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## **Marquette Range: [specimens] 25363-25454. No. 149 1893**

Van Hise, Charles Richard, 1857-1918

[s.l.]: [s.n.], 1893

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U. S. GEOLOGICAL SURVEY  
FIELD SECTION BOOK

9-891

*Marquette Range*

*C. R. Van Hise.*

# 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  $2 \times 2\frac{1}{2} \times \frac{3}{4}$  inches will be allowed, but in all other cases *large-sized specimens*, trimmed to a size of  $3 \times 4 \times 1$  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.



could not locate

#149

25376-80

25401-402-403-404

25410



Dehnbinnig, After noon July 21 '93

Started from Isipsum for  
Summit Mountain. On the  
way examined material from  
pits east of Winthrop in the  
southeast of the northeast of  
Sec 19-47-27. There were not  
specimens of <sup>but show</sup> typical (?) acti-  
clitic slates. We next skirted  
<sup>with side</sup> the large bluff of river form-  
ation in S.W. 32. There were  
found only the broken  
cherts with bands and  
shells of ore such as ordin-  
arily are found at the low-  
er part of Lower Marquette  
formation. They are  
exactly similar to specimens  
collected from the dipinas  
in the morning. We now  
proceed to Summit Mountain  
and pass on the way  
various pits in the same  
cherty iron formation.  
In climbing the summit  
the formation took on a

25363

a different character  
have a slate and gas-  
sory appearance although  
not becoming the typical  
jasper formation. Descend-  
ing the south slope of Summit  
Mt. N.E. 1/4 S. 26 47-27  
we found large exposures  
of typical banded ore  
and jasper exactly like  
that of the Cascade range.  
After passing the jasper  
is a narrow valley but  
still far up in the moun-  
tain where are test beds  
The material thrown out  
is intermediate between  
the jasper and the quartz-  
ite having base of true

25364

jasper inter laminated  
with other bands which  
are ~~in~~ largely mechan-

25365

ical sediments. We now as-  
cended to the next ridge ex-  
amining this and on any other  
ridges and bluffs which to



gation make up the south-  
 -son slope of Summit Mt.  
 The predominant rock is  
 a green crystalline schist  
 which is cut by white

- 45366 schistose granite in a most  
 intricate manner. Some  
 specimens of the granite have  
 45367 a vitreous appearance which  
 might lead one to mistake  
 them for quartzite. This  
 apparently R. M. Jones has  
 done as he placed two  
 of quartzite within the  
 green schist. Both the  
 white schistose granite  
 and the green schist  
 are cut in a most  
 intricate fashion by red  
 granite. Apparently as a  
 result of the intrusion  
 of this last granite in  
 many places the green  
 schists are paginated  
 parallel to the schistosity  
 and contain red feldspar.



the latter giving them an aspect exactly similar to many of the granodiorites of the northern area. The red granite occurs in masses which appear to be great bosses but this may simply be larger dykes, in great dykes in small dykes and minute stringers ~~to~~ which diminish in size until they can be no farther traced. In short the granodiorite in places appears perforated throughout with the granite. The minute alternations of granite and schist give the rock a gneissic aspect and this might lead to the conclusion that this is a sedimentary banding. The whole schistose granite is for a closely like that on the book section at Pat-

met. The broken fragments  
 are ~~very~~ <sup>very</sup> gneissous car-  
 bonate which weathers  
 out staining the rock  
 with iron. For a very  
 similar phenomenon a few  
 observed south of the Cas-  
 cade some formation in  
 the Basement Complex.  
 In all essential respects  
 this Sacrament Complex  
 forming the south slope  
 of Summit Mt. is similar  
 to the northern complex  
 south of Silver Lake area  
 described in notes of  
 today. The only differ-  
 ence is that in the  
 latter place we have a  
 gneiss, while at  
 Summit Mt. we have a  
 sheared granite which  
 may be a shistose gneiss.  
 We now drove north on  
 the Iron Cliff road toward  
 N. Spencer and at 1000.



S.

T.

R.

25375 Specimens of dirty car-  
bonate of lime from  
deep drill hole of Lake  
Superior mine along line  
of one of the ore bodies. Hole  
put down expecting to find  
ore analysis of one gave 18%  
of metallic iron.



equal places in the valleys we found actinolitic slates so common in the valleys of the great greenstone areas S.E. of Joppening. The first

25368 seen were just north of Lake Ogden & near N.W. cor. of Sec. 16. These are reg-

25369 ularly laminated and have S.  $76^{\circ}$  W, D  $48^{\circ}$  S. From an angular block but not certainly in place was taken

25370 specimen of sideritic slate from another exposure perhaps a half mile farther

25371 on was taken what appears to be both sideritic and actinolitic. Just ~~west~~ south of the Joppening road is another exposure of

25372 ferruginous slate, certain

25373 facts of which appear to

25374 be sideritic while narrow bands are cherty and jaspery.

Shpanning. Saturday - 7-27

Thompson and I drove to  
the Luyuria. Here man-

25376 ganes ore occurs with the  
iron ore. Specimens of pyro-  
lusite from this place also  
in the stock pile was found

25377 a piece of opolathite hematite  
needle ore. Going north  
now around the next thi-  
rite bluff we come to the  
Davis mine. Here the ore

is a soft limonitic material  
and this is associated  
with a regularly band-

25378 ed yellow, cherty slate  
25379 which might very readily  
be the sideritic slates

found in the greenstone  
to the south somewhat  
modified. Continuing along

this valley typical outcrops  
of jasper were seen but  
upon getting to the Milwaukee

25380 open pit, a soft, red hematitic  
slate is found which  
scarcely differs at all from the



more altered hematitic  
slate found on the Iron-cliff  
road near the Ponder Mill  
But in the latter place this  
slate seemed to grade into  
unaltered carbonaceous  
slate. Continuing our course  
east we examined a num-  
ber of pits all of which were  
typical cherts and jaspers which

Thompson said were un-  
questionably Lower Huronian.  
One specimen of banded jasper  
was taken from the old Green  
Bay mine just southwest  
of the isolated knob of 60  
miles in the N.W.  $\frac{1}{4}$  Sec. 8.

