Northeastern Minnesota: [specimens] 13851-14000, 14501-14511. No. 72 July 16-August 7, 1888

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U. S. GEOLOGICAL SURVEY

FIELD SECTION BOOK

No. 72.

July 16 – August 7, 1888

Northeastern Minnesota.

C. R. Van Hise

13851 - 14000, 14501 - 14511

SURVEY OF THE PRE-CAMBRIAN ROCKS OF THE N.W. STATES.

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 figure attached, showing the amount and inclination of the dip. Denote slaty or other very plainly bedded rocks by lines running in the direction of the strike, with figures and a dip arrow attached as before. In all cases where there is the least doubt about the true bedding directions, 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 as 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.

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, for instance: 4025 250 *N.*, 300 *W.*, *Strike*, *N.* 6° *E.*, *Dip*, 50° *E.* Then follow with as full a description of the ledge as possible.

3. The ruling of the left hand page is also arranged so that a smaller scale can be used. Each one of the black lines may represent a section line and the red lines quarter sections and "forties." The scale of the maps may thus be reduced, if desirable, to two inches to the mile (the ordinary town plat scale.)

4. Collect a specimen from each separate ledge of rock, or wherever there is a change of rock on any one ledge. In case of trips made on foot or in canoes, for long distances, neighboring ledges, unquestionably of one kind of rock, need not be sampled, the position and extent of the ledge being marked on the map, with a note that it is of a rock identical with specimen so-and-so. Under the same conditions small sized samples, trimmed to a uniform size of 2 x 2½ x ⅝ 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 § 3, chapter IV, p. 44, Regulations of the U. S. Geological Survey. In all cases collect chips for slicing. All specimens are to have numbers painted on them, in white on a black background, in the field.

5. 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., etc.

#72

Tower, Minn. July 16, 1888.

T. 62 N., R. 15 W., From Tower we went North from center of the section to about its north line, and then traveled east and west along the north line of Sec. 32. In traveling north over a bluff, there was passed in turn,
13851 a much foliated conglomerate. This foliation
13852 is so complete as to make the rock as
13853 much a crystalline schist as can any rock be. Were it not for the pebbles, the rock might be taken for a Laurentian crystalline
13854 schist. The pebbles are much squeezed, many of them are chert, jasper, black slate, etc. Other granitic pebbles were composed of almost pure feldspar. Just north of this
13855 conglomerate is a belt of ferruginous schist. In some places the schists, conglomerate, and ferruginous schist were found within 3 or 4 feet of each other. North of the ferruginous rock is another belt of foliated green schist, which contains no pebbles, and which is as thoroughly foliated and crystalline as any rock can be.

Is it possible that the Vermilion Lake iron series is the equivalent of the green schist area of the Marquette

Region, and that the Penokee and Ammisk are newer than these series. In this connection, it is to be remembered that the Marquette green schists, below the Huronian Series, containing the productive iron-belt, has within it layers of ferruginous schist.

July 17, 1888.

13856 Micaceous quartzite, from the Falls of Pike River. S.W. 1/4 Sec 3. T. 61 N., R 16 W. The rock at this point is mostly like the above, but it contains, interlaminated with it, belts
13857 of chert, which vary from those which are very minute sizes, to those several inches across. The strike is here W 5° S; dip varies from vertical to 85° S. Merriam's #10176 to 10179.

13858 From S.W. 1/4 of S.W. 1/4 Sec 34, T. 62 N., R 16 W.

13859 S.W. 1/4 of S.E. 1/4 of Sec. 34, T. 62. R. 16 W. Merriam's #8285.

13860 From center of west side

of island in the S½ of Sec 35, T. 62, N. R 16 W.

13861 From south coast line near north and south quarter line of Sec. 19, T. 62 N., R 15 W. Merriam's # 10191

On the mainland, in the S½ of the NW¼ of Sec. 19, T. 62 N. R 15 W, coarse mortar-like
13862 schist alternates with finely laminated
13863 slaty layers. Merriam's # 10197.

July 18, 1888.

13864 From East side of island, in the SW¼ of the NW¼ Sec. 24, T. 62 N. R. 16 W.

13865 From East side of island in West side of Sec. 15, T. 62 N. R 16 W. The rock is a coarse gneiss-like one. Does it belong to the Vermilion Lake Series? Merriam's # 10269-10.

13866 Mica-schist. From the SE corner of island, in the SW¼ of the NW¼ of Sec. 10, T. 62 N. R. 16 W.

13867 Sericite-schist } From west side of island,
13868 Sericite-slate } contained in Secs 3 and 10,

T.62 N. R 16 W. 13867 is south of 13868.

13869 Hornblende-schist & East side of same island, near its north end, in Sec. 3, T.62 N., R 16 W. The rock here contains some minute veins of a granite-like material.

13870 Fine-grained hornblende-schist. From near the middle of the east side of the same island, about on a line between Secs 3 & 10.

13871 From small island at the corner of Secs 33 & 34, T.63 N., R. 16 W. and Secs. 3 & 4, T.62 N., R. 16 W. The rock is here exceedingly foliated and looks like a hornblende of chlorite schist. The rock at the north end of the island contains granite veins several inches across, like the small granite veins found at the location of 13869.

From the above location, the shore of the large island, in Secs 34, 27, 26, 35, etc., T. 63 N., R. 16 W., was skirted. The dark hornblende-schist contains granite veins all the way. The relative amount of granite is

larger the farther north one gets, and on the north side of the island, Secs 27 & 26, forms a very considerable portion of the rock, perhaps 1/3 or 1/2. Going south again, in Secs. 26 & 35, the granite veins become less important. They are found in the
13872 coarse foliated gneiss, at the extreme east point of this island, in the NW 1/4 of Sec. 36, where, however, the granite veins are relatively
13873 small. At the sharp point, (name of rock) just south of the east and west quarter of Sec. 35 the granite veins have disappeared.

13874 From the west point of
13875 the main land, near the W 1/4 of Sec. 36. T. 63 N., R. 16 W. Merriam's #10279. The rock appears to be a schistose gneiss, and in it are found no granite veins.

It is noticeable that the schistose rocks become more foliated as soon as the granite veins appear in them. These veins gradually become larger in passing north, until it forms a considerable portion of the rock. This, in going south again, as gradually disappears. The rocks

marked respectively Vermilion Lake Series, and Green Schist and Granite Series upon Professor Irving's map, do not appear to be sharply separated from each other at any one point. The plainly slaty and conglomeratic material, in passing north, goes through various phases, becoming more crystalline, until at some points granite appears. The schists which do not contain granite, but are foliated south of the areas having granite veins, contain in their stead veins and seams of white quartz. This is true of the island at the corner of Secs. 33 & 34. T. 63 N. R 16 W., and Secs 3 and 4, T. 62 N., R. 16 W., where the minute granite veins first appear; and the white quartz is farther found in the green-schist south of the granite veins. Do the granitic rocks also contain white quartz veins? In strike, dip and foliation, the rocks, which do and do not contain granite along the line where the veins first appear, are remarkably alike. These veins of granite in the schists are extremely irregular in shape, cutting the schist in every direction.

