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Marquette Greenstone belt, Michigan: [specimens] 11610-11803. No. 56 July and August, 1886

Williams, George Huntington, 1856-1894

[s.l.]: [s.n.], July and August, 1886

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U. S. GEOLOGICAL SURVEY
FIELD SECTION BOOK

No. 56.

July and August, 1886

Greenstones, Marquette.

G. H. Williams.

11610-11803.

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 line 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 $2 \times 2\frac{1}{2} \times \frac{3}{4}$ 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 § 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.

6. Forward this note book, as soon as filled, as registered mail matter, to R. D. IRVING, U. S. Geologist, Madison, Wis.

Field Notes of Geo. W. Williams
asst geologist U.S.G.S.
and W. S. Bayley, assistant

Marquette + Negaunee, Mich -

July 12th to Aug. 6th
1886

Book I.

Maps to go in this book -

Legend of immediate or vicinity of Marquesas - Light House
Punta de Richie Islands etc

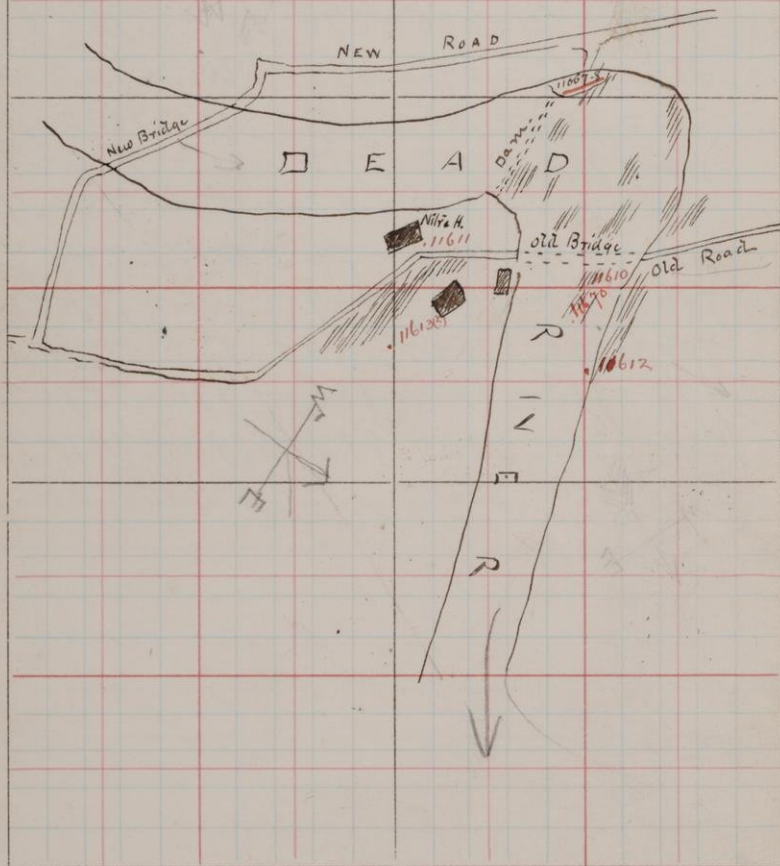
Numbers of microscopic sections -

11610 - 611 - 612 - 613 - 614 - 615 - 616 -
617 - 618 - 619 - 620 - 621 - 622 - 623 -
626 - 627 - 629 - 630 - 631 - 632 - 633 -
636 - 637 - 638 - 641 - 645 - 646 - 647 -
648 - 649 - 651 - 652 - 653 - 654 - 658 -
659 - 660 - 661 - 663 - 666 - 667 - 668 -
671 - 672 - 675 - 676 - 678 - 679 - 680 -
684 - 687 - 691 - 694 - 695 - 696 - 699 -
700 - 703 - 705 - 707 - 708 - 710 - 711 -
712 - 713 - 717 - 718 - 719 - 720 - 721 -
724 - 725 - 726 - 730 - 734 - 735 - 736 -
738 - 739 - 740 - 741 - 742 - 744 - 745 -
746 - 747 - 748 - 749 - 750 - 754 - 755 -
756 - 758 - 759 - 775 - 774 - 776 - 778 -
779 - 780 - 781 - 785 - 786 - 787 - 788 -
789 - 790 - 791 - 792 - 796 - 797 - 798 -
799 - 800 - 802 -

T.

R.

Lake Superior Powder Mills
Dead River
(cf. p. 20)



1

Monday, July 12th 1886. (afternoon)
Roved from Marquette to the mouth
of the Dead River and up this stream
as far as the falls at the Powder
Mills. Here is a very fine exposure
of granite (the prevailing rock) in
the most complicated relations with
the greenschists or schistose green-
stones. Both are interlaced in a
direction nearly E-W. Both are also
lenticularly schistose ("flaserig") by
pressure with nearly perpendicular
dip.

- 11610 Schistose greenstone. stream bed at the Old Bridge.
- 11611 From a narrow schistose greenstone dyke in the
granite occurring beside the Nitre House.
Strike E-W.
- 11612 Schistose Granite. Lower part of the rapids
below the Mill (Bailey coe.)
- 11613 Granite from a knob north of the river
below the Nitroglycerine House. This is
intimately associated with green trap.
- 11614 Knob of granite in the shore at the
mouth of Dead River. This greenish
from the presence of epidote and per-
haps of hornblende. It is almost pure
granite but on its lake side at

T.
Light House Pt.,
Marquette -

Fog Whistle.