It was not until the rail-  
road cut on the C.M. & St. P.  
was reached near center  
of  $8\frac{1}{2}$  Sec. 8 that any rocks  
were found which could  
not, without hesitation be  
referred to the lower Huron-  
ian iron formation or  
to altered gneiss. At  
the railroad cut however

25381

the rocks have a wholly different aspect. Here were found  
 25382 ordinary gray macker slates  
 inter stratified with band-  
 25383 ed, cherty ore. This place is  
 described and figured by Bay-  
 ley. We now went north to  
 the little greenstone knob  
 near center of Sec. 6. Here  
 a pit on its flank showed  
 again typical Lower Huroni-  
 an gneiss. A short distance  
 to the east is a large hill  
 of regularly laminated fer-  
 ruginous slates which Thomp-  
 son thought to be allied  
 to the ferruginous chert  
 in the railroad cut rather  
 than with the Lower Huroni-  
 an. However the beds are  
 not examined closely for  
 slates and graymacks, which  
 seems to be the only clear  
 point for discrimination  
 between the little alter-  
 ed phases of the lower iron



formation and the iron formation of the upper. In the afternoon we drove to the Saginaw again examining the section south of that mine. Thompson thought, as I did on the previous visit, that there is a gradation between the jasper and the actinolite slate at the test pit and exposure on the northwest part of the hill south of the Saginaw. After passing the greenstones on the south slope of the main hill a test pit is

25384 found from which quartzite has been thrown. This without any reasonable doubt belongs to the Upper Huronian. West of this pit on the S.W. slope of the little hill down by the camp are large 25385 shafts from which hematite 25386 slate have been taken

in large quantity. These  
 seem to be a ferruginous  
 quartzite rather than gneiss  
 and we could not be certain  
 from their lithological char-  
 acter that they are not at  
 the base of the Lower Huronian  
 Iron formation rather than  
 recombined material but  
 the latter is thought the  
 more probable. A pit  
 just to the south of the  
 above is a fine example of  
 25387 tricolitic strata. (The mapping  
 seems to be erroneous. Certain-  
 ly pits were found which were  
 so located) The presence of  
 quartzite south of the Good-  
 rich and Saginaw very  
 strongly suggests that a  
 north fold occurs south  
 of the main fold by means  
 of which the quartzite  
 enters the valley around  
 the pitch and occupies  
 an unknown area in the



southern parts of Secs 18, 19 & 20.  
 T47 N. R. 27 W. We now drove  
 to the gray rocks which  
 are interstratified with amy-  
 daloid in the northeast of S. 28.  
 The fragmental character of these  
 slates can not be doubted  
 and they are believed to  
 belong without question to  
 the Upper Huronian. While  
 these slates if not examined  
 closely appear to have a regular  
 ex. strike and a northern  
 dip of great regularity. When  
 examined closely they are  
 seen to be intricately fold-  
 ed into a series of sharply  
 overturned folds the axes  
 of which plunge steeply  
 to the east so that while  
 we have only northern dip  
 and ex. strikes the slates  
 are really in the correct  
 attitude to be above the lower  
 Huronian or formation  
 just to the west. Specimen

shows one of the less acute folds  
 this particular one being a syn-  
 clinal. The presence of a return-  
 ed fold here of a minor char-  
 acter compared with the  
 corresponding one of the large  
 fold northeast of the Will-  
 throp makes it very probable  
 that a major folding of the  
 same character has affected  
 this part of the district. If  
 this be true the successive  
 south of the Tazewell and  
 Gordrick would be explain-  
 ed. The test pits east of the  
 Willthrop near the declini-  
 line between Secs 21 & 22  
 were found to contain coarse  
 grained actinolite slate. As  
 at

15389-90

As a result of this days  
 work combined with those  
 of the two previous days  
 the transition from the  
 regularly laminated sider-  
 itic and actinolitic slates



occupying the valleys of the great greenstone area into the ordinary forms of chert and jasper of the Lower Huronian seems almost completely established. That these rocks in the greenstone area are Lower Huronian is indicated by the fact that the valleys containing these rocks are <sup>containing</sup> continuous with these special chert and jasper of the Lower Huronian of the greenstone producing district. Also the fact that with the sideritic and actinolitic slates are no graywackes or quartzites bears strongly against their being Upper Huronian. For with Upper Huronian or formation these graywacke rocks are always associated.

The apparent sparseness of iron ore in the valleys of the great greenstone area is probably connected with the absence of the upper quartzite.

Sunday - July 23 - 1893

Examined again the slates on the south slope of Dionie bluff just north of Lake Bancroft. Found these to be regularly laminated actinolitic and magnesian slates. Went down west on the county road and examined the slates in the northeast quarter of Sec. 7. The major part of the hill here is granitic schist containing which are much watered and stained with hematite and limonite. The rock clearly belongs with the volcanics rather than with the sedimentary slates.

25391



and probably is connected with the greenstone conglomerates and volcanic ash which occur in the section south. The two combined suggest that a minor anticline now rises in the great syncline and brings the green schist series to the surface. This is further suggested by the non-conformity in

25392 Section 18. On the north side of the green schist hill in the 7 are ordinary gray wacke slates which Phillips reports as being crumpled in a complicated way. We now broke across the exposures of gneiss in S.W. 1/4 S. 6 and found them to be typical Lower Permian gneiss. The exposures examined by me were almost vertical. The high dip which here occurs combined with the great width

of area in which exposures occur  
 make at all but certain  
 that the rock formation  
 is folded. Now took road  
 north crossing Co. NW Ry and  
 in a cut just east of the  
 crossing found gneiss, schist  
 25393 which on the wea-  
 thered surface has some-  
 what the porous texture  
 of that in Sec. 7. Entering  
 now the area of gneiss  
 schist we crossed the per-  
 idotite range and contin-  
 ued north nearly to the  
 northern quartzite across  
 Sections 26, 23-47-28. The  
 granite appearing in the  
 northern part is a coarse  
 acid granite. Near the  
 granite area the gneiss  
 schist were found to con-  
 tain small veins of peg-  
 matitic looking granite.  
 But this was not connect-  
 ed at any place with the



main granite mass. Then  
 in ~~West~~ <sup>in Sec 23</sup> to a farm and  
 thence south to the Mich-  
 igan Gold mine we travel  
 Sections 26 & 35 and so to Ish-  
 piring. At several places  
 the coarse granite and  
 the gneiss schist were seen  
 to be cut by a fine grained  
 pink granite of identical  
 character. The largest dyke  
 seen being two feet across.