July 19, 1888.

From the location of 13874-75, we followed the main land through Secs. 36, 31, 32, 33, T. 62 N., R 15 W. The rock for this distance is essentially the same as is 13874-75. Our course was then along the east side of Pine Island, the rock being of about the same character, until the NW¼ of the NE¼ of Sec. 4, T. 62 N. R 15 W is reached.

13876 Here 13876, sericitic schist was taken.

13877 Merriam's #10293. A like sericitic schist is found at the SW point of the island, in the south part of Sec. 4. The main body of water of the lake was then crossed, and Ely Island was traversed near the west line of Sec. 16. The specimens

13878 13878-79-80-81-82, were
13879
13880 taken from north to south across the
13881
13882 island. The whole island appears to be a sericitic quartzite, which in one place, 13880, becomes conglomeratic. The pebbles are white quartz, black chert, jasper, etc. Generally they are much foliated and have obscure forms, although in some cases their greatest length do not correspond with the lamination of the

rock. The conglomerate, in the character of its pebbles and in their squeezed condition, resemble closely that along the north line of Sec. 32, just north of Tower. Compare Merricum's 10300 to 10314. The iron mines near the center of Sec 27, T. 62. N. R 15 W. were next visited. The ore occurs in irregular masses in a lean banded jasper. The irregularities are fully as great as in the Marquette or Menominie regions, which is equivalent to saying that it is as irregular as it could well possibly be. The ore seems to be merely a portion of the jasper rock, in which the silica has become so small in quantity that the material is a merchantable one. In places adjacent to the mines the jasper is evenly banded, and in others has suffered the extreme of contortion. Also the solid pieces of pure ore in places show contortions like the banded ore and jasper. Has the quartz in these cases been dissolved out and iron oxide replaced it, or has an original material been replaced usually by ore and jasper and here only by ore? The pits contain a large

13883 amount of foliated schistose rock, which is taken to be an altered eruptive. This material becomes quite massive at times, and has a somewhat granular character, which is taken to represent the structure of eruptive diabase. On the dump pile
13884 a peculiar jasper is found, which crumbles
13885 into minute angular particles with apparent crystal outlines. The material looks like a mass of quartz-crystals, which have been quoted, or heavily stained in their growth with red oxide of iron. This material alternates with bands of ore, just as does the jasper and ore.

In traversing the distance between the mines and the lake, along the north and south quarter line of Sec. 27, the following section is found: First, Jasper containing ore. Second, foliated schist, containing cherty veins; this schist being similar to the green-schist which contains such veins in the north part of the township. Is this schist an altered greenstone? Third, a sericitic quartz schist, like that on the cross-section of Ely Island. Fourth, South of this, and forming the brow of the bluff

which overlooks the lake, is a great ledge of ore and jasper. In places this material is uniformly laminated, but in general it is highly chert. In a single small area may be found several or many complete folds. Do these curved bands represent bedding, or are they a secondary phenomenon? If bedding, there would be proof that the rock has undergone the extreme of folding. It would be quite natural to believe that the same force which made these hard resistant rocks take a somewhat close and irregular folding might be sufficient to give the softer dayey rocks between them and the mines the very strong foliation which they have. Professor Alexander Winchell has arrived at the conclusion that the whole Vermilion Lake belt is but a single synclinal. How is the repeated folding of the jasper beds to be explained? Also in some of the slaty schists, aside from the schistose parting, there is a lamination which shows evidence of sharp folding and probably represents bedding. It

seems to me that the facts point towards such extremely great pressure as to have, in most cases, entirely obliterated the bedding in the ordinary slaty and schistose rocks, and to leave nothing but a parting which is due to pressure; while in the more resistant quartzose rocks the pressure has not been sufficient to obliterate the lines of bedding, although it has produced, even in these cases, extreme folding. The green-schists (presumably modified eruptives) seem also to belong to the series including the iron formation. They are intimately mingled with the sericite schists and schistose conglomerates, which are certainly fragmental sediments. By considering them to be modified eruptives, which were interlaminated with, and often consequently folded with the fragmental rocks, is a satisfactory explanation of their exceedingly close association.

July 20, 1888.

13886 Slate. From extreme NW point of Sec. 29, T. 62 N., R. 15 W. Merriam's #0363. The same slate is found on the west side of the point, in the SE part of Sec 29, T. 62 N. R 15 W. This slate is intersected by a dyke 10 feet in diameter.

13887 A ferruginous slate on the north side of the same point.

13888 Schistose conglomerate. From a small island just off the sharp point of mainland, in the NW 1/4 of the SW 1/4 of Sec. 22, T. 62 N. R. 15 W. This island is a small one, but is entirely composed of a conglomerate, thickly studded with
13889 pebbles of very various sizes. Some of them are so large as to be great bowlders, and from this they vary to those so minute as to be indistinguishable from the matrix. Merriam's #0344.

13890 Ferruginous chert. From the north side of point on mainland of NW 1/4 of the SW 1/4 of Sec. 22, T. 62 N. R 15 W. Merriam's #0341-43

13891 Sericitic schist. On island just across channel from 13890.

13892 Ferruginous schist. From west side of point in the NE 1/4 of Sec. 22. T. 62 N. R. 15 W. Merriam's #10339.

13893 Sericitic schist. From island in the SE 1/4 of the SE 1/4 of Sec. 14, T. 62 N. R 15 W. Merriam's #10337.

13894 Three phases of a schistose rock, which is
13895 conglomeratic or pseudo-conglomeratic,
13896 and contains nests of white quartz at West end of point, in the NE 1/4 of the SE 1/4 of Sec. 14, T. 62 N. R 15 W. Merriam's #10332.

13897 Conglomeratic sericite-schist. From sharp point in the NE 1/4 of the NW 1/4 of Sec. 13, T. 62 N. R. 15 W.

13898 Slate. From west end of point, just north of 13897. Merriam's #10325.

13899 Another phase of slate-rock from same place.

July 21, 1888.

13900 Hornblende-schist. From north side of channel leading from Vermilion Lake into Mud Lake. The SE 1/4 of the NE 1/4 of Sec 11, T. 62 N., R 15 W.

13901 Sericite-schist. On stream leading from Vermilion Lake to Mud Lake, about half-way, probably about the SE 1/4 of the SE 1/4 of Sec 5, T. 62 N., R 14 W.

13902 Massive green-rock. From the point on the south side of Mud Lake, in the NW 1/4 of the NW 1/4 of Sec. 3, T. 62 N., R. 14. W. Irving's #9749-50.

13903 Cherty slate. South side of Mud Lake, in the SW 1/4 of the NW 1/4, Sec. 3, T. 62 N., R. 14 W. Rock like 13902 is found on north side of Mud Lake at the point SE 1/4 of the NE 1/4 of Sec 3, T 62 N., R 14 W. Irving's #9753.