Spante
1162

Light House.

Sericili
11653

11618

Quarrel

Ridgely

$$\frac{1}{1163} = 0.0008598$$

036-7

Beach

Beach

11615
11616

Arch. St.

least three very sharp black trap
dykes are to be seen. They are
very narrow

Tuesday, July 13th Light House Point.
Marquette.

The end of Ach St
descends a very steep hill to the
low flat which separates it from
the Point. Here is a large and
finely glaciated exposure of very

11615 massive gneiss (11615) with
occasional veins of schistose

11616 gneiss running through it (11615).
It is often seams with white quartz.

11617 From the center of the south arm of the
great dolerite dyke at the Point.
S. E. of Light House.

11618 } schistose gneisses near the point
11619 } south of the Light House.

11620 From a narrow (4 ft) felsite dyke
just north of the Fog Whistle. On
the water's edge.

The north arm of the great
dyke shows a sharp contact with
the adjoining banded rocks.

11621 From this contact. North side.

11622 From the center of this arm

Whatever is the nature of the schistose green rock, this dolerite trap is certainly a later intrusion, made after the other rocks had acquired their present form and character. This contact shows this. The trap on the edge is red and almost glassy with minute porphyritic crystals.

11623

Is a schistose green rock (gashed) from beside this contact.

Toward the end of the point the south arm of the great dike enters the lake just below the Fog-whistle house. It seems here to break up into several smaller arms. The finegrained granite or felsite is the youngest rock on the Point. & seems to break through all the others.

P.M.

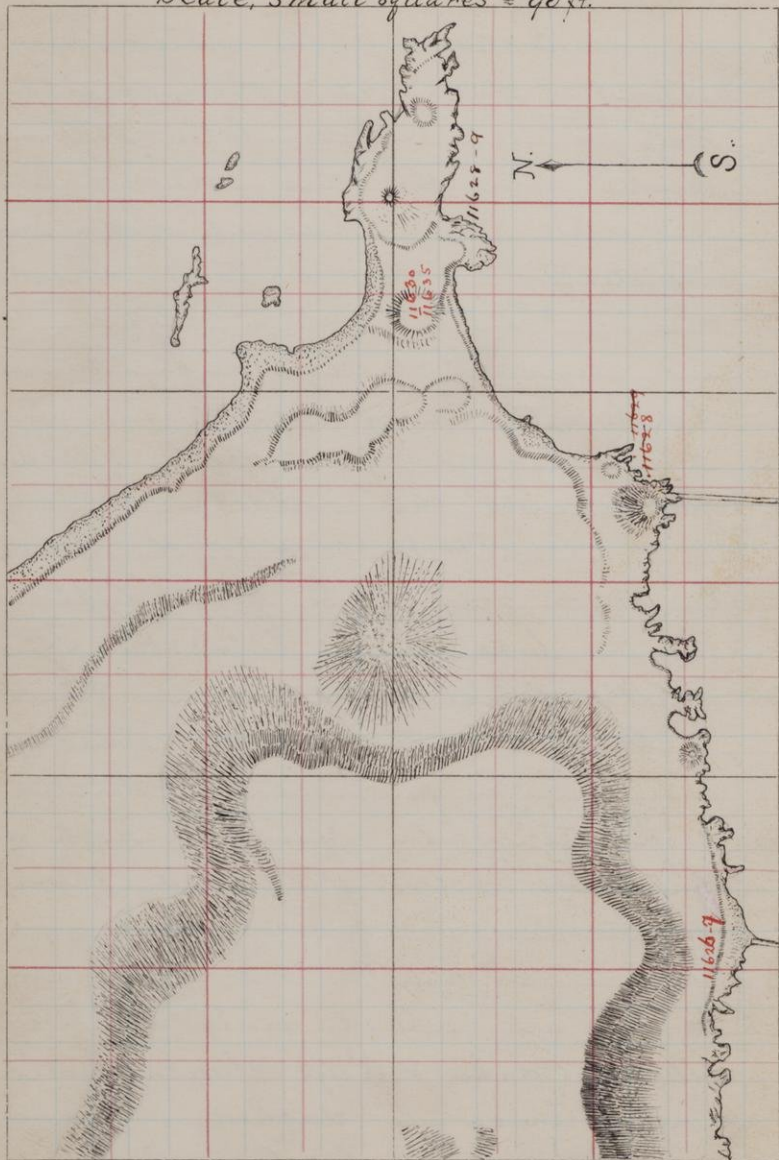
No rocks are exposed along the bluff between Lake & Ridge Street until Grace Furnace is reached. Here on the road is finely schistose white to grayish green rock, with a

Light-house Point

T.

R. Marquette Mich.

Scale, small squares = 90 ft.



greasy feel looks like a sericitic
 quartzite. Dips steep to the north.
 Sta E. W. (Blasted here for gold!)

11624 White variety

11625 Reddish gray do. } These belong to
 Ranniger's "Eureka Series", wh.
 extends some distance west between
 the northern & southern belt of
 Marquette greenstones.