18

Sleeping. Monday, July 24, 1893.

Drove to ~~the~~ the Michigan gold mine. Seeing a point where the granite and greenochist seemed to be near to fault just north of the west end of a pond in S.W.  $\frac{1}{4}$  S. 26-48-28, we went to the place and found the granite to be intrusive in the schist. In passing from the schist to the granite dykes of granite first appeared in the schist, then the granite gradually became predominant schist layers or anastomosing through the granite in an irregular way. Going on ~~still~~ the schist is only found as angular blocks in the granite and finally the solid granite appears free from schist. The relations are so exceedingly complex that they are difficult to de



scribe. Getting away from the central mass of granite the rock gradually becomes finer grained and resembles the fine grained granite mentioned in notes of yesterday. It is possible that the dykes of fine grained cutting both schist and coarse grained granite merely represent the final stages of continuous intrusive period. In passing from the solid granite to the road a broad zone of schist is crossed then granite of coarse and finally the continuous schist to the south. We next drove to the Dexter Mine in Sec 34 7<sup>th</sup>. Here is a large outcrop of quartzite making a great rounded hill and just north of this is the mine.

The material thrown out is  
 the typical chert and jasper  
 of the Lower Huronian ~~part~~  
 To the N.W. a short distance  
 is a large E.W. bluff of  
 banded chert and jasper  
 with a high <sup>imperfect</sup> almost ver-  
 tical dip to the north.  
 A little way to the S.W. on  
 the line between sections 3 & 4  
 is another long E.W. hill  
 rising in the plain the  
 south two thirds of which is  
 conglom. slate, quartz, ilr and  
 gray rock. Forming the  
 northern slope is typical  
 banded chert and jasper.  
 The conglom. slate band  
~~from~~ <sup>about</sup> 20 feet thick is  
 immediately adjacent  
 to the banded jasper.  
 At this point the uncon-  
 formity between the  
 iron formation and the quartz  
 ilr is not marked. The  
 dip is nearly vertical.



S.

T.

R.

(c) Just at the foot of

but is to the north rather than to the south the quantity thus by a slight overturn appearing to be under the information. To the north of this hill is another hill at least a quarter of a mile long low but rising more prominently at the west end in which is the banded chert and jasper.

(a) Upon the north slope of this hill is the ordinary state of the Upper Heronian. This exposure seems to make certain what was before suspected - that the great width of the jasper outcrops in Secs 5 & 6 47-27 and Secs 3 & 4 47-28 are caused by an antiform fold in the jasper and that the valley between belt of iron formation and the green tree schist is oc-



occupied by the slates of  
the Upper Huronian.  
This is also indicated  
by the appearance of  
chert and jasper in the  
north part of S. 3-47-27  
with outcrops of slate  
and gray rocks between  
this and the Excelsior  
belt of iron formation.  
The appearance of the  
latter formation in  
N.W.  $\frac{1}{4}$  S. 4 makes it  
probable that we have  
here the Eastern end  
of the Westward plunging  
syncline. Now more or less  
noting the quartzites in  
the N.E. of S. 3 and found them  
to have a southern dip  
than those on west of the  
Boston mine and therefore  
Clarkburg. The set-back in  
the granite in S. 30-48-28.  
This area was traversed  
east and west in S.  $\frac{1}{4}$  of S. 30.

It was ascertained that  
 there are here a series  
 of overturned folds with  
 dip to the south as a con-  
 sequence of which the  
 gneissoid granite protrudes  
 in the Huronian slates  
 in the N<sup>W</sup> 331 and is  
 infolded several times  
 with the granite in S<sup>W</sup> 30.  
 The south front of granite  
 in passing from west to  
 east swings to the south  
 by means of a series  
 of sudden projection in  
 the valley between  
 narrow valleys which  
 project toward the east.  
 These are accounted so  
 far as observed by quartz-  
 ite. The contact between  
 the quartzite and granite  
 was found in two places.  
~~in a~~ <sup>both</sup> result of which is  
 a result of overturned  
 folds, the quartzite dips



under the granite at  
 One of the places is in  
 the ravine just north of  
 the westernmost point  
 of granite in S.E. of 25 and  
 the other being more  
 of the tongue of quartzite  
 which starts into the  
 granite area along one  
 of the valleys coming in  
 from the Southern Plain.  
 Quartzite was also found  
 north of the main point  
 of granite showing that  
 this rock probably occu-  
 pies much of the valley  
 in the central part of 8/30.  
 Near the west end of this  
 main valley the quartzite  
 was seen to grade up to  
 slate ~~beds~~ dipping to  
 the south under the  
 granite and the slate  
 thus appearing to be lower  
 in the series. The thick-  
 ness of the quartzite at

this point was estimated  
at fifty feet. The folds in  
the slate gave an opportunity  
to later mining the  
western pitch of the folds  
results vary by 1000 to 2000  
feet. Now the contact of the quartz-  
ite and granite the former  
rock was found to  
be conglomeratic in places  
and to contain large

- 25395 rounded crystals of feld-  
spar and a paragneiss
- 25396 Small pebbles of the gran-  
ite itself.

The foliation of the  
granite gneiss corresponds  
very closely with the  
bedding of the quartzite  
and need doubtless pro-  
duced as a result of  
shearing during the  
folding which followed  
it in parallel to the  
beds of the quartzite.  
This series of overturned



folds explain the sudden widening of the Huronian series in this area.

~~Shippensburg~~ Tuesday.  
Shippensburg, July 25 1893

Drove to the exposures of granite conglomerate north of the Cayman. The contact between this conglomerate and the ferruginous slate was again examined. There is here certainly a minor unconformity but nothing which could not be explained by supposing the granite conglomerate to have been a volcanic product formed in Upper Huronian time and the slate deposited upon it after a slight ero-

S.

T.

R.