13904 Cherty slate. From north point of east end of Mud Lake, NE 1/4 of NW 1/4, Sec 2. T. 62 N., R 14 W.

Immediately upon leaving Mud Lake, in the passage to Burnt Side Lake, we find rocks which are extremely schistose, containing granite veins. This same schist with granite veins is found throughout Burnt Side Lake. Here the granite veins have in many places a great development, large intersecting veins being shown in the schists and gneisses in a beautiful manner. Frequently whole points, or solid islands also, are composed of massive granite.

July 22, 1888.

13905 Green schist. At point in the NW 1/4 of NW 1/4 of Sec 29, T. 63 N., R 12 W., Long Lake.

13906 Green schist. Point of Long Lake projecting east on the east and west 16th line, in the NW 1/4 of Sec. 29, T. 63 N. R 12 W. Irving # 9774

13907 Green schist. Main land of Long Lake, opposite island which is in the SE 1/4 of SE 1/4 Sec 30, T. 63 N. R 12 W.

13908 Matrix of a conglomeratic rock. From an island in the SE¼ of SE¼, Sec 30, T. 63 N, R. 12 W. Irving's #9779 to #9782.

13909 Hornblende schist. Outcropping on railroad track at cutting near Ely, SE¼ Sec. 28, T. 63 N. R. 12 W. The same kind of rock is taken out in large quantities in mining the ore. The ore is here unlike that at Tower, Minnesota, being a soft hematite, more like the Gogebic ores. A greenish schistose rock is the only material that is taken out of the mine aside from the ore. North of the mines banded jasper and ore is found, and from the latter point, all the way to the lake, the only rock found is the green schist.

July 23, 1888.

Leaving Ely in the morning, we went to the east end of Long Lake, thence into Falls Lake, and from Falls into Farm Lake. The only rock noted in Falls Lake was green schist. About halfway across the portage from Falls to Farm Lake, an exposure
13910 13911 of magnetite – actinolite schist at the height

of the ridge was found, in the NE 1/4 of NW 1/4 Sec. 20, T. 63 N. R 11 W. The rock is exposed by test-pitting and test-trenches and has nearly a north and south strike.

13912 Banded jasper and ore. From large southern exposure about 1/2 mile southwest of the southwestern long arm of Farm Lake — that is, near the center of Sec. 30, T. 62 N. R 11 W., near Merriam's #6683.

13913 Feldsitic schist. North side of farm of Farm Lake, in the NW 1/4 of the NW 1/4 Sec. 29. T. 62 N., R 11 W. The exposures otherwise noted on the west side and southwest arm of Farm Lake are as described by Irving.

July 24, 1888.

13914 Granite veins contained in green-schists. At sharp east point at Entrance of Farm Lake, probably (for more accurate location)

Just below the rapids, at the outlet of White Iron Lake, in the NE 1/4 of the NE 1/4 Sec. 32,

13915- T. 63 N. R. 11 W. the nominal rock is a

13916

ferruginous hornblende schist. In this
13917 schist are seams of impure limonite, and
13919 mingled with vein quartz, the two are seen
13918 together in 13918. The vein material, which conforms in direction with the schistose structure of the rock, has in one place a brecciated appearance, which best shows upon the weathered surface where the chert stands out in sharp nodular forms. Is this true brecciation, due to squeezing, or an appearance due to irregular honeycombing of the chert itself? Both the unaltered and altered material have a close resemblance to corresponding material near Agenda, Wisconsin, on the so-called South Range. The more ferruginous unaltered hornblende-magnetite-schist is remarkably like the Agenda rock of the same character. It appears plain that the iron oxide in the veins has concentrated here by means of percolating waters, which has oxidized iron in place, brought in iron from some other source, at the same time it has decomposed and removed the other original materials present. There seems to be little resemblance to the iron forma-

tions of the typical Marquette, Vermilion Lake, and other iron ranges.

After leaving White Iron Lake, the Mishiwishiwi River was followed, and along it nothing but coarse schists and granite were found, the latter being predominant.

13920 Heavily ferruginous hornblende-schist. About halfway on portage from Mishiwishiwi River to Lake North, which runs from near the center of the NE 1/4 of Sec. 24, to the NW 1/4 of the same section. The specimen is about the center of the NW 1/4 of Sec. 24, T. 63 N. R 10. W. The granite extends about 1/3 of the area on this portage. Then appears a heavy foliated black-schist, which extends to the north side of the ridge between river and lake. At the north end of above trail, on mainland, just opposite to small island appears
13921 13921, magnetite-actinolite-schist, min-
13922 gled with 13922, a ferruginous chert, which resemble very closely an unaltered ferruginous schist at the outlet

of White Iron Lake. The strike of this rock as determined was about east and west, dip nearly vertical. The rock has a banded structure, and the hand-specimen, 13921, might easily be taken as coming from the iron-formation of one of the ordinary iron regions

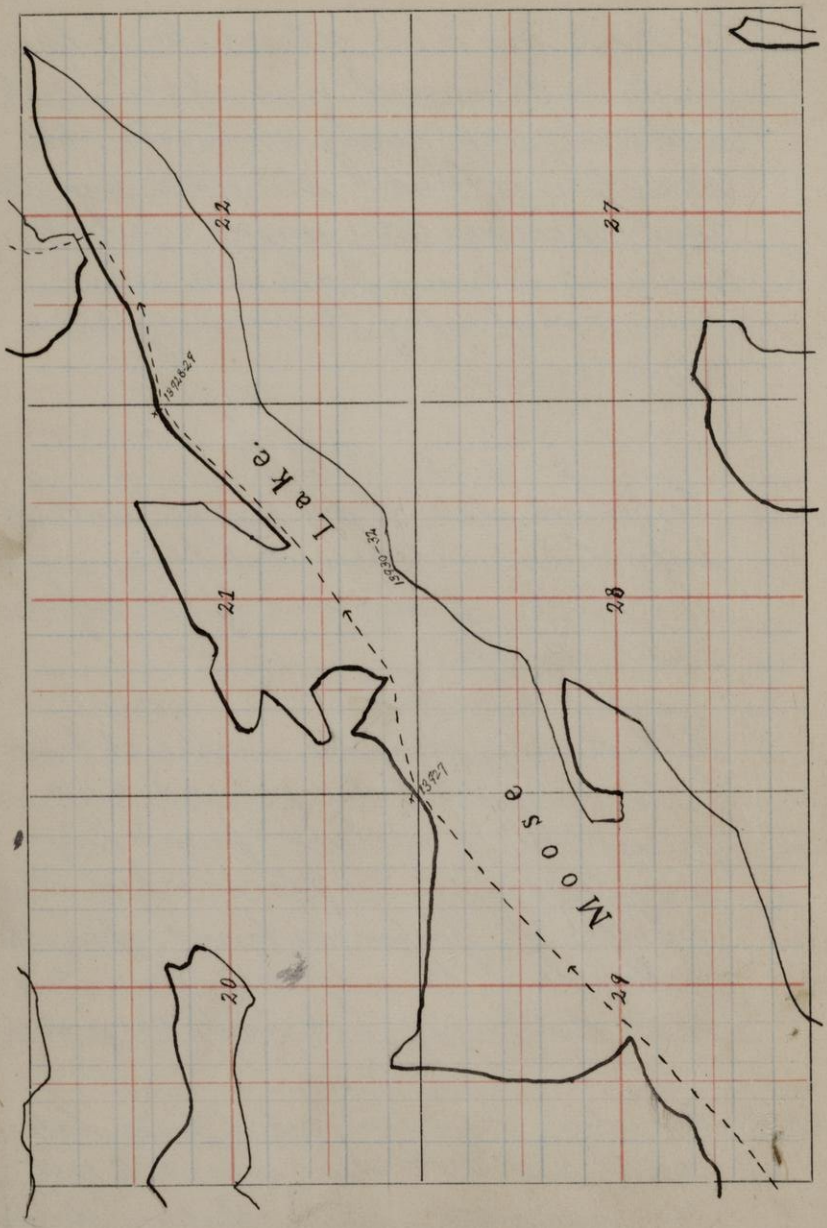
July 25, 1888.