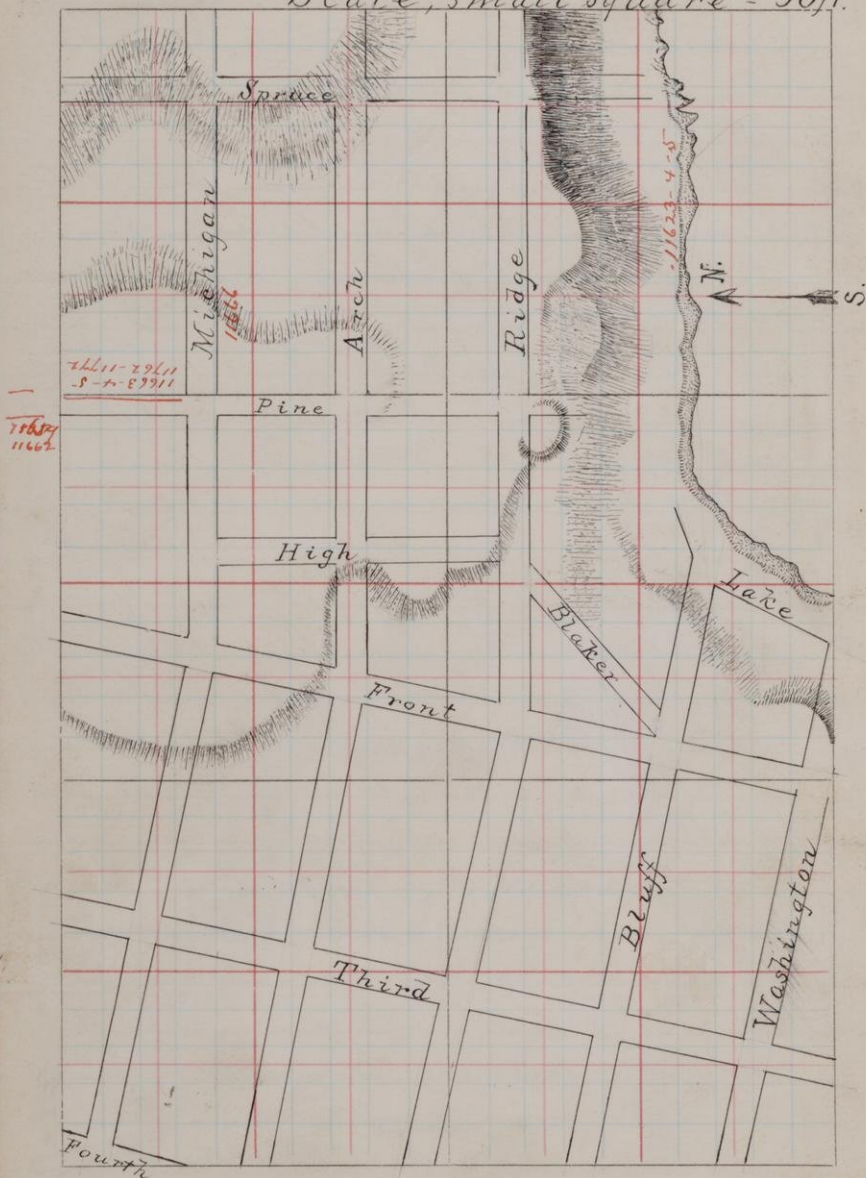
Beyond this point Lake St
 cuts across the strike of these
 rocks at a low angle, exposing a
 good section. At the east end of the
 lake, ^{named} exposure ⁽¹¹⁶²⁴⁾ the rocks are very fissile
 & fractured. They are green & divide into
 the finest lamellae. Beyond here
 where the wooded plain very ascends
 to Ridge St. these rocks are not less
 fissile but they are of a lighter green
 color. Beyond this point they become
 more and more massive. They are
 much gashed and seamed with
 quartz & calcite. In the wall just
 before the saw mill is reached they
 are light green & quite massive
 with irregular jointing. Further
 on they become banded & schistose

Part of Marquette Mich.

T.

R.

Scale, small square = 90ft.



again as at Light House Pt.

11626

From near Burgess' Saw Mill in Lake St. Dip always steep to N. St. E.W.

Near this saw-mill between the ends of Lake Ridge Sts another band of reddish schistose rock is exposed. (Sericite-porphyrroid?) This is conformably interstratified between the two belts of schistose greenstone exposed on Lake St. above & below the saw Mill.