*By the slate*



sion. The schistosity of the conglomerate is cut across at a gentle angle for several feet at one place. The conglomerate is weathered in a peculiar pitted form. The pebble like areas are usually subangular although some of them seem rounded. On the weathered surface they have a green or yellow color but when the rock is fractured the pebbles are scarcely distinguishable from the matrix. The rock has strongly the appearance of a volcanic ash but it may have fallen in and been rearranged by water. The slate is imbricated by horizontal and is folded intricately in a minor way the axis pitching to the west of

about  $30^{\circ}$ . Now drove in to the exposures of granitic conglomerate in N.W.  $\frac{1}{4}$  S. 13-47-28. Here a ledge of granitic conglomerate, identical in appearance with that just described shows on its east face a distinct bedding cutting across its schistosity. This bedding at the center of the ledge had S.  $110^{\circ}$  E and D  $35^{\circ}$  W. The ledge as a whole however seems to be the crown of an eroded anticline the pitch of which is that of the dip just mentioned. This is indicated by a slight northerly dip on the north side of the exposure and southerly dip on south side of exposure but more emphatically by many minor anticlines and synclines which have E.W. axes



and a western pitch. The bedding is clearly shown by layers of different degrees of coarseness and of varying color. Some of the beds are of coarse conglomerate, others fine conglomerate, 25397 and other layers quartzite or even slate. All layers alike have a schistosity, cutting almost vertically across the almost horizontal beds (that is as it appears on east face). The schistosity has  $S N 60^{\circ} W$  and  $D 75^{\circ} S$ .

Now drove to the old Excelsior Mine. Here the strike of the slaty quartzite runs N 60° E and S 60° E and at the latter  $S N 10^{\circ} E$  and  $D 30^{\circ} E$ . It appears as though the quartz-

its and slate were mount-  
 ing upon and mantling  
 around the east end  
 of the Chert and Jasper  
 at this place. This is far-  
 ther indicated by the  
 facts that at the east  
 end of the pit we have  
 slate, quartzite, while at  
 the west end and lower  
 down we have ore con-  
 glomerate. Driving north  
 from the Excelsior band-  
 ed Chert and Jasper was  
 seen in the road at in-  
 tervals for perhaps a quar-  
 ter of a mile. Driving on  
 to the St Lawrence near  
 the N.W. Cor. of Sec. 3, the  
 material exposed in  
 the open pit was found  
 to have all the charac-  
 teristics of the Upper  
 Huronian formation.  
 That is it is regularly  
 laminated or slaty if con-



tains very little chert or  
 jasper, has an arena-  
 ceous texture and mi-  
 ter laminated with it  
 ore layers of gray wacke  
 like material. Strike  
 on east and west with dip  
 of cleavage of slaty materi-  
 el on north side of pit  
 70 to 75° and that of  
 more ferruginous layers  
 on south side of  $\delta$  or  
 hanging side  $\delta$  (about)  
 The latter is probably the  
 true bedding. Now drove  
 to Deer Lake furnace ex-  
 amining greenstone con-  
 glomerates on the way. In  
 places and especially  
 just north of the St Lawrence  
 River Miss many of  
 the pebbles suggest a  
 basalt conglomerate that  
 is in the sense that they  
 are water worn. While  
 their outlines are readily

discriminated on the  
 weathered surface the  
 material of matrix and  
 pebbles is so similar  
 that on a freshly frok-  
 on surface the two are  
 scarcely distinguishable.  
 At Deer Lake the con-  
 glomerate appears to  
 have been more strongly  
 sheared as a conse-  
 quence of which the  
 conglomeratic character  
 of the rock is less con-  
 spicuous. While many of  
 the ledges were exam-  
 ined from all sides and  
 from the top not one  
 trace of bedding could  
 be detected. Every where  
 was the same unifor-  
 mity of character and  
 the masses cut more or  
 less conspicuously by  
 the schistosity. If these  
 rocks were matrix depos-



it did they now appear  
in the field with no  
evidence of it. Their  
more probable origin  
would seem to be  
volcanic matter  
laid upon which  
corals had fallen or  
wholly ash is not  
easy to determine.

Again examined con-  
tact between Teal Lake  
quartzite and the  
green schist the con-  
clusions reached be-  
ing the same as  
those of last year.

I was strongly im-  
pressed with the  
dense, homogeneous  
and crystalline char-  
acter of the schist - whether  
it has a white green or  
brown color or where  
having a schistosity in  
a uniform direction

The rounded, glaciated ~~knobs~~  
 retaining their smoothed  
 and grooved surfaces  
 with no tendency to weather  
 to m. pits or other evidences  
 of a heterogeneous com-  
 position. The quartzite  
 near the contact with the  
 schist while having a  
 northern dip has been  
 crumpled in a most in-  
 tricate way by an east  
 and west pressure  
 which causes north-  
 ward plunging minor  
 anticlines and syn-  
 clines. The quartzite  
 close to the contact ~~take~~  
~~on~~ has layers of differ-  
 ent degrees of metamor-  
 phism, it is strongly  
 banded and appressed.  
 The minor folding has  
 broken the ridgid lay-  
 ers at many places  
 the rock becoming a



breccia. The layers of  
 slaty quartzite border  
 the south slopes of the  
 schist and mantle a  
 round it in such a way  
 as to present a very con-  
 fused appearance unless  
 closely examined. It is  
 however always possible  
 to separate the green  
 crystalline schist from  
 the quartzite, for the  
 kind looks. Specimen  
 25401 of green schist adjacent  
 25402 to quartzite. Slaty quartz  
 its from layers directly  
 in contact with schist.

Now drove to the Neal  
 Lake Range and exam-  
 ined the orpimentation  
 and the slates of its  
 western half. The rock  
 of the orpimentation has  
 all the characters above  
 described as found at the

S.

T.

R.

open pit of ~~flint~~ mine



St Lawrence. At one large  
open pit the ore and the  
shadily ferruginous slate  
rest upon a gray rock  
slate. This constituting  
the northern or foot wall.  
The dip of the ore forma-  
tion was estimated  
to be  $45^{\circ}$  to the south.  
The slates of the foot  
wall have a cleavage  
which dips at a much  
steeper angle to the south  
 $60^{\circ}$  to  $70^{\circ}$ , but across this  
cleavage the bedding  
goes at an acute angle  
thus corresponding  
with the ferruginous  
layers. In several  
places at this pit and  
elsewhere, the ferrugi-  
nous layers were observed  
to follow the bedding in-  
stead of the cleavage.