13923 Carbonated slate. From portage south of Jasper Lake and near that lake — that is, near center of east line of NE¼ of Sec 11, T. 63 N. R 10 W.

The high ridge along the southeast bank of Jasper Lake, NW¼ Sec 1, T. 63 N. R 10 W, is a greenstone, or at least I found only greenstone at the two places where I crossed it. Jasper was found upon the north side of the ridge near the water's edge. See Irving's note-book 45 pp. 66-67

13924 Greenstone. From east end of Jasper Lake. The NE¼ of NW¼ Sec 1, T. 63 N. R 10 W. This greenstone is like that on the bluff

T. 64 R. 9 W.



along south side of lake.

13925 Slate. } About middle of
13926 Fine-grained conglomerate } portage from Jasper
to Moose Lake, NE 1/4 of NW 1/4 T 64 N. R
9 W. Irving's 8604-5.

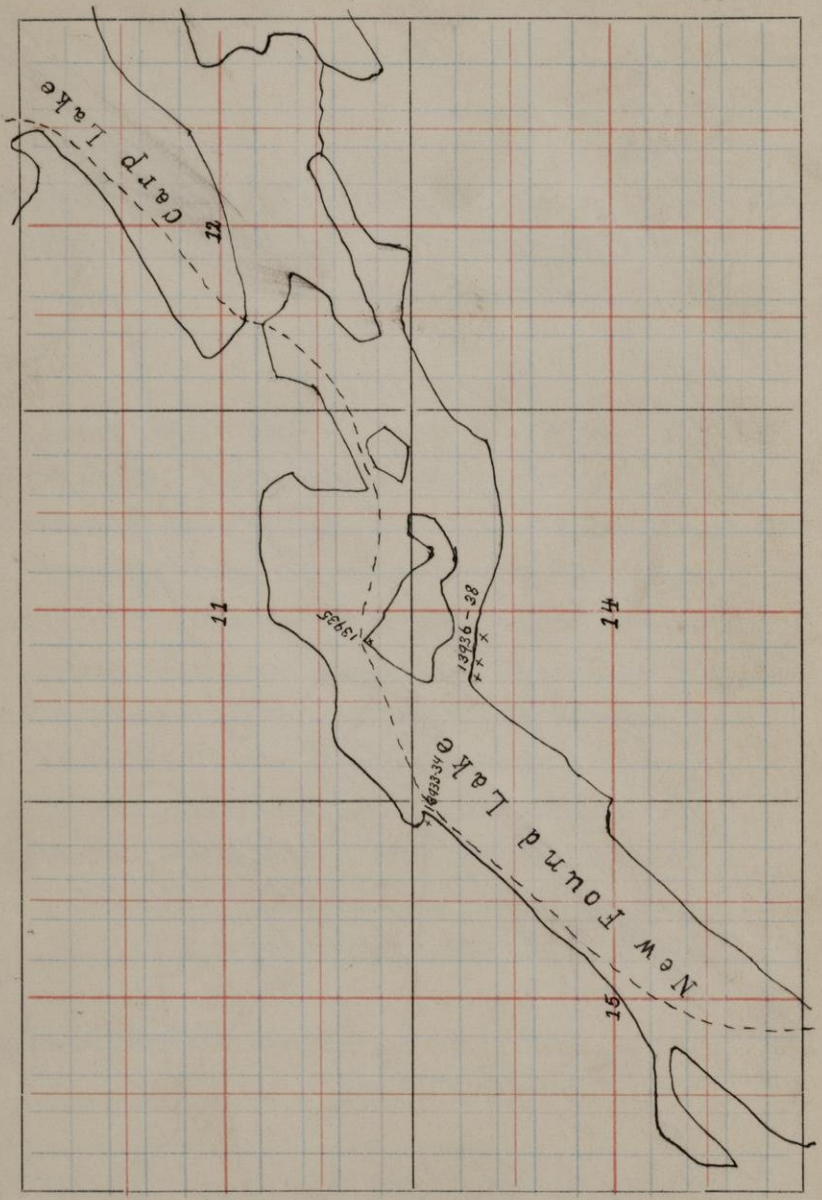
July 26. 1888.

The north shore of Moose Lake, from point just west of center of Sec. 29, to portage in Sec. 22, T. 64 N. R. 9 W., is composed of essentially the same sort of rock, a chloritic or sericitic slate. The rock varies in coarseness, in color, and in degree of foliation. It however strikes with great uniformity north 30° to 40° East magnetitic, and dips vertical. In color, it is green to red. In texture, it varies from thinly laminated or foliated to quite a coarse foliation.