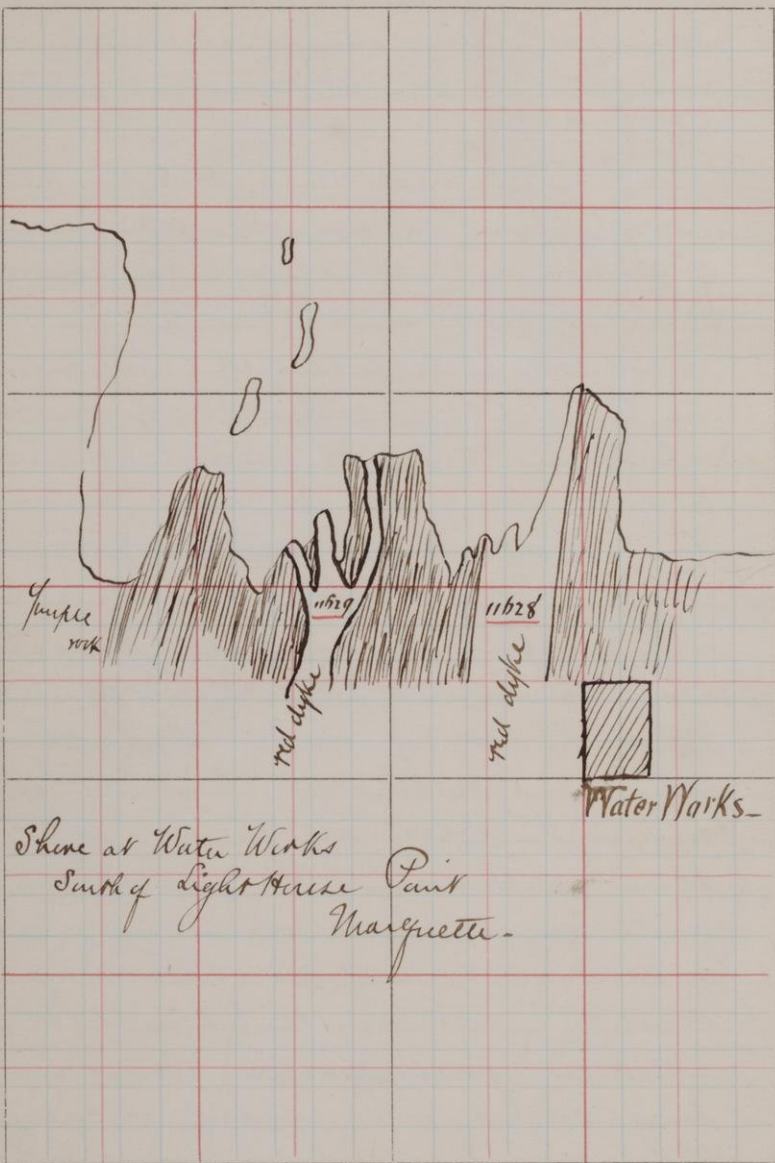
11627

From this red band.

East of the Saw Mill there is a very fine exposure of greenstone along the Lake. It is exactly like that at the end of Lake St. Light green & very distinctly banded in different colors and shades where it is weathered. It often appears quite massive in which case it is dark green with a folio-schistose structure. Across this schistose banding it is finely parted, the seams being covered with quartz or calcite. This parting becomes more marked when the rock weathers and tends to

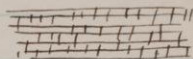
T.

R.



Shore at Water Works
South of Light House Point
Marquette.

break it up into short square blocks.



At the end of this exposure toward the east, when the rocks jut out as points into the Lake (as the Water-Works ahead of the BrakWater) the schistose red band is again well exposed in a band 45 ft wide. The rock is here the same as above. It is very irregularly parted in many directions but still has a very distinct structure parallel to the planes of the enclosing green rock i.e. dip N Strike E-W. In many respects this band resembles the granite and felsite dykes occurring in the greenstones of Light House Point and if the schistose parting of the greenstone was the secondary result of pressure this band was probably such an acid dyke. (11628)

11628

At the next point above this (north) the red rock occurs again - here more massive with a very dyke-like structure. Here it branches and looks very like

11629 the granite dykes. (11629) Still it descends conformable to the dip of the green beds.

In the last and largest of these three points there is a great deal of a dark purple rock, most confusedly mixed up with the green one. Both are equally similarly schistose. The contact between them is sharp as it would not be if they were sediments.

Greenstone Quarry between the Foot of Arch St. & Light House Point. This is an oval area from which all the rock has been removed down to the level of the street, except a small amount in the S.W. corner. In some places the rock is quite coarse-grained and massive, although much altered 11630. It is everywhere cross-jointed. Very finegrained homogeneous varieties are much more common. These are either light or dark green and often show a banding of light and dark layers, exactly like slates, even when they do not cleave

11631 very readily (11631) It does not seem probable that such layers could have been produced by pressure alteration and yet all these rocks — coarse and fine — are inseparable.

11632 Schistose Variety (11632)

Interstratified with these rocks are bands of red acid ones.

11633 (11633) These are local & often suddenly diminish in size and run out.

In one place a well marked dyke of a typical fine grained trap cuts across the area nearly at right angles to the strike. The walls of this dyke are very sharp and in one place the trap has sent out small arms into the adjoining acid rock as it crosses it. (11634)

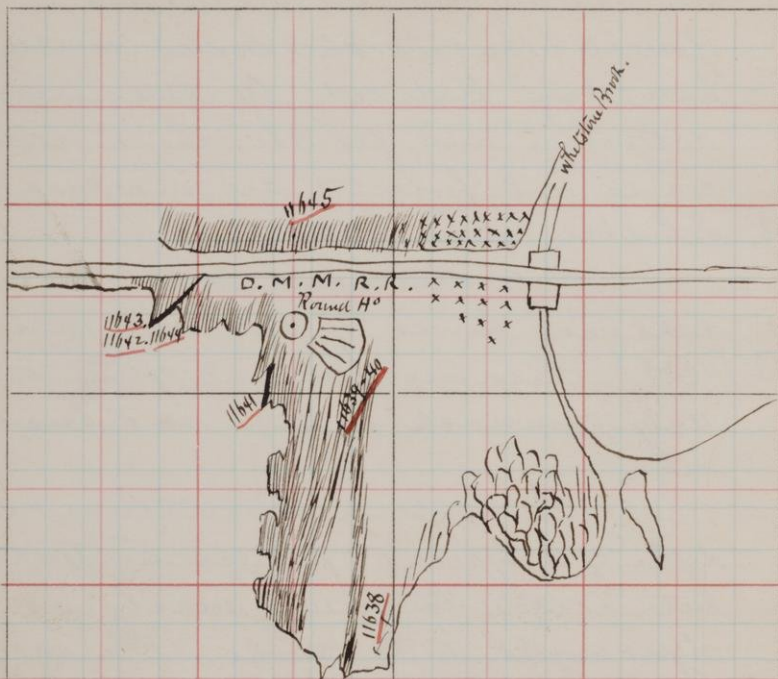
The great dolomite dyke of Light house Point runs along the north side of this quarry. It is very different in appearance from any of the other rocks here.

