. This conglomerate was from 2 to 4 feet or 6 ft. thick, and at one place where it was the thickest it in the same sudden way grades up into jasper (42043). In places the chert and jasper layers are so thin that the boulders of the conglomerate protrude through them. The change from the deposition of a coarse conglomerate to the fine sediment was extraordinarily abrupt, and accords with the fact noted yesterday that in the granite no fragmental material between the Animikie iron formation and the granite could be noted. At the second place where the conglomerate occurred there were intruded jasper pebbles in the conglomerate.

42040 42041 42042 42043

Those conglomerates below the chert

These conglomerates below the chert and jaspers and below the slate offshore on the island must be Animikie. They dip flat toward the lake. The dip of the slates on the island is 5° to 8°. We thus have here, contrary to our experience of yesterday, a basal conglomerate to the Animikie. This raises the question as to whether the other conglomerates observed yesterday are Animikie or Keweenawan. If the former, they are interformational; for there is no question that in places the conglomerates is in the Animikie, but the abundance of Animikie material is such as to rather lead to the conclusion that they are Keweenawan. However, against this it may be said that the Animikie conglomerate contains chert and jasper, and the dominance of the greenstones in the conglomerate is explained by the fact of the conglomerate on the greenstone combined with the resistant character of the latter as compared with the granite. In this connection it is notable that the granite fragments are rather plentiful in the Animikie conglomerate while they are rather sparse inthe conglomerate supposed to be Keweenawan.

At various places between the island and bay thinner skims of conglomerate were noted on the greenstone, and also in depressions slaty rocks. Some of themat a careless examination

might be supposed to be interlaminated with the greenstones, but a closer examination shows that they were sands and conglomerates which have filled up depressions and clefts in the greenstones. (42044 and 42045) represent two phases of the sediments, while (42046 and 42047) represent two phases of the conglomerate. Of course in many places the conglomerate is much coarser.

42044
42045
42046
42047

Opposite the island containing the sills of dolerite a little fresh vertical sill of dolerite about 6 in. across was seen to cut straight through the greenstone and the conglomerate. Also a big dolerite sill 10 or 15 feet across, running nearly parallel to the shore and with horizontal columnar structure, was seen to cut the greenstone.

It appears that between the point below Magnet river and Schreiber Bay the greenstones and granite of the Archean, the fragmental basement, the iron-bearing member and upper slate of the Animikie, and probably the basal conglomerate of the Keweenawan,- the latter resting in part upon the granite and in part uponthe Animikie. If not this, a remarkable intraformational conglomerate, the pebbles of which must have been altered in the same way as the Animikie from which they were derived. All in all a

remarkable set of phenomena, and hard to match in so short a distance.

In the basal conglomerate of the Lower Marquette at the Cascade range; also in the basal conglomerate of the Marquette chert and jasper are found. which are supposed to be derived from the veins of greenstone.

In the afternoon coasted to east side of big bay east of the Les petits Escrits. Schreiber Point is mainly composed of the typical spheroidal weathering greenstone. Some of the spheroids are very large, several feet in diameter. At Schreiber Bay the greenstone is cut in a most intricate way by red granite. Both masses, and irregular areas and branching dikes, and straight dikes, as well as the peculiar irregular relations described by Lawson as typical of the various irruptive contacts. As the outer part of the point was neared, the granite became first sparse and then absent. The granite and the greenstone diabase dikes, large and small, with the characteristic horizontal columnar structure. Where the dikes are small, these are also small; where large, i. e., 50 or 75 ft. in diamater, these are large, being several feet in diameter. The majority of the dikes cut in the point nearly at right angles to its side, and on its end one was observed to extend a long way parallel to it, i.e., in the same

direction as that on the side of the point, and in general parallel to the coast. On the mainland east of Screiber point, the red granite came in as the dominant rock. This is a very massive red granite, showing no schistosity; but oftentimes a regular jointing with somewhat even spacing. This granite composed the Les Petits Escrits and other islands.

Tuesday, Aug. 10th.

From bay to Steel river. The same red granite is dominant on the shore to Victoria Cape. The granite seen both days is also cut by the columnar dolerite, but the dikes were not so numerous as in the Screiber Point.

Victoria Cape is composed of the spheroidal weathering greenstone, again cut by dolerite and by granite. In short, the description of Screiber Point is the description of Victoria Cape. The spheroidal greenstone is the dominant rock to Steel river. At Jack Fish and Jack Fish Point on the way to Steel river, this rock is magnificently shown. The great spheroids of greenstone are packed in with the matrix in heir usual peculiar way. At Jack Fish the greenstone and granite are seen in intimate and characteristic peculiar relations. In some places where the granite is dominant the greenstone has a laminar or gneissic appearance, as if metamorphosed by the granite. Some of the dikes of red granite, on leaving Jack Fish, may be observed cutting the greenstone below the water, and these, when the dikes are straight and of uniform width and continuous, present a striking appearance.

Upon the whole the greenstone to a large extent has escaped the intense mashing characteristic of much of the rock in the vermilion district.

In short, it is like the great areas, the centers of which have escaped mashing in the Vermilion district, the borders only of which are mashed.

Topography for several days.