13927 Near NW corner of
Sec 28, R. 9 North.

13928 More foliated phase } From SE 1/4 of NE 1/4
13929. Green slate } Sec 21, where lake

T. 64 N. R. 9 W. MINN.



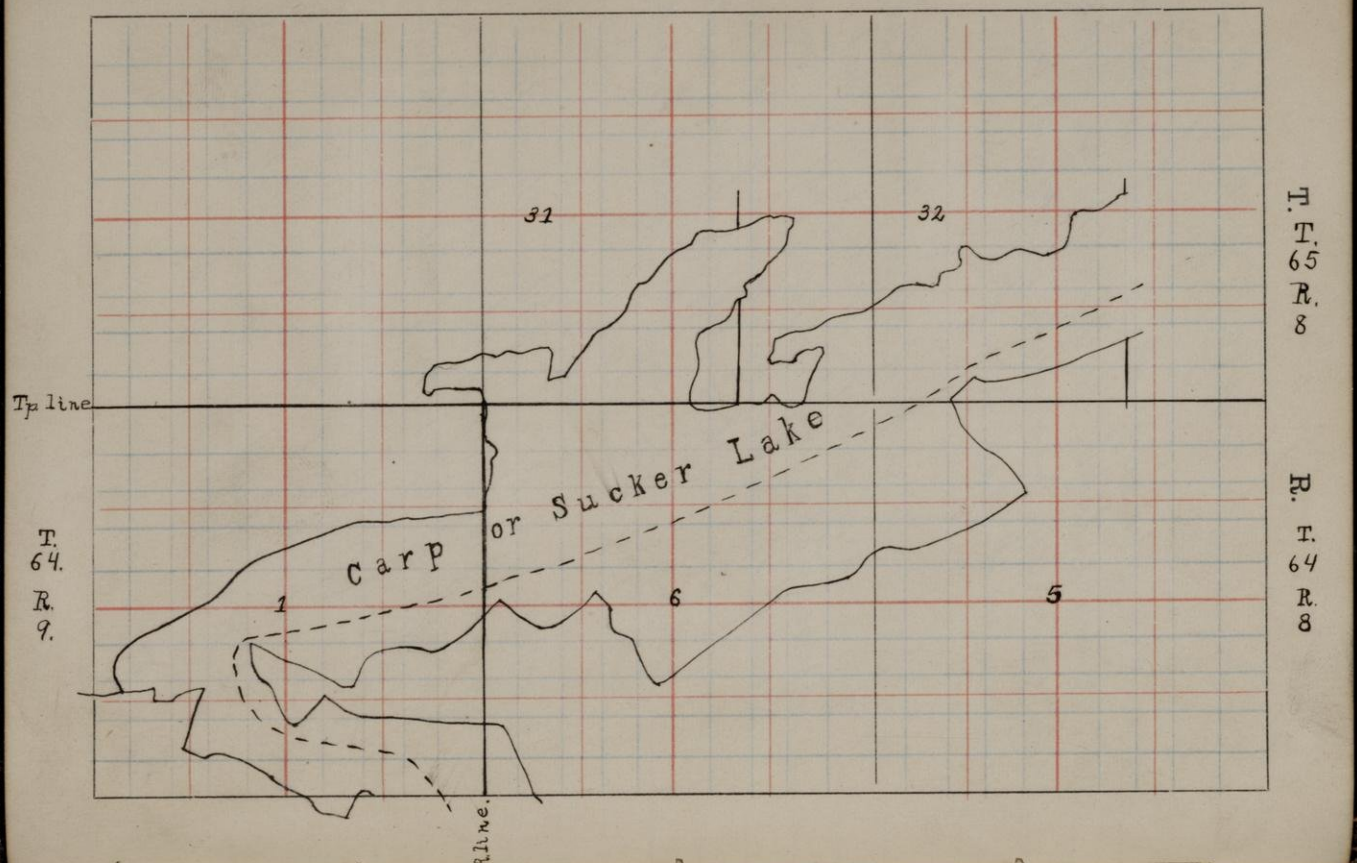
crosses the East line of the section.

13930 Three phases of slate. From south side
13931 of same lake. Collected by Mr Hoskins
13932 between the west side of Sec. 28, and the center of Sec. 22.

Upon both sides of New Found Lake, for some distance slate, like that on Moose Lake, outcrops. At the east end of the lake the most of the rock is a somewhat different character, although slate is here still found like 13927

13933 Slate, and } Show the nature of
13934 Coarse greywacke } the rock in the extreme NE corner of Sec. 15, T. 64 N., R. 9 W.

13935 Green schist. From north point of large island in the SE ¼ of the SW ¼ Sec. 11, T. 64 N. R 9 W.

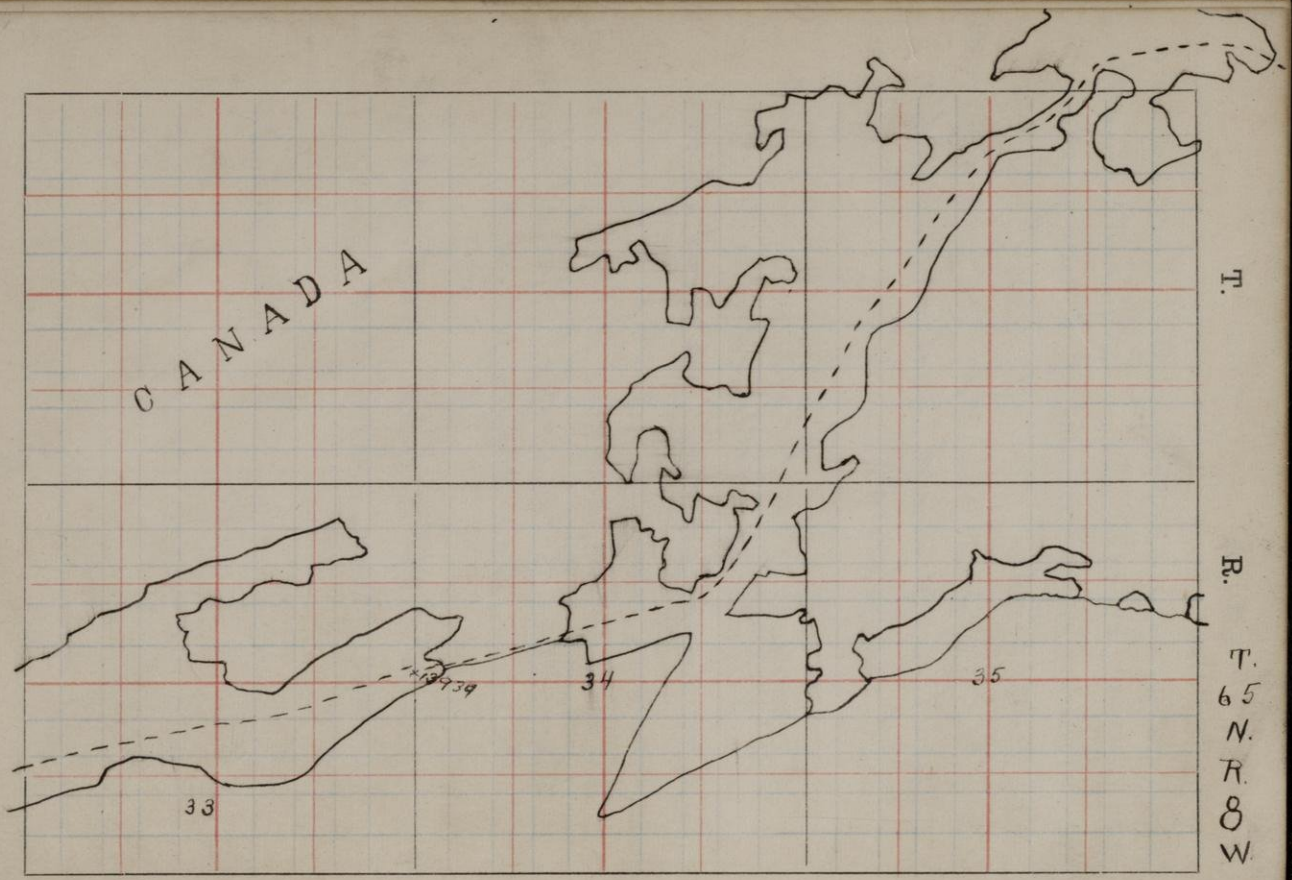

31
32
Tp line
Carp or Sucker Lake
T. 64. R. 9.
1
6
5
R line.
T. 65 R. 8
R. 7. 64 R. 8

13936 Fine-grained conglomerate } Taken West to
13937 Coarse Slate. } East along South
13938 Green massive rock } side of New
Found Lake, Sec. 14, T. 64 N. R. 9 W.
The conglomerate is probably at the north
point of the land, in the NE 1/4 of the
NW 1/4 of Sec 14.