11636 from its center }
11637 " " edge }

11635 another banded greenstone from the quarry

T.

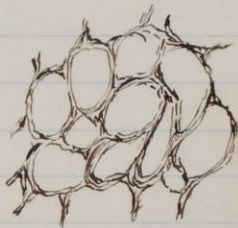
R.



Mouth of Whetstone Brook
S. of Marquette L.S.

Wednesday July 14th '86. Road south-
ward along the shore as far as the
mouth of the Camp River. Shore
occupied by a high drift bluff
between the Camp & the East Forks, where
at the mouth of the next creek, sandstone
appears. The first real exposure is
at the mouth of Whetstone Brook where
a promontory of the greenstone ex-
tends out into the lake. This pro-
montory is double, the portion nearest
the brook (north) being finely smoothed
& striated by the glacier. [Striae in
two sets running 10° E of N & 50° E of
N. compass] On its smoothed surface
this rock shows no banding or strati-
fication like that on Light House Pt.
It is light green in color and apparently
quite massive though it is broken
up into curious oval and round areas
by schistose veins which traverse it
in all directions.

When it is much broken
or weathered, the rock
shows a sharp diamond
parting with nearly
vertical dip. This is better displayed





South Marquette Marsh

Scale, small sq. = 90 ft.

on the southern part of this point -

- This southern arm is very schistose along its southern edge. Dip nearly vertical. Str. E.W. Toward the north it is more massive (11638-) but now here has narrow schistose bands running through it. These often enclose massive lenticular cores as at Quinnesec. The south part of this point is also massive these two portions being separated by a schistose band (11639) which unites with the main schistose portion of the south edge a short distance inland. This specimen (639) is very light green - 11640 is a darker purplish green with quartz lenses.

This rock seems much crushed and is filled with quartz scacite. Its schistose structure is caused by two sets of joints making a low angle with each other and dividing the whole into very pointed diamond-shaped rhombs.

The most massive rock at this locality is light green and seems to have been min-



crystallogically much altered before it lost anything of its massive character. Here as at the mouth of the brook the breaking up of the mass into round & oval areas is visible - [This looks very like the spheroidal parting & weathering not uncommon in basic eruptive rocks!!] Along the south edge of this point is a band of red jasper like the Ansonian Onondaga Jasper (11641) This is very narrow & in places the green rock looks as though it had flaked in veins into it.

In the southwest corner of the point near the RR the rocks are wholly different. They form alternating purple and light green bands very fissile and having the same nearly vertical dip & E-W strike. They show the same sharp diamond parting as the others. They are plainly fragmental and look like tufas. Their present schistose structure is a cleavage produced by pressure.

11642

11643

Typical rock from here
same banded -

At this place there is a cross band of a
brown rock cutting across the strike
and running 150° W of N. It is
schistose parallel to its sides and
looks like a much altered trap
dyke. (11644)

The RR cutting through the
point shows a light green very
schistose rock at the south (11645)
and the massive greenstone like
11638 at the north end. The schis-
tose structure is however only a
very sharp diamond parting and
gives no decisive strike. The
schistose and massive rocks
grade into each other — the first
contains cores of the second wh.
become more and more numerous
until the massive rock pre-
vails and contains veins of
the schist. Two large veins of
red Jasper here occur com-
mable to the green schists and
dip to the N with E-W strike.

I.M. At the foot of Front St where the R.R. crosses it there is a fine exposure on the west side of the R.R. The rocks here are quite massive and crystalline. They weather purple on exposed surfaces (11646) Only rare schistose seams traverse it; some dipping N; some S.

South of this directly in front of the Summit House the rock becomes pale green and very finely schistose, dipping S. This encloses some superb cores which plainly show that they are continuous with the schistose bands.

Most of this rock however, is compact and massive. It is traversed by several hard red jasper veins. The next exposure just above (S)

of here) shows the massive roughly jointed rock. Both of these exposures appear at the Lake in the same form.