25403

Specimen shows bedding, mark-  
ed by ferruginous layers, and  
also cleavage. From large

The slates and gray-  
muckas to the north were  
also found to have a slaty  
cleavage and the slates  
at many places showed  
evidence of corrugation.

It is therefore clearly im-  
possible to determine the  
thickness of these slates  
from breadth of outcrop  
and angle of inclination.

25404 Slate showing bedding cut-  
ting across cleavage.



Idahopeming. Wednesday

July 26, 1893

We visited the great bluff of actinolite-magnetite schist south of Humboldt. The east end was first examined. Many ledges of this country far more gneissous than mapped by Merriam. A vertical schistosity with strike and dip as mapped by him. However, the most fair of our ledges are or are an alternation of layers which was the true bedding. The structure here is felt most directly across the schistosity that is the strike of the layers is about ~~the~~ north and south, as determined from a series of minor rolls which plunge in a direction south of east. These little rolls have a

tendency to turn toward the  
 north on the north side of  
 the ledge and toward the  
 south on the south side.  
 We appear to have here an  
 anticline plunging south  
 of east, the anticline how-  
 ever being complex. Doing  
 now to the Barron Mnt.  
 found on ascending the  
 cliff that the strike of  
 the actinolite magnesian  
 schist is parallel to the  
 ridge at this place. We  
 followed the crest of the  
 slope southward east up  
 till ~~the ridge~~ on the north  
 side of the cliff just south  
 of Summit. The strike  
 is very nearly parallel  
 to the front of the hill  
 and has thus turned  
 about  $90^\circ$ . Now crossed  
 the ridge toward the south.  
 finding the dip northerly  
 with low strikes until



a little valley was reached  
 near the south slope of  
 the bluff. Crossing this  
 valley the dip is to the  
 south. Following along the  
 brow of the hill toward  
 the Brown the ~~strike~~ <sup>strike</sup> turn  
 toward the north. Crossing  
 the west outlet of little val-  
 ley above mentioned the  
 strike approaches ~~W.S.~~  
 While the above description is  
 true in a broad way the great  
 anticlinal dome has a  
 secondary folding and  
 these ~~tertiary~~ <sup>and so on</sup> and there  
 a quaternary until minute  
 crinkles are reached. The  
 axes of these minor folds  
 correspond with the dip  
 of the Cayson of the dome.  
 Where the turn is sharp at  
 the corners of the hill the  
 schists are extremely com-  
 plex or even brecciated. This  
 is most marked at the

sudden turn on the south-  
west corner. The road north  
of Clarksburg was follow-  
ed to the outcrop of slate  
and graywacke occurring  
along it. These have a  
conspicuous northern dip  
but when examined  
closely it is found that  
the rocks are bent into  
a series of closely com-  
pressed folds. The north-  
ern dips ~~are~~ are not very  
steep and the folds are  
so close as to cause the  
shorter layers to have about  
a vertical dip although  
in some cases steep  
southern dips occur and  
in others steep north-  
ern dips that is the  
folds are overturned.  
Moreover the manner  
of overturning is the same  
as in the quartzite <sup>the</sup>  
adjacent to the granite



in the north. As the  
 sections are less  
 marked in the states  
 than in the quartzite  
 it appears that the con-  
 tinued folds are dying  
 out and this is what  
 would be expected as  
 we approach the centre  
 of the trough.

142 Photo represents  
 one of the folds in the  
 slate one side of which  
 has the usual northward  
 inclination and the  
 other shorter leg has a ver-  
 tical dip.

Champion July 27 1893

Examined the conglomerate on road of Champion mine just south of Actinolite schist and mine east of the Champion. The ma-

25405

25406

trix of the conglomerate is garnetiferous mica schist.

25407

This matrix of a very crystalline character holds very numerous pebbles and boulders of many varieties: crystalline schist, granitic, actinolitic schist, quartzite or quartz schist etc. Some of the fragments or fragment-like areas are great boulders several feet in diameter. Their great size caused me to wonder whether they could be parts of folded layers, but this seemed hardly possible. Specimens show different phases of pebble broken from the fragment. If all are true pebbles there



must have been a prior  
 quartzite for one of them  
 is certainly quartzite.  
 Am not sure that any  
 of the gabbros are actinolite  
 schist. This is one  
 of the most crystalline  
 if not the most crystal-  
 line schist conglomer-  
 ate which I have seen  
 in the Marquette Dis-  
 trict. Drove now to the  
 iron actinolite exposure  
 of Merriam in the west  
 part of Sec. 1-47-29. Found  
 same to be very crystalline  
 and the Northern Expo-  
 sure to have a strike which  
 varies from N.W. on the north  
 side of Exposure to consid-  
 erable west of north on  
 south side as though the  
 strike was swinging around  
 to correspond with that of  
 the exposure to the south.  
 The north exposure is also

folded acutely in a minor  
way, the apex pitching  
to the west with the dip.

✓ 25408 Specimen of iron actinolite from North exposure showing minor folds. In large many of the lesser folds are very acute but could not get specimen.

✓ 25409 Actinolite schist from S. Exposure. The only essential way in which these rocks differ from the actinolitic schist south east of Champion is the presence of mica, particularly in the first

25410 Exposure. The actinolite schists south east of the Champion mine were next examined. They are very dense, retaining their glacial form almost untouched, have bands alternating with varying amount of silica and thus vary from light green to



Cherty white or weathered  
 surface and are little  
 folded in minor fashion.  
 They have rather regular  
 structure and a north-  
 ern dip. Almost immedi-  
 ately to the north of these  
 are actinolites are expo-  
 25411 sures of Mica Schists which  
 have a different banding,  
 an irregular weather-  
 ing certain constituents  
 dissolving out and giving  
 the rocks a rough ridge ap-  
 pearance no difficulty in dis-  
 criminating between this  
 and the actinolite schist  
 in the field. The I.A. seems  
 to be entirely cut out by 25-  
 411 and the schist conglom-  
 erate before the Champion  
 mine is reached. The gran-  
 ite also takes a northward  
 swing just east of the mine  
 so that it seems to stand  
 allwart the actinolite schist

Going back into the Ardennes  
 most of the knobs are found  
 to be granite, but certain of  
 them are schist and this  
 in some cases is cut through  
 and through in the most  
 intricate fashion by the  
 granite. In some ledges  
 one rock is predominant,  
 in others the other. Also  
 in the granite are blocks  
 25712 of schist. Spurrer shows  
 schist or gneiss cut by gran-  
 ite taken southeast of Champin Mine.  
 Now made section near quar-  
 ter post between Sec. 30 & 31-48-29  
 all along the south side  
 of the ridge was found ac-  
 25713 trolite schist which is  
 hardly distinguishable from  
 that south east of the Cham-  
 pin. It seems a little  
 more siliceous, is less  
 dense and coarser grained.  
 but could not certainly  
 discriminate two in the field.



yet the two may be totally  
different.