From New Found Lake we went into
Carp Lake and followed the U. S.
boundary to portage at west of the
center of Sec. 34, T. 65 N. R 8 W. The rock
here is slate, similar to that found in
New Found Lake, except that it is in
the main less thinly foliated.

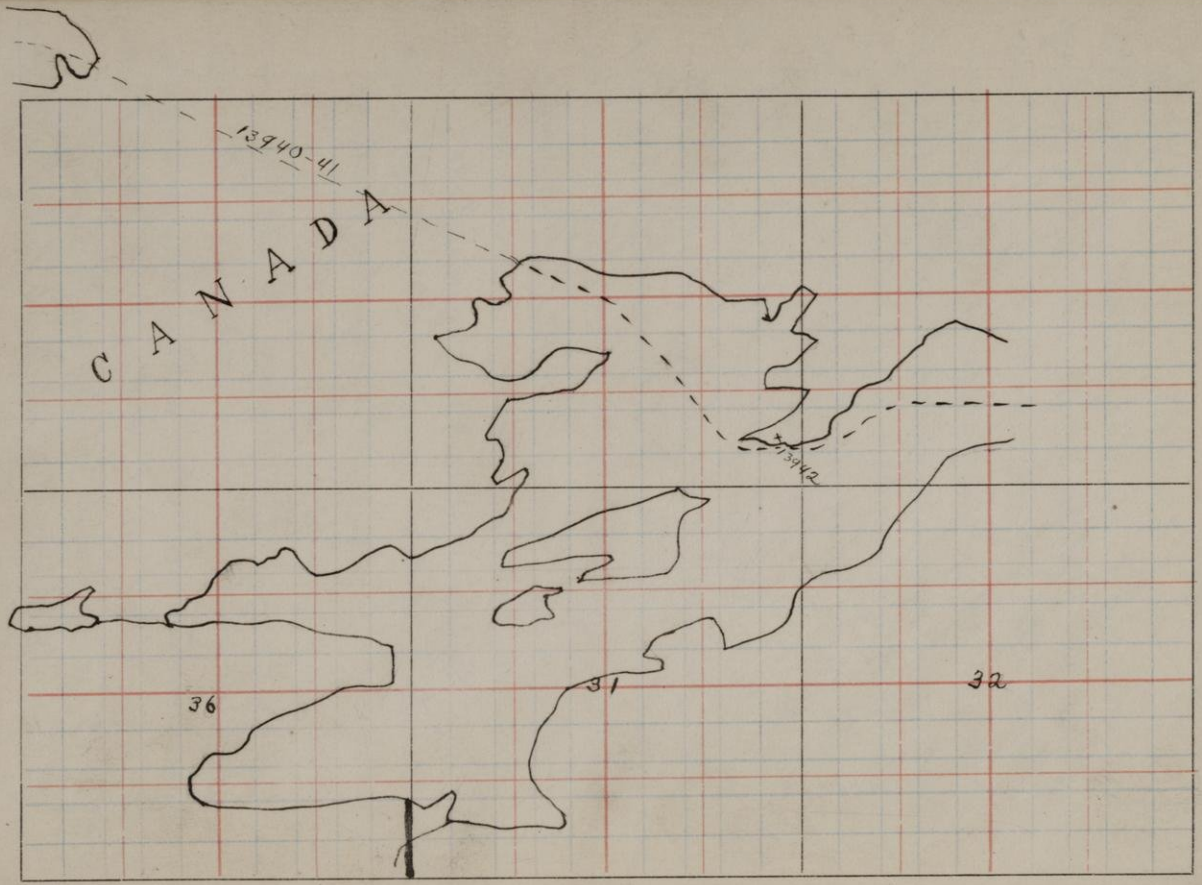
13939 Slate. From island just west of
portage above mentioned

Draw map to locate specimens from
13927 to 13948


CANADA
T.
R.
T. 65 N. R. 8 W.
33
34
35

July 27, 1888.

In passing from the portage in the NE¼ of the SE¼ of Sec 34, T. 65 N. R 8 W, to Knife Lake, the canoe route which passes into Canada was followed. By this route we continued northeast in Carp Lake for about three miles, and then reached the north side of Knife Lake, by means of two portages in Little Lake. The rock for the whole of this distance, until the last portage is reached, is essentially like the slates in the west part of Carp Lake;- that is 13935. See also Merriam's notes. However, at the south side of this lake, the fine and coarse slates are mingled with
13940 chert and (13941) cherty quartzite. The
13941 cherty quartzite and slate are all intermingled in the most irregular fashion, each phase grading into the other in intermediate ones. The portage to the north side of Knife Lake is over the same slate, interlaminated with chert and cherty quartzite, or greywacke, which continues until the black
13942 slate is reached, at the north side of Knife Lake, about North of the west line of Sec. 32,
13943 T. 65 N. R 7 W. The same slatey chert and


1940-41
CANADA
1939-42
36
31
32
T. 65 N. R. 8 W.
T. 65 N. R. 7 W.

13944 quartzite are found at the west point of Knife Lake, which just extends into the NE¼ of the NE¼ of Sec. 28, T. 65 N., R 7 W. In passing from Knife Lake to Kakakebic, the rocks exposed were the same slate and coarse greywacke slate so largely developed in this region. Merriam's 8848 to 8857 inclusive. On Kakakebic Lake there are large exposures of a peculiar dark-colored conglomerate. This conglomerate often varies into a non-conglomerate crystalline schist within a distance of two feet. The conglomerate indeed cannot be distinguished as such upon a freshly fractured surface, unless it is very coarse, because the matrix is as tough as the pebbles and closely resemble them in appearance. This characteristic of the conglomerate is explained when the pebbles are examined. At least 99/100 or more of them are composed of a single kind of rock. In all probability the matrix is but finer particles of the same material, perhaps cemented by subsequent infiltrations or by alterations of the original minerals present in the fragmental particles. These finer

conglomeratic or non-conglomeratic kinds are exceedingly tough and massive. It would, in fact, by any observer be taken for a massive eruptive rock. The conglomerate has a great extent over the lake. It was so frequently located as to show it to be practically continuous for the whole distance along the main shore line in Secs. 34, 35, and the West half of Sec 36, T. 65 N. R. 7 W. The conglomerate was carefully examined at many places, and the coarse conglomerate was found again and again to vary into the finer, or even non-conglomerate kinds within the space of a few inches. That the non-conglomeratic crystalline-appearing rock is a part of the fragmental material, there can be no doubt. The pebbles, as shown by the specimens, are well rolled. Can this conglomerate be in the nature of a tuff?