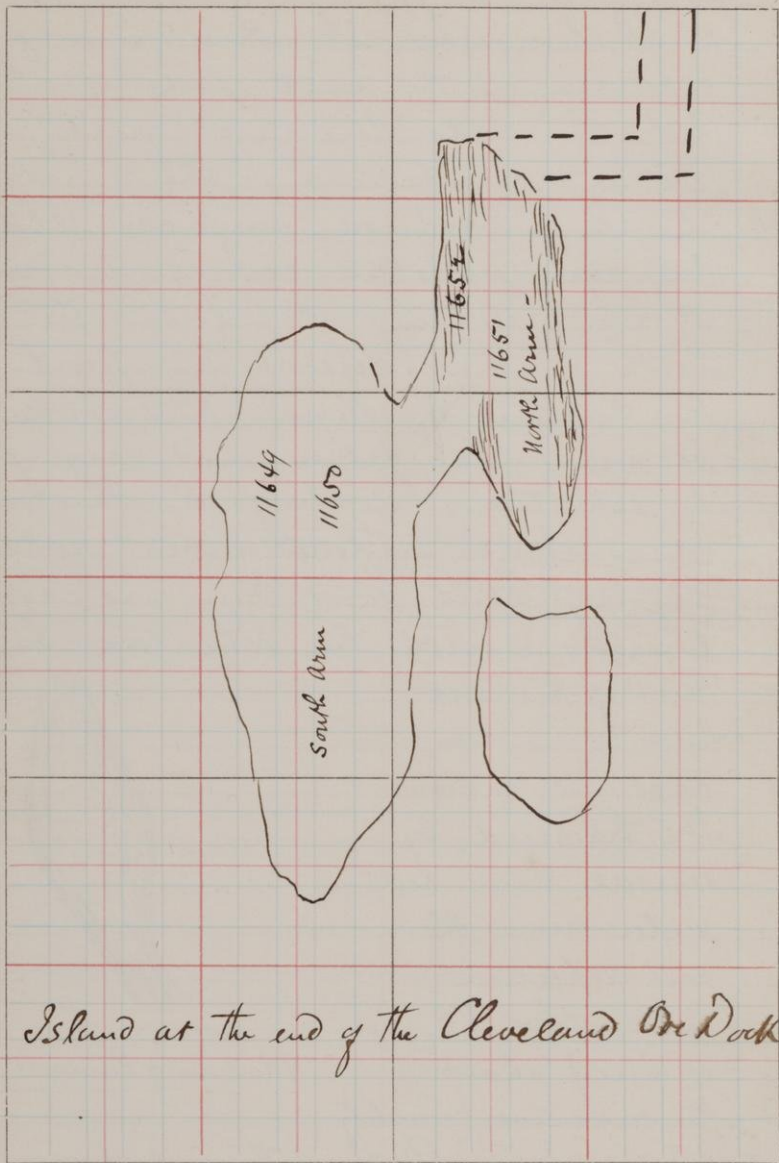


R.R. Front of Summit House

T.

R.

One Dock



Island at the end of the Cleveland One Dock

Back of the RR, the south side of Whetstone Brook is composed of a large hill of greenstone, its north bank of sand.

The Island at the end of the Cleveland Ore Dock is composed of two portions - N & S. connected by a neck. It has been considerably blasted. South arm is composed of a compact hard brown rock - sometimes coarse grained or porphyritic. It is mineralogically much altered but undoubtedly a trap. It is full of epidote. Brown trap. (11649)

11649

11650 Brown trap with fibrous epidote.

The north arm is composed of rock just like that at the mouth of Whetstone Brook. It is massive and light green in the center but schistose on both sides.

11651 Massive.

11652 Schistose.

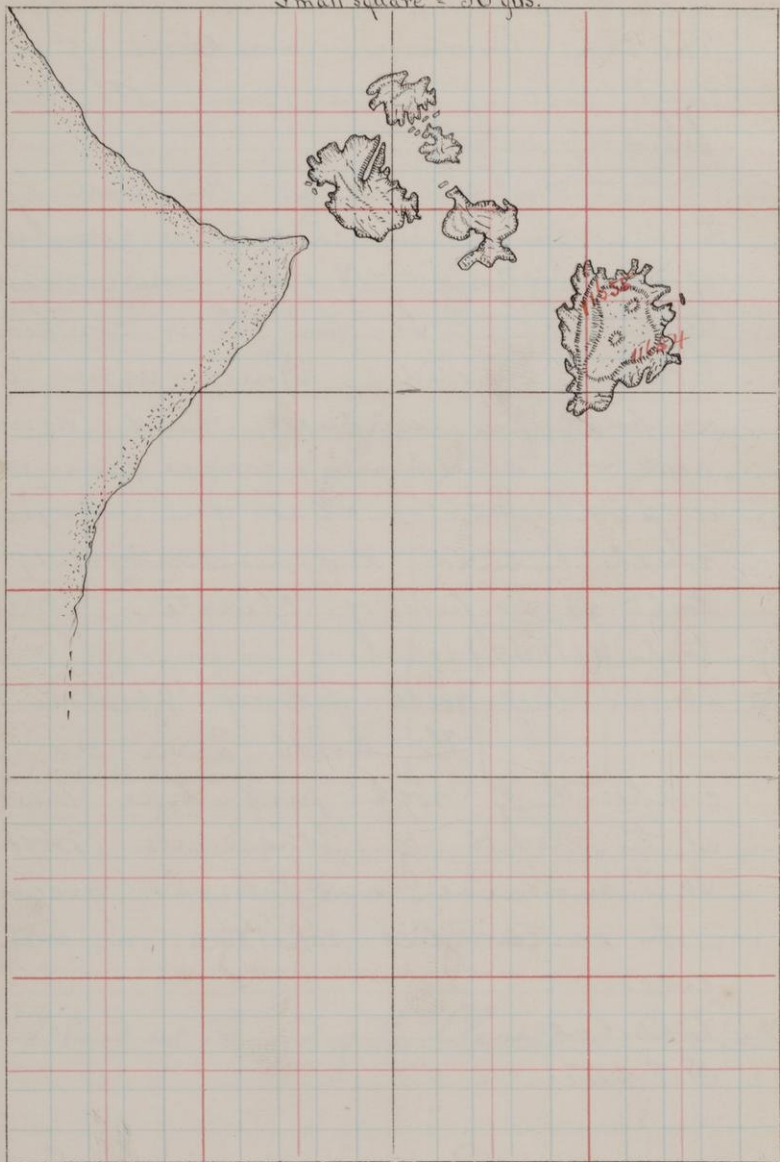
On the north side of Light-house Point are two wide bands of

Picnic Islands Picnic Islands

T.