Immediately upon leaving the area of the Keweenawan the character of the topography changed. This statement applies equally well to the topography north of Nepigon and that to the east of it. The granites and greenstones not having layers of regularly varying resisting power, and the slates and dolerites do not so readily record the high line of Lake Superior. They present no regular escarpment with vertical cliffs, but on the other hand take on at once the peculiar rounded bluffy character, often with steep slopes characteristic of the similar rocks on the south shore. Their forms are those of pre-Glacial time modified into the roundish forms of the glacial period. The waters of Lake Superior at higher levels and subsequent erosion have alike failed to seriously modify them. (It seems probable to me that the cliffs of the Keweenawan and Animikie are largely post-Glacial development, of course developing at places favorable and subordinate to the general topography

of pre-Glacial as modified by Glacial time.) One has to look sharply for the wave-cut terraces and sea-cliffs of the higher levels of Lake Superior. In places I thought I could see them, but there is no such continuity as obtains in the Keweenawan and Animikie areas. I however have little doubt that a close study would discover them at many places, and especially as they could be correlated with the high level beaches and constructed terraces in the bays. These continue the same as before; and nowhere else have I seen them with suhh regularity, perfection of development, as between Jack Fish and Steel river. After rounding the rock point below Jack Fish, we came to a long stretch of level wave-constructued terraces with beach, and no rock exposed. This beautiful high level serves for the Can. Pac. Ry for some distance. From the higher level to the water's edge there are flour distinct terraces cut in the higher terrace before the level of the lake is reached.

After the next point is rounded and one goes to the mouth of the Steel river, the phenomena are again seen with equal perfection. This terrace is again owned by the C. P. Ry., and it is difficult to believe that the other terraces as seen from the lake were not almost artificially made, so horizontal, regular, and so perfectly

do they resemble a Ry. embankment which has been so long unusdd as to be covered with shrubs and small trees. (Fire has burned all the old trees.)

Aug. 11th.

With aneroid made cross section of beaches and terraces in Steel River Bay. Up to about the 100-foot level there was a succession of pebble and boulder beaches, more than a score of distinct beaches counted. Between the 100 and 200 feet levels there are three very distinct and well marked terraces. The upper two are partly wave-cut with sea cliffs, and partly constructed. One may pass from the wave-cut terraces at the base of the sea cliffs to the constructed forms At the place of transition there are great boulders, just such as are found at the sides of points at the present day. In short, the phenomena in passing from the upper points of rocks to the re-entrants are identical with those in passing from the points of Steel Bay to the beach. At the former are the destructional, at the latter are the constructional forms.

The upper cut terrace is probably about 200 to 220 feet high. It can be very distinctly seen on the west side of Steel Point, and less clearly seen on the lower cut terrace.

Made a traverse up Steel river. Here on the river above the Ry. bridge,
42048 and for some distance, is exposed slate The relations of the slate to the greenstone were not determined, but I have no doubt that same is Animikie, since it is practically identical

with the slate of Screiber Point.

Aug. 12th.

In the morning coasted from the mouth of Steel river for about 6 miles. The rocks for the entire distance are the greenstone series. However they are here much more Schistose than west of Steel river. Indeed in this respect they resemble the greenstone schists of Marquette, especially in those at Light House Point. There are belts in which the rocks are
42049 so schistose as to be slaty. (42049), and other belts where there is a dis-
42050 tinct banding (42050) alternating with dense masses. In all of these ~~at~~ respects the parallelism is complete. However in places the rocks are still so little mashed as to show the characteristic ellipsoidal structures. The schistosity is nearly vertical, and strikes N 60 to 70° E. These rocks are cut by the fresh dolerite dikes, vertical or nearly vertical, and with the usual horizontal columnar parting. The dikes vary from thoseof small size to those 50 or 60 feet across.

The bay in which Pic river is located was not visited, but the rocks as far down the west coast as I could distinctly see with naked eye and glass, in topography, color, etc., seemed to be the greenstone. What is in the N. E. side of the bay I could not determine, but with the glass could

distinctly see large masses of red rock which may be the red granite heretofore noted, or may be the red syenite of Pic Island. At Pic Island the sharp point which projects ferthest west is found to be composed
42051 of gray coarse syenite. (42051)
42052 This seems to grade into red syenite toward the north, and the rock continues to the north end of the island, and along its north side. The mainland also was found to be composed of the same rock. At the central point of the peninsula jutting
42053 south toward Pic Island the syenite is found to intrude a dioritic rock in the most complicated fashion. Stringers go all through the syenite, and many of the stringers are coarser than the main mass of the red rock. In some of the boulders the phenomena are best seen. Here will be the diorite cut through and through with the overturning veins and stringers of the red rock, and in other boulders the red syenite contains numerous fragments of the dike rock. Did not go into the big bay adjacent to Peninsula Harbor, but it is certain that many of the rocks are massive and intrusive. It looked from the color and topography as if the greenstone composed much of the country back of Little Pic Bay and Peninsula Bay; but judged this only fromthe fact that the greenstone gives usually more rugged, the granite

more rounded forms.

The Peninsula itself is composed of even more basic rock than the syenite, almost a gabbro. This peninsula is a beautiful smooth drive, accoring in form to the various intrusive rocks.

It may be possible that along the shores of the deep bays some slate occurs, but of this I saw no evidence, even by pebbles on the beach which were examined to see if slate might be adjacent.