13945 Fine-grained conglomerate or non-conglomerate phase, in the N½ of the NE¼ of Sec 34, T. 65 N. R. 7 W.

13946 Pebbles from above.

13947 Conglomerate. Point in the center of the S½ of Sec. 34. Merriam's 8861.

13948 Schistose conglomerate. North point in the SE¼ of the SW¼ of Sec. 34. This schistose structure is exceptional in the conglomerate. Is it due to the result of weathering? This is suggested by the fact that the schistose appearance is only found upon the weathered surface. How far can weathering develop a schistose structure in a rock which has been squeezed but which in fresh parts exhibits no foliation?

13949 Conglomerate. The SE¼ of the SW¼ Sec 3, T. 64 N. R. 7 W. Just east of Merriam's 8865. The rock here shows peculiar weathering described by Merriam in 8871.

13950 A schistose green rock. From southwest end of large island near center of Sec 3, T. 64 N. R. 7 W. A little farther north the rock becomes red like Merriam's #8863 The island just west of the center of Sec 3, T. 64 N. R 7 W, also contains material like Merriam's #8863.

July 28, 1888.

13951 Small fragments from matrix of fine-grained conglomerate or non-conglomeratic parts, collected along the shore of Secs. 35 and 36, T. 65 N. R 7 W.

13952 Pebbles collected from the conglomerates along the north shore of the lake, in Secs. 35 and 36.

13953 Exceedingly compact and apparently wholly non-conglomeratic phase of rock which is largely exposed on an island near the center of Sec. 36. T. 65 N.R. 7 W.

13954 Pebbles from coarser conglomerate, distinctly interlaminated with non-conglomeratic seams. The pebbles at this place are large, being 6 to 8 inches in diameter.

13955-56 Porphyry or granite porphyry. Like rock at the east side of Bay in the NW ¼ of the NE ¼ Sec. 36. T. 65 N. R 7 W.

13957 Green schist or slate. Kakakebic Lake. Main land between the NW ¼ & NE ¼ of the

NW 1/4 of Sec 32, T. 65 N. R 6 W. A conglomerate containing schist and granite pebbles was observed on the portage between Kakakebic and the little lake in the SE 1/4 of Sec. 29, T. 65 N. R 6 W.

13958-59 Conglomerates on portage between small lakes in the NW 1/4 of the SW 1/4 of Sec. 28, T. 65 N. R 6 W. The specimens were selected from the finer portions. The conglomerate contains pebbles of granite, in places as much as from 4 to 6 inches in diameter.

A red jasper conglomerate was continuously observed at portage between small lakes near the center of the north line of SE 1/4 of Sec 28, T. 65 N. R 6 W. ~~The shore of Agishki Manissi Lake were followed from small~~ The above observations upon the route followed connects the Kakakebic conglomerate with the Agishki one. The conglomerate of these two large and intervening small lakes is evidently a continuous belt. At Kakakebic Lake no granite

pebbles are found, and but few if any save the one massive eruptive variety. In passing eastward towards Agishki, along the shores of and upon the portages between the small lakes, are found jasper and granite pebbles, but rather sparsely; but when Agishki Lake is reached the granite pebbles are as fully abundant as the green schist pebbles, and sometimes predominant.

July 29, 1888.

The day was spent in a trip from the small island in the SE 1/4 of the SW 1/4 of Sec. 23. T 65 N. R. 6W to Gobbemichi Gonog Lake and return.

13960 Gabbro. Gobbemichi Gonog Lake. NW 1/4 of the SE 1/4 of Sec 31, T. 64. R 6 W. Merriam 8902.

13961 Silicified greenstone, a short distance north of 13960.

13962 Greywacke. near center of SW 1/4 of NE 1/4 of Sec. 31, T. 64. R 6 W. The massive gabbro was also visited on the southeast

side of the lake.

13963 A Silicified gabbro. From this place. Merriam's 8897-98-99. The silicified gabbro, when found in connection with the unaltered rock, occurs in nests in it. It seems that a re-crystallization of the original rock has taken place, producing smaller crystals, the silica coming in at the same time. As a result of this alteration, the coarsely crystalline gabbro becomes a finely crystalline silicified rock. The slates and greywacke on the portage from Agishki to Fox Lake, and beyond Fox to Agimak Lake, are very interesting. Merriam's 8908-16 inclusive. In places they are sharply bowed and contorted, like the jaspers at Tower. They are, however, hard and brittle like them, and, as a result of the folding, they have been shattered. Their contortions are, however, sufficient to indicate that if they represent bedding, that the folding has been very close

The alteration of fine and coarse material is very marked, and this alteration is taken to correspond to bedding. In general, the cherty belts run in straight lines across the ledge. Strike given by Merriam, and the dip is about vertical.

July 30 1888.

The shore of Ojishki Lake was followed from the small island in the SE of NW 1/4 of Sec. 23, T. 65 N. R 6 W. to about the East line of the section, and the rock for this whole distance is the typical coarse conglomerate of the region.

13963 Fine-grained conglomerate. Ojishki Manissi Lake. NE 1/4 of NW 1/4 Sec 24, T. 65 N R. 6. W. Opposite Merriam's 8940-41.

13964 Frog Rock Lake, Near center of Sec 18, T. 65 N. R. 5 W.

13965 Frog Rock Lake. NE 1/4 of SE 1/4 Sec 18, T. 65 N. R. 5 W. About a hundred steps north of Merriam's 8925

(same)

13966 Mouth of inlet of West Gull Lake.
Short distance southeast of Merriam's 8921

13967 Red jasper conglomerate On West Gull Lake.
Location same as Merriam's 16495.

The remainder of the day was spent in the passage from this place on West Gull, through Red Rock, to near the center of Saganaga Lake, on the way to Gunflint Lake.

July 31, 1888.

Was spent in passage to Gunflint Lake from Saganaga Lake, and in taking a preliminary look about Gunflint Lake. All the way to Gunflint from Saganaga we were in the granite.

August 1, 1888.
Gunflint Lake.
(For location of specimens see Merriam's map Notebook 54)

13968 Magnetitic Chert. } From the top of a high
13969 Magnetitic Schist } ridge above the eastern
Bay in north arm of Gunflint Lake.

13970 Lean banded ore.
13971 Concretionary chert.
13972 Chert
} From same place as Merriam's 10582. The cherty bands are here much contorted. They are almost as irregular as the jaspers in the Vermilion Lake Series.

13973 Concretionary chert.

13974 Concretionary chert.
13975 Chert. Showing irregular banding of rock, which is again as in 13970-72. The large bluff from which Merriam's 10583 was taken shows the Gunflint beds in a complete cliff, above which is capped by a thick layer of greenstone.

13976 Coarse-grained stone from near top of bluff.

13977 Greenstone. Six to eight feet above contact with the Gunflint beds.

13978 Greenstone. At contact with iron-bearing rocks.

13979 Ferruginous slate. About one inch below

the contact with greenstone.