R.

Small square = 30 yds.



compact felsitic sericite rocks. They are light colored and coarsely jointed into square blocks. Schistose structure coarse but they cleave readily. Structure is brought out by weathering. These two bands are separated by a narrow granitic (11653). They seem to cut in the island and form the holero just north of the Light house. The

11654 The largest of the Picnic Islands is a huge, coarsely crystalline trap showing no other signs of alteration than seams filled with bright green epidote; sometimes with calcite and specular iron. It has been largely quarried here and fresh specimens are abundant. In the main mass are dykes of an aphanitic black trap evidently a later eruption. One such dyke runs lengthwise through the island 25° N of E. and is somewhat schistose parallel to its sides. (11655.) Other such masses may also be seen. The feldspar of the main rock is red + bisilicate seems to be

Lomblende.

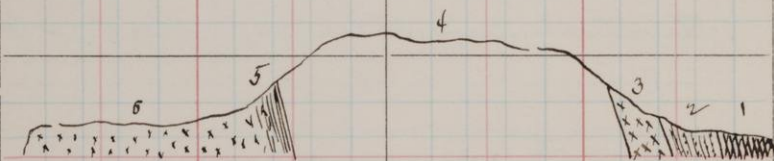
On the north side of this island the rock becomes more compact and finer grained. It also becomes redder and more acidic. This belt also makes up the south side of the next island and then in the north the main rock succeeds. In the island north of this the trap and granite are mingled in the most complicated and irregular manner, proving beyond a doubt that both of these rocks were plastic at the same time. A still later wide trap dyke cuts through the other rocks here. No signs of schistose structure anywhere in these islands.

July 15th '86. Thursday -

The woods lying immediately north of Marquette are composed of finely banded & schistose light-green rocks, much like those on Light House point. They strike a few degrees N of E and dip steep to the N. (11656) They are here

T.

R.



S Section at the so-called Gold Mine
just west of Pine St.

N

everywhere scamed with granite dykes or veins which follow their strike and often swell out into lenticular bodies, causing the strata to bend around them.

Several round bosses of this rock also occur in the greenstone, as marked on Rominger's Map.

11657 (11657) The greenstone is perfectly jointed in three rectangular directions, making the obtaining of good handspecimens difficult.

11658 " is a gray felitic rock occurring in large quantity at the north foot of the most easterly of these granitic bosses. It resembles the felitic sericite rocks on the north side of Lighthouse Point. A cut made by a quarry directly across this eastern granite boss near its eastern end gives a fine section of the rocks.

- 1 N. end regularly bedded greenstone like 11656
- 2 15 ft of the sericite felite like 11658
- 3 band of black massive rock looking an aluminite trap. Very fresh

but still showing indications of a schistose lamination which would become very pronounced on weathering - (11659)

11659

4. Main mass of granite - muscovite granite (11660)

11660

5+6 Massive greenstone wh. is schistose near its immediate contact with the granite as may be seen on the east side of the cut. (11661)

11661

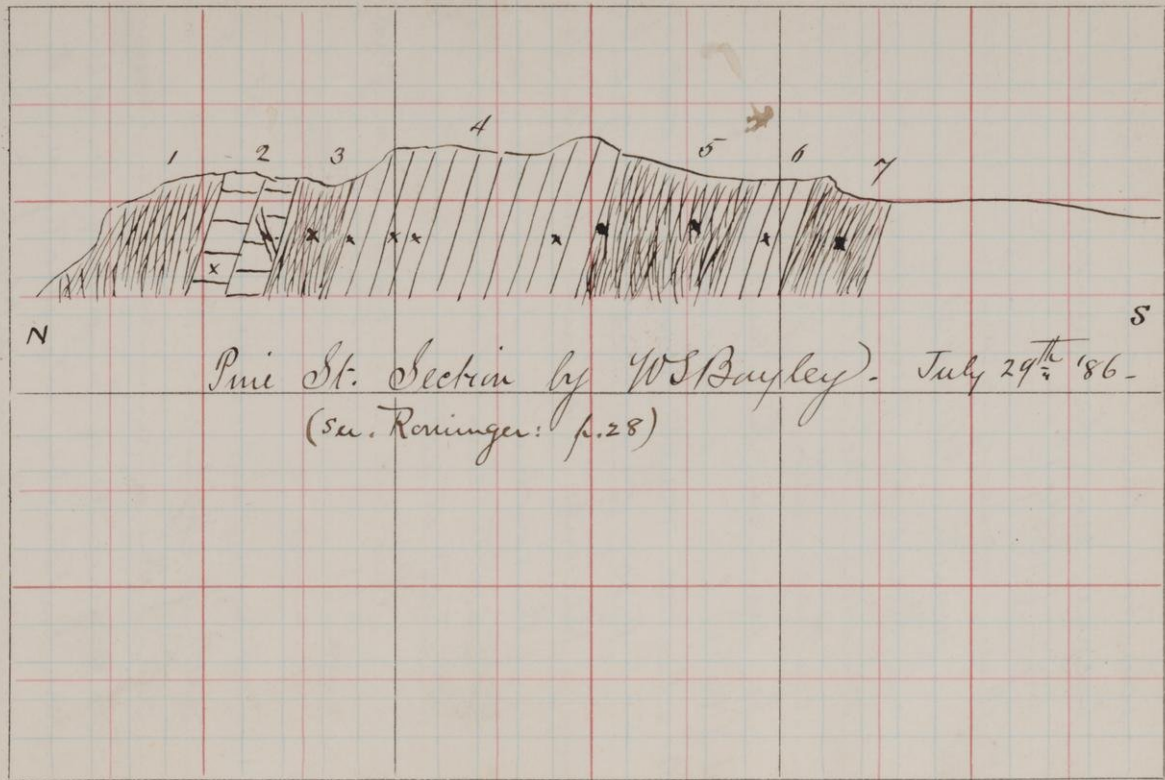
11662 schistose variety from east end of knob, in contact with granite - Becomes massive two ft to the south.