- Going north, after a short  
25414 interval appears actinolite  
25415 is gray rock which is  
certainly fragmental and  
belongs to the upper series.  
Going still farther north  
25416 rock found chert or porac-  
ulite. This ~~rock~~ is much  
brecciated by folding and  
25417 north of this is quartzite  
and still farther north  
at the end of the exposures  
25418 Conglomerate or breccia  
25419 at quartzite. This rock  
much resembles a conglom-  
erate having fragments  
of quartzite, but yet  
it seemed rather more  
like a breccia. Between  
the actinolitic ~~schist~~ and  
the following rocks there  
is certainly a very sudden  
break. All the latter are very  
crystalline; the schist locally

does not correspond with the bedding in some cases if any and the brecciation and schist conglomerate show evidence of shearing.

The south face of the south-east ridge was examined in places at the forks of the road where is located the old Champion Furnace and everywhere the

25420 actinolite schist was found.

25421 These form just above the old furnace. The strike here is nearly southwest and northeast and there has been pronounced minor folding although the general strike is as indicated.

Now went north to the old mine in S.W. 1/4 S. 29. Here took to the rock pile  
25422 ac. thin siliceous ~~schist~~ slate.

Drove on to the great descending ridge where is another mine and looking



across valley which seems  
to extend along nearly east  
and west, saw the wall  
of Granite forming the  
boundary of the Hero-  
man. The ridge of northern  
actinolite slate seems  
to differ from that south  
east of Champion in the  
coarser grained variety  
character of the actino-  
lite, in having black  
layers

51

Michigamme Friday - 7-28

Visited the large exposure  
of mica schist in S.W. 1/4 S29  
South of Michigamme.

25423 Found the mica schist here  
25424 to be garniferous and staurolitic and very crystalline.

25425 Throughout it is vein-  
<sup>in a micritic way</sup>

25426 ed with a granitic looking

25427 material. In the fine veins

this seems to be merely  
the altered schists but in

25428 some places the material  
appears to be clearly granitic

The cleavage is nearly vertical and cutting across  
the cleavage are <sup>faults</sup>  
which are little more than

25429 a micaceous quartzite. They

25430 appear to be imbricated

through and through  
by the granitizing

as though the "granite" juice  
had penetrated the space be-

tween the quartzite particles  
and had thus produced fold-



spar in the rock when it could not do this in the more dense mica schist. These feldspathic micaceous quartzites on the weathered surface. Dor

granitic but they are clearly but metamorphosed coarser beds. The dip is judged from these beds to be from  $45^{\circ}$  to  $60^{\circ}$  or  $70^{\circ}$  to the south rather than nearly vertical. Some of the beds are of intermediate composition and these have bands differently stained with red feldspar.

- 2542 Gray rock schist intermediate between the mica schist and the quartz schist. The rock is also cut through by veins of coarse pegmatite. These are perhaps more truly quartz
- 25432
- 25433

veins carrying feldspar.

Although examined very closely I could not convince myself that igneous injections had been introduced from the outside. It seems to me that the facts are rather explained by water action and that the rocks are still ones to which the term metamorphism is applicable. The whole rock seems to have been permeated by hot solutions which introduced new minerals and especially feldspar and quartz in all spaces whether between the grains along minute cracks or in fissures. Also in the rock are curious oval con-  
25434  
cretions. In many cases the centers of these decay more rapidly than the leaving holes on the weathered surface



In the afternoon made section across the mine and examined outcrops between the greenstone and the granite north of Michigamme.

Beginning with the greenstone the next rock to the south is red jasper dipping in general at a high angle to the south —  $70^\circ$ . The strike at one place back of the mine is  $N. 80^\circ W.$  At this place the jasper shows a slight <sup>giving</sup> a dip varying from  $35^\circ$  to  $45^\circ$  South. This about the same as that at the mine. and the locality is not so near the greenstone as the <sup>which</sup> gave higher dips. The jasper varies from dark red to light red and has the usual bands of hematite. It differs in <sup>from most</sup> from most jasper in having <sup>very</sup> bands of the fine jasper six or eight inches in width <sup>entirely</sup> from iron bands.

The jasper is almost arena-  
cous in appearance and  
when fractured breaks a-  
long the crystal faces which  
as shown by the  
innumerable glittering  
facets seen when held  
in the sun. Upon nearing  
the ore bodies the red jasp-  
per bands fade into those  
having a white color. This  
appears to be a result of  
shading. Between the  
white jasper and the red  
may be seen layers.

23437

23438

which contain both white  
and red jasper. The same  
phenomenon have been  
observed at Republic ex-  
cept that at this place the  
white bands are more re-  
mote from the ore than  
the red bands. Up on the  
jasper and belonging with  
it in small part at least  
is the magnetic ore bed,



but most of the ore body is ap-  
parently in the recombined  
formation as shown by the  
fact that in one place the  
conglomerate goes entirely a-  
cross the ore horizon. Above  
the ore is a great gasper con-  
glomerate the matrix of which  
is largely ore. (In specimen  
pibble is necessarily small)  
Many of the gasper pebbles  
are six or eight inches across  
and because of the peculiar  
of the original ore the  
most of them are pure gasper.  
This conglomerate reminds  
one of the Goodrich con-  
glomerate but is different  
in the respect that the  
last the gasper is laminated  
with ore bands. The conglom-  
erate rather abruptly ends  
and is overlain by quartzite  
and this grades up into  
actinolitic graywacke and  
then into

25443 this into actinolite schist.