13980 Ferruginous slate. A few feet below this contact

13981 Chert. Interlaminated with 13980.

13982 Ferruginous slate. ~~Very~~ Thinly laminated. 20 feet or more below contact with greenstone.

13983 Jasper. Interlaminated with 13982.

13984 Black chert. Interlaminated with 13982-83.

This one ledge of the Gunflint beds contains very many varieties of the rocks of the iron-bearing belt, — about all the phases except the unaltered cherty carbonate.

At the location of Merriam's 1058, the dip was taken, and was found to average about 12° (which way?)

13985 Magnetite-actinolite-schist.

13986 Jasper

It is not certain that there is a ledge here, but from the large number of angular fragments and bowlders of ferruginous rocks which cover the side of the hill, there is little doubt that these specimens belong here.

13987 Slates From a small thinly laminated cleaved slate from a small exposure near the water's edge

13988 Massive black greywacke. From an exposure of some size.

13989 Greenstone. The most of the point is massive and coarse, instead of the amygdaloidal phase exhibited by the specimen.

13990 The rock is here sharply folded. It strikes northwest and southeast, and dips from 10° to 30° to the northeast.

13991 Iron carbonate.

13992 Cherty iron carbonate. The chert is here in the nature of angular fragments. The fragments in the carbonate are often six to eight inches in diameter, and have a rounded appearance at times. The specimen very well exhibits the peculiar appearance of the rock seen upon a large scale. In places the carbonate and chert are as evenly banded as they are here shattered. The bowing of the strata and the shattering are indications of considerable folding. There is all grades between the evenly bedded carbonate and chert and that which is thus shattered. Some of the iron carbonate along the shore is as
13993 regularly banded as is 13992 brecciated. The two phases of rock change from one to the other with great rapidity. The same large fragment broken down from a ledge have perhaps for the most part regularly bedding, and along a line at which it has been banded there is a zone of fractured material. In other cases the chert, instead of being in bands, is in nodules or oval concretionary forms which

13994 when large resemble rolled fragments. Some of these rounded nodules are eight to ten inches in diameter. The same specimen at times exhibits the irregular fashion in which these nodular areas vary into irregular ones and also into bands. The silica here in all these varied forms is evidently of like origin and must have been present before the bowing of the strata which caused the brecciation.

13995 Somewhat altered cherty iron carbonate, which resembles remarkably the cherty carbonates on the outlet of Sunday Lake in the Penokee region.

At a Bay just west of a small stream toward the east end of the lake are found in close connection the Gunflint beds and crystalline schists, with a strike approximately East and west and have a vertical dip. These schists are evidently unconformable with the Gunflint beds. They extend from this point west for quite a long distance upon the north side of the lake, being found just north of the location of 13995. These

crystalline schists and their relation to the Gunflint beds are described by Irving and Merriam.

13996 Ferruginous chert. About 250 or 30 feet
13997 from 13997 vertical foliated schist.

13998 Concretionary ferruginous chert

13999 Cherty iron carbonate

14000 Actinolitic chert and iron carbonate. From near the east end of lake.

It is interesting to compare these flat-lying Animikie iron-bearing rocks to the similar ones in the Penokee-Gogebic Series. The succession across these beds is like that across the iron-bearing belt of the Penokee-Gogebic Series — that is, the most altered phases of rock, ferruginous chert and actinolitic slates are found at or near the base of the belt, while at the uppermost horizons the unaltered cherty carbonates are prevalent. This succession

in the case of the Penokee-Gogebic Range has been explained as due to the fact that the alterations have taken place subsequent to the tilting of the belt. The same reason would seem to apply to the Gunflint Beds.

It is suggested that the lower quartzite of the Huronian at Gunflint Lake is not found, if such exist, because the Series is not highly folded, and its bowing has not been sufficient to cause erosion to bring it to the surface. It is noticeable that the Gunflint beds are not simply flat-lying ones, but are gently bowed almost everywhere, and are frequently sharply bent so that one sees one of several folds in a single exposure. These gentle folds have a chert and iron carbonate in alternate bands, and one cannot doubt that this alternation represents true bedding. Is it not then probable that the jaspery belts in the Vermilion Lake beds which show an extraordinary and a bowing, also represent true

Bedding 2

August 2, 1888.

From Gimflint Lake, the party traveled as rapidly as possible, along the boundary through North, South, Rose, Rose Mountain, Moose, North Fowl, South Fowl lakes and Pigeon River to Grand Portage. As Merriam had already traveled this route and collected specimens, and as the Animike Series here presents the regular interlaminated succession of slates and eruptive flows, no systematic attempt was made to collect specimens or to make observations, especially as it was desired to join W S. Bayley at Pigeon Point.

14501 Ferruginous chert and jasper. The northeast point of Sec 16, on North Lake, T. 65 N. R. 2 W.

August 3, 1888

14502 Fine-grained quartzite. At the west end of Moose Lake. A few rods from lake at the extreme S E corner of Sec 13, T. 65 N. R. 26 W.

August 4, 1888.

The journey was from South Fowl Lake to Grand Portage.

August 5 and 6, 1888.

were spent at Pigeon Point and neighboring islands in company with C. K. Bayley. The time was taken up in attempting to get at the probable relations of the fragmental quartzite, the intervening red-rock, and great gabbro dyke of the point. While the ground was not thoroughly gone over, the general impression was gathered that the red-rock is a material which has resulted from the contact of the gabbro and quartzite. The occurrences were such as to indicate that the quartzite, through a quick transition, varies into the red-rock and the red-rock into the gabbro. The quantity of typical crystalline red rock is far greater than that of the transition zone between the red-rock and quartzite, but this is what one would naturally expect for the whole of the red rock had resulted as a contact material between

the gabbro and quartzite. The typical red rock is completely crystallized and certainly has been in a ~~co~~fused condition. If it is really a mixture of the ~~co~~fused gabbro rock and quartzite, it would be natural that its quantity would be much greater than the narrow belt which is in a semi-fused condition between the quartzite and the red rock.

August 7, 1888

was used in getting to Beaver Bay from Pigeon Point by way of Port Arthur. About a half a mile northwest of the lake at Port Arthur, forming the side of the hill which runs back of the town, are numerous outcrops of iron-formation rocks belonging to the Animike Series. These exposures are not natural ones, but have been made by the excavations and grading of the town. In their character they are identical with the Animike iron-bearing rocks at Gunflint Lake, on the north side of the main sheet of water. The Port Arthur rocks consist

of somewhat altered carbonate of iron, mingled carbonate and chert, and chert, with all grades between these phases.

14503 14503-4-5-6-7-8 show the varieties.
14504
14505 The chert occurs in the same
14506 alternating regular and irregular
14507 manner in which it is found in the
14508 Gunflint beds. 14509-10 show thinly
14509 bedded carbonate and cherty material
14510 precisely like the cherty carbonates in the Penokee Series at Black River.
14511 An exceptional phase of cherty material interlaminated with the other phases. The strike of the rocks is East 20° South, magnetite, and the dip was estimated to be 20° north. This dip is abnormal, and indicates that probably here we have the gentle subordinate bowing within the series which characterizes the Gunflint beds.