For a description of Peninsula Harbor rock see Bureau of Mines Rept., vol. VI, Pt. II, pp.146-149.

Aug. 14th.

Coasted from the peninsula to Heron Bay, and examined the rocks along Ry. track from near head of Heron Bay to Heron Bay station. The gabbros and granite continued for more than half way to Heron Bay; then came in the greenstone-schist series. The greenstone formation here nowhere was seen to show the spheroidal weathering. However it is strongly schistose. On the Ry. track near the bay the strike of the schist is nearly e. - W. and the dip 60° to the north. At the south point of the
42055 bay the schist (42055) is conglomeratic,- is indeed a typical schistose tuff in all respects, like the best known schistose tuffs of the Vermilion district. Indeed, identical with the great greenstone-conglomerate-schist north of the "Manitou" Lake formation, and also like those of the Marquette district at Deer Lake.

This greenstone-conglomerate or tuffaceous schist is cut in the most intricate fashion by a somewhat acid
42056 rock(42056). Indeed, this rock makes more of the point than the tuff. Both are cut by the characteristic dolerite dikes which have been following so long.

On the Ry track and near the head of the Bay the schistose tuff is much mashed, indeed so much so as to make the

tuffaceous character indistinct for most of the way, and in places the mashing has extended so far as to obliterate the pebbles and to produce a fissile banded schistose or gneissic rock. The phenomena are identical with those observed north of the "Mans" Lake on Hunters Island. This schist or gneiss and the tuff pebbles in it, is porphyritic in places, in this respect resembling the porphyritic greenstone of Moose Lake. All are cut by various later intrusives, of which the dolerite is the last. No attempt was made to systematically specimen the greenstone-schist and tuff series.withtheir intrusives; since this would require many specimens and the former at least would be identical with the tuffaceous greenstone-schists of various localities on the south shore.

No slate or other water-deposited clastic was found.

Aug. 15th.

The Ry. section between the camp and the station was carefully examined. Found the greenstone-schist was in many places interbanded with the reddish felsitic rock. The bands varied from those a few inches in diameter to those several feet. It seemed to me to be a case of parallel injection. In places the rock was also observed to be amygdaloidal. In other places the felsite seemed to be fragments cemented by a matrix of greenish material

Coasted from Heron Bay to island north of mouth of Pic river. The schistose tuff is finely exposed on the south side of Heron Bay and at the point. There is here the same intimate mixture of green-schist and felsitic material. At the south point of the entrance of the bay the felsite matrix seems to be flattened rounded fragments in a sparse matrix of greenish material. As we go south from Heron Bay the felsitic intrusive materialis dominant, as it is north of Heron Bay. At the island north of the mouth of the Pic the rock is a dense greenstone.

42057

As usual dolerite dikes cut the material.

Aug. 16th.

Coasted south from island north of mouth of Pic river to Spruce Harbor. For two or three miles the dense greenstone cut by intrusives are the rocks found.

The reddish massive felsite intrusives become dominant, and these seem
42058 to change into a coarser rock which is cut by masses and veins of a red
42059 granite. In this massive rock fragments of the greenstone-schist were found. This greenish intrusive rock, as we continue along, becomes banded and takes on the character of a typical
42060 gray gneiss. (42060) Where the greenstone-schist ceases to be dominant and the massive intermediate rock is the chief one, Coleman places the boundary between the Huronian and Laurentian. Massive, schistose, and gneissic phases of the intermediate rock south of this is cut through and through by dikes of red granite, small and great and by masses of the same.

At Oiseau Bay Coleman's map shows granite as taking the place of the Alurentian; but I could see no difference except possibly that the red intrusive granite is rather more plentiful than farther north. Also a coarse massive pink granite is abundant. However the schists are almost everywhere seen, and there is certainly no such thing as a sharp line between the

two. In fact I saw no areas which I would map as granite with the implication that we have to do with a different series than to the north. Indeed, I should doubt if the granite is even dominant for parts of the areas mapped as granite; i.e., granite in the sense of the massive red or pink veins which have not a gneissic structure.

Aug. 17th.

Went from Spruce Harbor to cape about 3 miles northwest of the mouth of Pocaiguia river (C. L. C.) For the first 6 or 8 miles sailed rapidly, and did not examine the rocks closely. Followed shore from bay in which Swallo river enters. The rocks from there to the bay which Coleman marks as separating granite and Laurentian contained much pink and red granite, but the schistose rocks were not excluded. I could see no difference between the areas north and south of the bay. On Otter Island the schists and gneisses cut by the granite were more prevalent.

If the areas are to be mapped as Laurentian and granite on the basis of prevalence of granite or of gneiss, with no transition belt, Coleman's map may be called roughly correct as to this; but as to the separation of the Laurentian of Otter Island and the Huronian of Otter Head and the belt to the S. E., so far as I went, I am wholly at a loss. The two seemed to me to be absolutely identical in their elements. I should unhesitatingly call both Archean. I know of no better places where the complexity of the Archean can be seen than on the S. E. end of Otter Island, and along the S. W. side of the Head. Here schists, banded gneiss, schists interlaminated by granite with the most complex parallel

injection, schists in dike-like forms in granite, a cutting red granite, and later dolerite dikes, all may be seen with remarkable closeness. If I correctly interpret the order, it is as follows: A hornblende- gneiss or schists is the oldest rock. This is in considerable masses and in places is
42061 comparatively free from injections.