25444 From 25440 to 25444 is a continuous exposure and the gradations are insensible. The most actinolitic and magnetitic layers are interstratified with fragmental phases. In this cross section the Upper Marquette may be seen folded repeatedly. (See Figure)



Two anticlines and synclines occurring within 20 feet.

Just to the south.

25445 not more than fifty feet is  
 25446 typical actinolite slate  
 25447 exactly like that north of  
 Champion. It has all the  
 qualities described of that  
 actinolite and also the re-



markable toughness parallel  
to the schistosity which  
was mentioned in the  
case of the Champion. It  
is corrugated in a most  
complex fashion in minor  
rolls with horizontal axes.

Generalization. - The  
coarse actinolitic slate  
and schist are Upper  
Marquette and the  
ridges running from Mill-  
gamma to Champion  
belong together, whether  
the actinolitic schist south-  
east of Champion also be-  
long here has not yet  
been determined.

Going now north of the  
greenstone the first expo-  
sure found is garnetiferous  
25448 actinolitic schist. A little  
farther away from the  
main mass of greenstone

and along the strike to the east is micaceous. quartzite or quartz schist. which dip away from the granite at a flat angle and also pitches to the east. One of the exposures shows a base of granite with the schist overriding it for the most part and on the north the dip is  $5^{\circ}$  or  $20^{\circ}$  north while on the south of the base the dip is almost flat. Evidently the intrusion of the granite has influenced the dip of this rock. Also dykes from the base cut across the layers of quartzite in finding itself between the layers in the most intricate fashion. ~~Going~~

Going to the north toward the granite the quartzite dip to the south at a steep angle away



from the granite.

The granite is cut by numerous dykes of later red granite but none of these could be found in the quartzite, mica schist or gneiss.

### Generalizations:—

1. The upthrowing of the great mass of greenstone has caused an anticline in the ordinary slate. This is supported by the higher dip of the gneiss near the greenstone than the jasper Lower Marquette by the north dips and by the same affects produced by the minor bosses in the micaceous quartzite to the north.

2. Probably the jasper lacks but little of being

brought near the surface  
on the north side as shown  
by the actinolite schists  
which appear not to be of  
great thickness and on  
the south but just above  
the Upper Conglomerate.

3 Between the green-  
stone and the granite  
is a synclinal

4 The granite is the oldest  
rock of the district as is  
shown by the red dykes  
which are later than the  
granite and almost cer-  
tainly older than the  
series

5 Is it not true for the  
whole district that the  
exposures of Lower Mar-  
quette are due to the  
granite intrusion  
South of Niagara and  
Skeppring are Lower Huronian  
and granite. West of  
Skeppring the Upper  
Huronian formation must  
be in main valley



Michigan July 29.

- 25449 Jasper back of Spurr  
25450 Banded white jasper at  
mine.  
25451 Conglomerate just above  
the ore. Contains boulders  
of banded material like 50.  
25452 Actinolite-magnetite <sup>split</sup>  
just north of 25449 in rat-  
leg. Dip to the south apparently  
under 25449.

Drove to the Spurr mine and  
found it to be in substance  
a duplicate of the Michigan.  
Just below the ore is the pe-  
culiar banded white jasper  
(25450) and ore. A short dis-  
tance south of this is the typ-  
ical red jasper. Just south  
of the ore comes the pit in  
upper conglomerate. This con-  
glomerate differs from that at  
Michigan in that the  
fragments are wholly from  
the white jasper. This, taken in  
connection with the occur-  
rence at Michigan, as  
though the two forms red-  
and white existed as such  
before the Upper Mesquite  
Series was deposited, either



this or else the secondary ef-  
 fects have been of like  
 character in both the or-  
 iginal and derived rocks.  
 The first thing seems the  
 most plausible but the  
 latter may be the true one.  
 A very short distance north  
 of the Jasper is actinolite  
 schist of typical charac-  
 ter belonging to the Upper Hu-  
 roman. This dips under  
 the Jasper apparently  
 but is doubtless pure  
 fold. Its appearance  
 at this point suggests  
 that the true Jasper band  
 is fairly very narrow.  
 And perhaps it does not  
 extend much west of the  
 spur if any, being over-  
 hidden by the Upper Series.  
 The fold shows the series  
 of rolls which make the  
 actinolite schist dip to  
 the north, and south half  
 a dozen different times  
 as observed in the high  
 hills just west of the round



house extension to the Spurr.  
Evidently the folding of the  
Upper Huronian is of a very  
complicated character.

To the north of the actinolite schists just mentioned and about half way between the Michipicau and the Spurr, the true jasper was found hanging on the flank of the elevation the crest of which is the greenstone. Thus the jasper horizon may run all the way from the Michipicau to the Spurr. Or along upper as detached small lenticular areas.

Returning to the spot visited last night north of the Michipicau mine greenstone, the mica schists in a place a little further along the road to the east were found dipping toward the greenstone which appears after a very short interval not more than 20 feet to the south. This suggests that the

intrusive greenstone in places has broken through without pushing up in a marked degree the mica schists. At such places there is displacement of the sedimentary strata on opposite sides of the ridge and doubtless this is the case to some extent all the way.

In the afternoon examined the conglomeratic slates at Clark'sburg and the greenstone and greenstone mylonite in Sec 17 Southeast of Clark'sburg. At Clark'sburg Sta 53 the actinolitic slate is inter laminated with ordinary graywacke slates and this grades in almost continuous exposure up into a conglomeratic slate closely allied to the greenstone conglomerates. If indeed it is not a phase of them.



This conglomerate has pebbles of gneiss tone and also occasionally ones of banded chert. The conglomerate is distinctly bedded and corresponds in strike and dip with the slates below. From the topography this belt of actinolite slate and conglomerate appears to be a continuation of that north of Champion although the valley of the Escanaba breaks the continuity.