This is cut by great masses of pink or gray granite. In places the granite has irregular boss-like forms; in places follows the schistosity, and the beautiful parallel injection gneiss is produced. This irregular gneiss has bands varying from these a fraction of an inch across to those a number of feet. These two are cut by a light red granite. This granite is in dikes and considerable masses cutting the banded gneiss. , the earlier granite, and their complex mixtures. It also injects itself parallel to the red injection gneiss, thus giving three parallel elements, two of which are injection granite. Finally, the whole
42062 is cut by the late dolerite dikes with the usual horizontal columnar structure. The specimen was taken from a dike about 30 feet wide, but others are wider and many are smaller.

Of these elements and the succession I am morally certain, but there may be other elements which I have overlooked In places the schist and granite after

injection seem to have been mashed, and show minute plications. The island and mainland on the big bay S. E. of Otter Head contains much granite, and at the point at which I camped, this rock is dominant. Would myself map this area with "Coleman's" granite rather than the Huronian. Irving's map in Mon. V, following Logan much better, would make all the areas south of the Pic which I have seen Laurentian; and this in the sense o Archean including later intrusives I agree. (Irving, Puckwunga)

Aug. 18th.

From Peninsula between Otter Head and Pwcaqua river to Pilot Harbor.

The Peninsula is mainly composed of pink granite, as are also the island and the mainland to the north. If one were to follow the Canadian method of mapping he would call the coast Laurentian from about two or three miles below Pic river to below the Peninsula. In the islands and on the mainland below the Peninsula greenstone schist, cut by granite, comes in. At the Pwcaqua river, just below th rapids, the rock is a distinctly schis-
42063 tose rock with parallel reddish bands, in places presumably due to injection, strike N. 40 W., dip 30° to 40° N. E. In places the rock is an amygdaloid. At the river the rock has become a den e hornblende-sc ist (42064), and at the
42065 point about 1 1/2 miles east the rock is a massive greenish gray granite(?) which weathers green and gives a sufficient occasion for its being called Huronian by the Canadians. All are cut by red granite; and this, as well as the greenstone-schists, etc., are cut by the dolerite.

42066 42066 represents the granite which cuts 42065 at the place where we landed, a point beyond the little island about 2 miles from Pwcaqua river. The rock
42067 is hornblende-schist (42067) which is cut in an intricate fashion by schistose
42068 felsite (42068). The latter rock has a

platy structure; and where a specimen is shaped many pieces break into small polygonal b ocks. Between the felsite and the hornblende-schist there is a breccia, showing faulting and differential movement between. It is certain that after the injection of the finer grained felsite or granite movements of an important kind have taken place.

42069 The next point beyond, just before creek is reached, is also hornblende-schist, and this is cut by granite dikes, great and small, in a most intricate manner. The schistosity of this rock is about N. 20 ° E., and the dip flat to the N. W., 30° , or thereabouts Up to this time I had not doubt of the Manistican? Manistican? Keewatin character of the formations.

On the point immediately east of creek there appears a peculiar spotted rock, different from anything before seen, which has a strongly tuffaceous appearance; i.e., a peculiar spotting, and also a suggestion of banding in places.

42070 42070, 42071, 42072 represent three
42071 phases of this rock. This may be a
42072 much metamorphosed clastic partly? deposited by water; but I should have unhesitatingly placed it with the previous rocks were it not for the succession following at the east end of the point. The schistosity strikes about N. E., and dips to the N. W. Corresponding with the schistosity is a set of

intrusive rocks following to the east; i. e., under the greenstone, as follows (thickness estimated)

Dolerite, 8 ft., with cross columnar structure at right angles to schistosity.

42073 Felsite, or granite, 8 ft.

Dolerite, 8 ft.

Black ferruginous chert, 40 ft.

42074 Slate and conglomerate, 15 ft. (This conglomerate did not specimen. Slate directly below dolerite.)

42075 Jasper and ore, 6 ft.

42076

Slate and conglomerate, 10 ft.

Jasper, 1 ft.

Slate and conglomerate, 40 ft.

42077 42077 slate; 42078 and 42079 fine
42078 conglomerate boulders, 1 ft. or more
42079 common. 42080 fragments of conglom-
42080 erate, and pebbles. Pebbles mashed. In places pebbles appeared to be from iron formation.)

Jasper, 1ft.

Conglomerate with fine belts of jasper and chert, 1 ft. or less in thickness total thickness 50 ft.

Dolerite, 20 ft.

Banded greenstone conglomerate with ferruginous streaks, 20 ft.

Dolerite.

Greenstone conglomerate, grits, and slates, making up the great mass of the end of the point; and the east side of same contains 4 lean ferruginous chert bands from 4 to 8 ft. in thickness.

42081 From the grit or greenstone schist

42082 Ferruginous chert from the thickest belt (This is almost identical with the bel at Marquette in green schist.)

The strike of these rocks is about N. 45° E., and the dip is 45° N. W. That the above is a sedimentary bedded succession I could not have the shadow of a doubt. The conglomerate has a strongly tuffaceous appearance. When the material was being thrown out coarse clastics formed; when these stopped fine conglomerate or grits appeared; when there were conditions of quiescence the chemical or organic sediments of the iron formation were laid down. One might say it is possible that the iron formation material is vein stuff; but for this I could not find theleast indication. The jaspers to be interbedded. They do not have the appearance of veins. One might say that the sediments are on a flat overturned syncline in the greenstone conglomerate; but again for this there is no evidence, and against this are the several beds of conglomerate. The greenstone-schist interbedded with the chert and jasper is cut by granite in an intimate fashion. (Photo 12 represents this.) The granite was not noted to cut the iron, but these as well as the dolerites here followed the bedding.

From the above point to south of end of Pilot Harbor at the Gull rocks, the greenstone cut by granite containues. At many places this greenstone has the

peculiar spotted tuffaceous appearance of a tuff; in others is an intricate mixture of greenstone and granite.

Disregarding other localities, one would hardly doubt that the iron-formation material is in, and a partof the greenstone-tuff series. That this is separate from the hornblende-schist farther west there is no evidence although this is possible. Both are cut by granite. These relations have great significance in the interpretation of the general structure of the region.

Aug. 19th.

Sunday; rain and wind.

Aug. 20th.

From point south of Pilot Harbor to Eagle river. The greenstone continued as the chief rock until within a short distance of Pipe river. However the cutting granite steadily became more abundant as we went east until at Pipe river it becomes the dominant rock. For a distance west of Pipe river the intricate intrusive relations of the granite to the greenstone are beautifully shown. The granite is for the most part pinkish gray granite; but besides this, pegmatite veins or dikes are seen, and in places to two are almost as intimately mingled as on Picnic Islands at Marquette. The green stone continues to have the same spotty appearance all the way. In places the white spots appear like inclusions of an earlier rock; in places the rock looks tuffaceous; in places the rock is schistose, in others massive. Where the greenstone is schistose, parallel injection has taken place, giving the characteristic banding of greenstone which I have called injection gneiss. The relations are practically the same a at Otter Head and east of same.

It is certain that if the banded gneiss is Laurentian, then have two. The granite east of Pipe river is
42083 dominant. (42083) Pinkish gray granite from island near Ganley's Harbor is representative. The greenstone and granite, as well as their mixture, are cut by numerous dolerite dikes. One 70 to 100 feet wide was seen. At one place a granite point was seen cut by five dikes, from 10 to 30 feet across. The dolerite seemed to be particularly abundant along the transition zone between greenstone and granite, and less plentiful after the main mass of granit is reached.

If the granite area is to be separated as Coleman's map shows, the same must begin at Pipe river. Here is the place where the N. W.- S. E. [illegible] due to [illegible] structure of greenstone and cutting dike change to N. E. irregular [illegible] of granite.

The granite continued as the domi ant rock to the middle of the big poin between Ghost river and Eagle river. Shortly after Ghost river considerabl areas of schist are seen in the granit many of them as inclusions. The chan however from dominant granite to domin ant greenstone is generally sudden, th one being dominant on one side of the point, the other on the other. At the transition area the granite may be seen intruding and including an epidot
42084 ichornblende-schist, represented by

Here Photo 1, roll 3, was taken, showing the granite intrusive in the schist. East of this intricate mixture the granite is seen in dikes and stringers in the schist; also parallel injection is seen. The schist in places is hornblende-schist, much contorted and apparently granitized.
42085 represents the schist at the mouth of Eagle river. (

Aug. 21st.

From mouth of Eagle river to Mountain Ash river. The rock for a number of miles is the various forms of the greenstone formation; in places
42087 massive; in others schistose, occasionally somewhat banded. The whole is cut by granite in the same intricate fashion as at Eagle river, but perhaps the granite is quantitatively less important. At the second point west of Boat Harbor the rock is distinctly schistose; in places is fissile like slate; has parallel injections, contains calcite seams; but I would unhesitatingly place same
42087 in greenstone formation. At bay between this point and the point making the west side of Boat Harbor
42088 the greenstone is in sharp contact with a calcareous schist which has a well developed fissile structure or cleavage, and may be taken as slate. Indeed, I am not sure that it is not. This rock continues from this point, and makes up the island off the point. At this place the rock has to a remarkable degree the appearance of a grit and slate. Certainly it is this, or else a schist has been injected with an acid rock parallel to the schistosity, and then the two subsequently folded.
42089 represents the green slaty rock at this place.

42090 is the grit or felsite rock, much mashed.

42091 is another band which looks more like an igneous rock. In places the felsite or grit bands cut across the schistosity, and take on a true granitic texture, so there is no doubt of injection. The only question is whether these are both banded sediments metamorphism, and subsequent injection

East of this point into Boat Harbor the slaty rock appears to grade into the green schist west of the point; many bands in the green schists might be regarded as evidence of the same. However it is possible that there is complex infolding of sediments and a greenstone series. However if this be true, the contact conglomerates if any existed there have been obliterated. Upon the whole, I am inclined to regard all as the same greenstone series; but if so, the banding, the plications of the bandings producing northward pitching folds, present a remarkable case of the simulation of igneous rocks combined with metamorphism and injection, producing a rock which looks like a metamorphosed, banded sediment. The strike of the contact mentioned of 42088 and 42089 is N. S., the dip is 50° to 60° E. The schistosity of the adjacent greenschist to the west is at a high angle. (Photo 2, roll 2, represents the contorted schist and granite injection

Beyond Boat Harbor the rock becomes

the ordinary greenstone series, however with new areas having the slaty appearance of the point of Boat Harbor. Also in places it takes on an unmistakeable tuffaceous appearance, and also in places has the same peculiar spotty appearance of
In places these certainly seem inclusions; in other apparently seggregations

From bay west of Dog or Mountain river. The greenstone and granite continue to Dog river. Here slate is found, which in places is conglomerate. The conglomerate and slate are banded; the strike is N. 30° W. mainly, and the dip vertical.