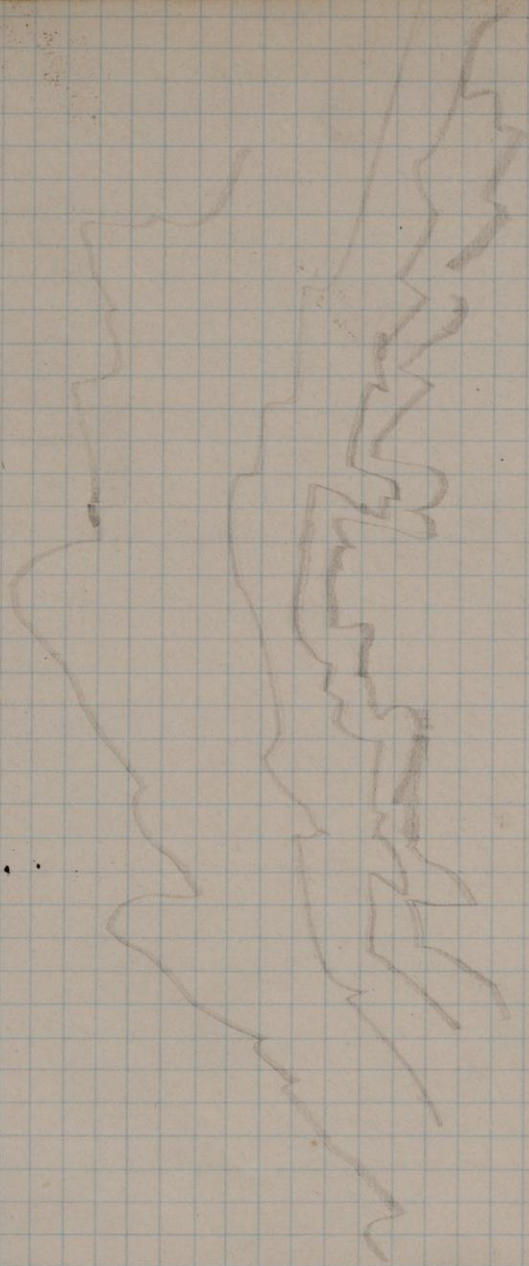
Going now to Sec. 17 the ledges in N.W.  $\frac{1}{4}$  were found to be massive greenstone. Passing east of the small stream near the  $\frac{1}{4}$  line greenstone conglomerate comes in. In one ledge near border between greenstone and greenstone conglomerate one end seemed to be massive greenstone.

60

Going north the rock takes on gradually a distinctly conglomeratic character. In studying the greenstone and greenstone conglomerate about Clarkesburg and Humboldt under the microscope it was difficult to tell the massive greenstone from those which have porphyritic characters. The significance of this apparent transition is not clear.

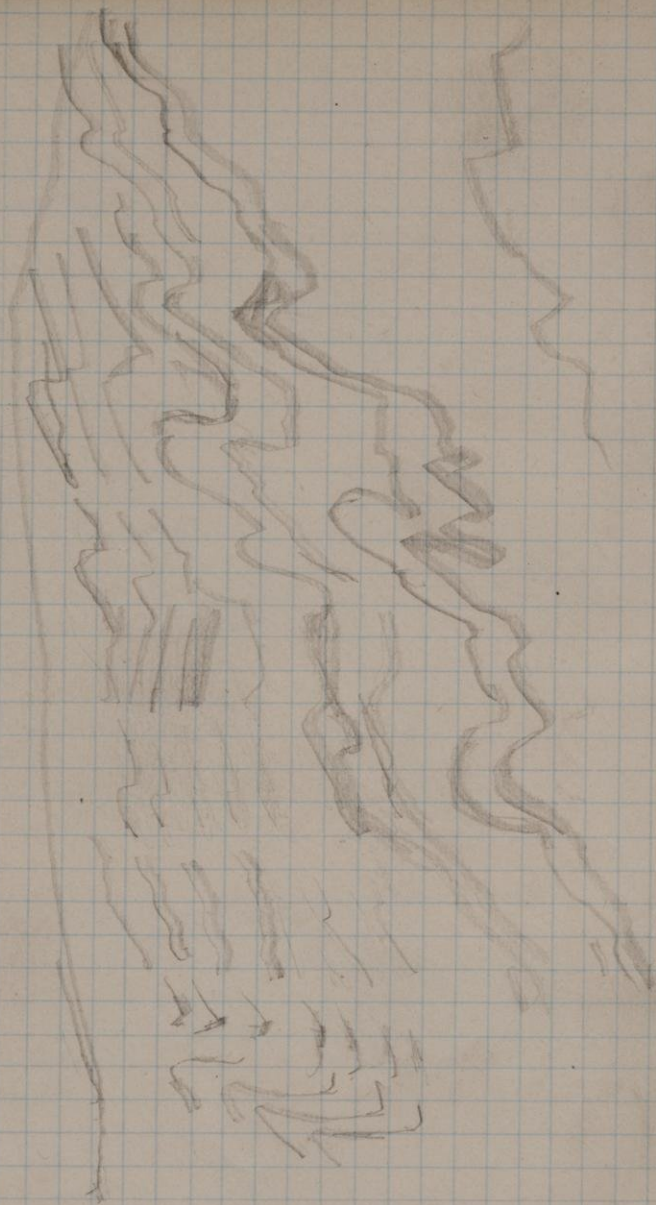
It appears from the study of different days that the volcanic material which starts in north of the Saginaw and continues as an almost unbroken belt to Champion. The center of the volcanic activity and the great north of the belt being in sections 7, 8, 17, 18, 19 & 20-4/28



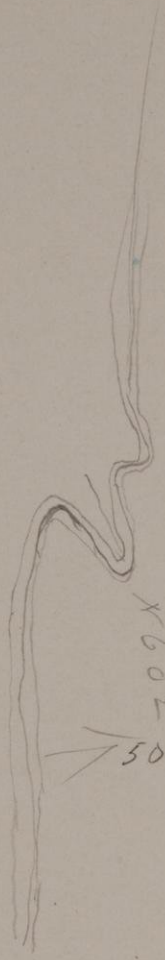


The great mass of green-  
stone here and the volcanic  
fragments suggest that  
~~the~~ some where in this  
vicinity was an Eocene  
Harriman volcano proba-  
bly an island. The vol-  
canic products flowing  
in the water were depos-  
ited with ordinary  
sedimentary material  
and thus the regularly  
bedded appearance of  
many of the rocks and  
their inter-termination  
with and gradations into  
the ordinary Eocene  
slates.





3



50

309X

7

M<sub>1</sub>



I.C. 513 8180°2 D 45°N

S.S. 81165°N D 45°S