Herrick is correct in saying the bedding and cleavage are accordant. The conglomerate contains granite, felsite, and greenstone pebbles as the dominant varieties; but chert pebbles are also plantiful. I did not however see any unmistakable iron formation pebbles. The felsite is unmistakably the same felsite or granite which so notably cut the greenstones and greenstone-schists of the area. The granite is also like the granite seen at various places. The characteristics of the pebbles from the greenstone- granite- felsite complex is clear evidence, it seems to me, of the later age of the slate. The greenstone pebbles might not be regarded as of special significance; but the felsite and granite pebbles

show that the greenstone formation was injected by these rocks before the slate was deposited. The felsite cuts the greenstone formation on both sides of the slate and conglomerate, and to the east at the very first place the greenstone is recognized.

I did not search for the contact of the slate conglomerate and the greenstone west of the river as I should have done, for it did not occur to me that the slate had such an extent; but banded rocks similar to these which I saw east of the river led me to think that the slate is also found there. However the contact was observed east of the river. Here there is absolute continuity of exposure, and also accordant cleavage. It is impossible to puts one's finger to the rock at the contact; but one may say within a few feet, "Here is the slate; there the greenstone-schist." The texture, manner of fracturing, and appearance of the two rocks are different. The greenstone-schist, as its name indicates, is green chlorite, and has the coarser texture; the slate is gray, micaceous, and has a finer texture. There are two zones of conglomerate, the rock on the point showing the first exposures east of Dog river; the other within a few feet of the greenstone. The latter is notable in containing many more pebbles from the greenstone than the other; the greenstone being dis-

tinctly subordinate to the granite and felsite in abundance nearest Dog river.

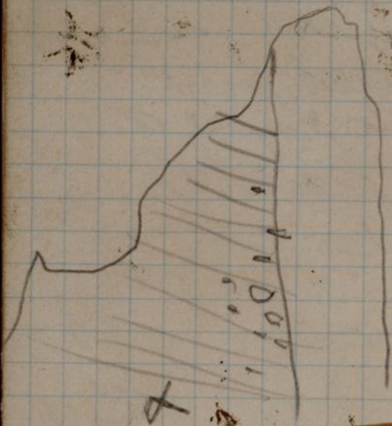
After the greenstone appears it is immediately cut by the felsite; whereas in the slate and conglomerate there is no cutting felsite, and it would be difficult to find in this vicinity an area of the greenstone of equal magnitude which is not slate.

I have little doubt that many would say that the slate and greenstone formations are the same; that there is a transition between them. They could point to apparent interlaminations of the two; but I regard this as due to infolding. However the felsite pebbles, the cutting of the greenstone but not the slate and conglomerate by the felsite, leaves no doubt in my mind as to the great break between the two.

42092 42092, slate; 42093, graywacke-
42093 slate; 42094-95, conglomerate; 42096
42094 pebbles in conglomerate; all from first
42095 point east of Dog river.
42096

42097 slate near greenstone; 42098 greenstone
42098 schist next to slate; 42099, felsite
42099 cutting greenstone-schist, like some of the pebbles of 42096.

The slate and graywacke-slate specimens very different. 42088-89 wh which might be thought to be slate, as explained on previous page, but whid I thought to be schist, and now feel certain of it.



S.

[illegible] [illegible] [illegible] tunnel [illegible]
conglomerate of [illegible] pebbles
sandstone or [illegible] showing
pebbles [illegible] flattened in direction of
cleavage. Cut by dike of
granite [illegible] [illegible]
crushed [illegible] [illegible]
contact [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]

[illegible] [illegible] dip [illegible] 8 [illegible]
[illegible] [illegible] This cut by granite

Aug. 22nd.

From Mountain Ash river to Michipicoten village the granite continues to the bay next west of Dore or Pickerel river: In this bay the granite cuts the green schist in the usual intricate fashion. There are here two kinds of granite, a coarse pinkish gray granite, and in less quantity the bright red granite. The relations of the two were not studied. At the point east of Dore river the conglomerate noted by Logan, mentioned by Hunich, and described to some extent by Coleman came in. At this place the relations of the conglomerate to a somewhat schistose greenstone are shown in sketch. The greenstone cut by granite occupies the west side of the point. The east side of the point is taken by a schist conglomerate. The schistosity of the conglomerate abuts almost at right angles against the greenstone I am inclined to regard the especially as similar relations are seen on the west side of the point farther north, and an exceedingly contorted dike was seen in the conglomerate.

The conglomerate is remarkably schistose. Many of the pebbles are intensely flattened; so much so that I thought the rock might be an injection conglomerate, and it is certain that some secondary injection has taka

place, and perhaps a part of this is paralleled.

42100 represents the schistose greenstone at this point.

42101 the matrix of the conglomerate.

42102 some of the pebbles from the same.

42103 a lava which may be injection material or much flattened pebble.

While the majority of the pebbles are much flattened, some of them, and especially the large granites, have resisted flattening about altogether; they being resistant solids to which the flowing matrix and pebbles of other kinds have accomodated themselves.

Near the mouth of Dore river on both sides however the conglomerate is seen on the greatest scale. Here are gray granite boulders 2 or more feet in diameter, many kinds of green stone, felsite, quartz, chert, and iron formation material. The granite is very abundant; but the various greenstones together are probably dominant. The unmistakable iron formation is sparse.

42104 represents fragments from pebbles just east of the mouth of Dore river. The schist conglomerates were first noted at the point,- strike N. 70° W.- and at the river N. 80° W. The dips of the schistosity and banding are both practically vertical and identical so far as one could see, just as said

by Herrick. However close inspection shows the usual directions, and therefore the apparent accordance is evidence only of intense mashing. The conglomerate at the point, and east of the river, is cut by granite.
42105 The specimen (42105) is from the little place where the granite and schist after the injection of the former have been folded together, giving most intricate cross-cuttings and irregular relations.

Before the head of the bay west of Gros Cap (Little) is reached the exposures disappear, and we cut across by some islands.

The first of these are composed of the schist-conglomerate; but the last island before reaching the mainland is found to be composed of greenstone-
42106 schist (42106). The mainland just beyond shows the typical ellipsoidal weathering which I have so often correlated with the Archean. Going south along the east side of the point there is a little break where appears
42107 schist or slate (42107), then (42108)
42108 graphitic slate, and (42109) ferrugin-
42109 ous chert. This is again followed by the slate or schist; after which is another little island, and again the spheroidal weathering greenstone appears. No better one has ever been seen by me. The great ellipsoids are in some cases 15 or 20 ft. across (Photo 3 represents same.).

Could not here determine the relations of the iron-bearing material to the ellipsoidal greenstone. The greenstone continues nearly to the end of the point; there is a little bay
42110 in same, more ferrugonous chert interlaminated with some vein quartz. The chert on the north side and west end abuts abruptly against the greenstone-schist, as if faulted against it.
42111 ferruginous slate at old workings on east side of point near south side.
42112 slate or greenstone-schist just to the north.
42113 greenstone north of iron formation. Helen mine.
42114 iron formation north of mine.
42115 ore.
42116 white chert where pitching east of ore deposit at base of cliff.
42117 greenstone-schist or mashed porphyry, south of ore.
42118 from same bounding formation on Ry.
42119 track going west. Then follows ore formation, the specimens being taken in order from east to west; and as dip is east at high angles, apparently from top towards bottom. As dip is high toward mine, a traverse was made from east to west.
42120 chert near 42119.
42121 graphitic slate in Ry. cut somewhat farther west.
42122 chert, in great quantity along Ry. cut, and breccia at west end of exposures near where Ry.

The old workings on the east side of Gros Cap near the south end were next examined. Here the iron formation (42111) is wider and contains more iron than at the other places. The dip is here to the south at about 50° or 60°. The iron formation is in absolute contact with the spheroidal weathering greenstone. No transition; no rock of unusual character. The iron formation is underlain by schist (42112), which appears to grade into the greenstone, and is supposed to be a mashed variety of it.

Most geologists would certainly hold from the localities here that the iron formation is in a bed in the greenstone formation, and such appears to be the relations in the west side. The repitition of iron formation material on the west side may be due to infolding; but the spheroidal character of the greenstone, even though the spheroids are rather flattened, is rather against the supposition.

The spheroidal greenstone extends along the west side of Gros Cap to the villageof Michipicoten, and constitutes the shore, at least as far as the little brook.

Aug. 23rd.

Examined the iron mine about 12 miles from Michipicoten. In almost every essential respect the relations are as at the Ely mines, except that the pitch, which appears to be west, there does not prevent a belt of iron formation from continuing some disyance to the east; how far, I did not learn.

The iron formation dips to the south at a high angle. The belt of iron formation and jasper must be 1/4 of a mile wide. The ore of the Helen mine is exposed by shallow stripping at the east end of the lake where it constitutes a very considerable hill, behind which run higher hills of the iron-bearing formation. The iron-bearing formation is bounded to the north by greenstone (42113, to the south by greenstone or porphyry, much mashed, (42116, 42118, 42119).

The ore is rich drusy ore, which has the characteristic black color and even fracture of such ore (42115), like the best soft ore of the Marquette mines. While the character of the ore at the lower benches is represented by the specimen taken, the surface material is yellow and limonitic, plainly as a consequence of weathering. The iron formation adjacent to the mine is rich in iron (42114), although at the base of the

hill above the mine some granular chert (42116) is found. This chert pitches to the east at an angle of 30°. To the west of the mine along the railroad track the iron-bearing formation is much leaner in iron,- is, indeed, a very lean ferruginous banded chert (42120, 42122)

Here apparently at the base of the formation exposed at the west end of a long cut (the dip is high) is a
42123 breccia (42123) which I thought might possibly be a basal conglomerate for the iron formation, but which upon the whole is more probably breccia. At a high horizon, using the same basis, is a black graphitic slate (42121). This slate, the chert here, and the iron formation, so resemble that at Gros Cap that I cannot doubt their equivalence. It seemed to me probable that the pitch of the Helen orebody is to the west under the lake. My reasons are (1) the topography, the rich ore bodies being usually found below the minor depressions because of earlier erosion, and (2) the observed pitch at the east end of the mine.

The presence of the iron formation and especially the ore bodies below bodies of water, the consequence of differential erosion and especially glacial erosion,- apply to the general statement of topography.

The relative poverty of Canada is partly explained by absence of

formations, like those of Marquette and Gogebic and Mesabi. The Gunflint iron formation is very thin, and on an ancient basement with no slate below belonging in the series. The remainder all the equivalent of the Vermilion.

Aug. 24th.

At Sault Ste. Marie.

Aug. 25th.

From Copper Mine Point, Manamuse,
to Corbey Point. The rocks of Copper
42124 Mine Point are bedded amygdaloids.
42125 The strike is somewhat west of north,
and the dip somewhat south of west.

The next little bay south of
Copper Mine Pt. shows luster mottled
42126 melaphyr or dolerite.(42126) ~~There~~
The second little bay below the
Point shows conglomerate with amyg-
daloid below and above. The same is
shown again inthe next bay to the
south, but here the conglomerate is
thicker and the beds coarser. The
south east wide indentations of the
bays are due to the strike, which
averaged about N. 20° W., dip 20° S. 6
W., and the softer character of the
conglomerates as compared with the
lavas.

The conglomerates contain very
numerous granite, gneiss, and schist
pebbles of various kinds. Indeed,
the material seems to be more plen-
tiful than that derived from the
Keweenawan itself, although in the
conglomerate many basic eruptive peb-
bles were noted. The strike and
dip of the rock is such as to carry
them to horizons, until the band takes
on a N. W.-S. E. direction.

Higher and higher members of the series are seen to the long N. W.-S. E stretch of conglomerate, running from Pancake Point to island 3 miles south of Copper Mine Pt. Here the Keweenawan rocks may be seen striking parallel to the shore, and extending at one place for a mile continuously, and dipping lakeward at angles of 20° to 30°. In larger measure the rocks are lava flows, and where the lavasa are broken through by the waves so that they get at the sides of the flows, one sees the peculiar in-cutting, which Winchell has called "purgatories." It also appeared that some of the rocks were conglomerates, but because of the high swell and breakers it was impossible to come close to the rock.

Cut across from Pancake Pt. to Carboy Pt.. As soon as the Cambrian sandstone comes in the high mountainous district, of which Ste. Memoire is the culminating point, drops off to flat country. The contrast between the level, flat, low-lying, richly wooded, Cambrian, and the rugged, broken, vertically cliffed mountains is most marked.

Aug. 26th.

From Carboy Point, via north side of Batchelwahnung Island, to head of Batchelwahnung Bay; thence south and west along shore to S E. end of bay. For some distance along the north shore of the bay the Cambrian comes to the water, as mapped by Irving; but went north of Batchelwahnung Island to point east of east end of same; thence south of Batchelwahnung Island, showing the Cambrian has the same level, low topography as the mainland underlain by the Cambrian.

To the north of the island the rugged topography of the older rocks comes to the shore. At the point slightly north of east from the east end of the island, found hornblendic
42127 rock (42127) in small quantity, with
42128 granite (42128) in greater force, the latter apparently cutting. Passing southeast across next small bay, the
42129 next point is composed of graywacke
42130 and graywacke-slate (42130). The
42131 next point to the S. E. is also com-
42132 posed of graywacke (42132) The rock is thoroughly indurated, is much seasoned, has a slaty structure, which however accords with the bedding. The strike is somewhere near N. W.-S. E.; the dip is 20° to 30° S. W. The strike was somewhat difficult to determine, but the strike joints run N. 65° W., magnetic. While on the ground I had no doubt that I had to deal with the Huronian slates, as had

as had never seen Keweenawan sandstons so indurated. Certainly the contrast between these and Keweenawan sediments of Manaunee is most marked.

The next point to the S. E. to my surprise I found to be composed
42133 of banded gneiss (42133) cut by granite in the most intricate fashion. The next point is west of south, and opposite this is an island. Here the rock, to my surprise, is amyg-
42134 daloidal, which presumably is Kewee-
42135 nawan. This rock is somewhat ~ It continues along the shore to the south to near where trout stream comes. Beyond the strem is another point before the extreme south of the bay is reached, and here the rock is a most intricate mixture of ancient hornblendic greenstone, banded gneiss of various kinds, and cutting red granite.

I have no doubt that the granite-gneiss-schist of the bay is Archean (Laurentian) That the graywacke is Huronian, I feel almost certain. That the amygdaloids are Keweenawan seems probable. If this is so, Bachschwanung Bay is unique in showing four systems,- Archean, Huronian, Keweenawan, and Cambrian.

It seems probable that the bay is structural, being a minor syncline. The Huronian was all but removed before Keweenawan time. The Keweenawan and Huronian were folded into a westen

plunging syncline, and the Keweenawan of the east and south sides were all but removed.