11662

The granite here shows no signs of schistose structure.

This cut was made as a gold-mine !!

Section on east side of Pine St just north of Michigan St. Fine new cut. This is remarkable as showing the occurrence of the jaspery hematite ore conformably interstratified in the greenstones, wh. are supposed to always underlie them.



Pmi St. Section by W.S. Bayley. July 29th '86 -
(see Rominger: p. 28)

T.

R.

- 1 Schistose gneiss
- 2 Very coarse wholly crystalline +
11663 massive black trap (11663)
- 3 Green schist
- 4 Band of finely laminated jaspery
11664 hematite (11664)
- 5 Massive gneiss (~~11665~~)
- 6 Second band of jaspery ore
- 7 Schistose gneiss finely banded
+ cross jointed extending to the
11665 corner of Michigan st. (11665)

[Specimens numbered 11762 - 11772 inclusive, collected July 29 in company with Prof Irving & Van Heise, were taken by Mr Bagley from the points marked with a x. They were collected singly & are sent to Madison.]

On the south side of Michigan St near Pine St the great trap dyke of Light House St again appears and is
11666 exposed in a deep cut (11666)
On the other (north) side of the street the banded gneisses are well ex-

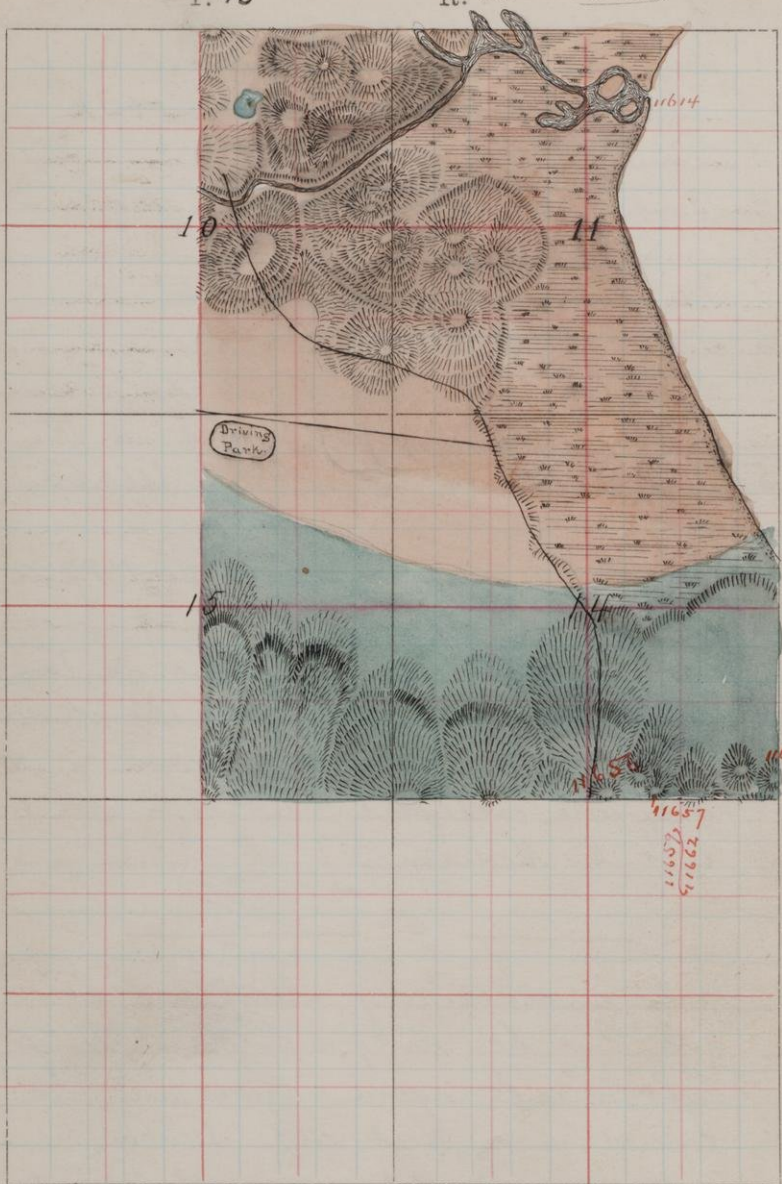
map A

T. 48

R. 25

Mich.

127



posed on a glaciated surface where the acid (granitic) and basic (greenstone) rocks are curiously mingled. Both are equally schistose.



Friday July 16th 1886. Lake Superior
Powder Mills. Dead River. [cf. p. 1.]

The rocks on the west side of the river at the end of the old dam display on a glaciated surface the singular intermingling of the granite and greenstone in an admirable manner. The green and red rocks form lenses and stringers with their longest axes parallel to the schistose structure (E.W.) The green rock here is much the more schistose of the two (11667). The red granite is jointed and not very fresh like 11612. There seems in some places to be an intermediate rock formed by the mingling of the two. (11668)

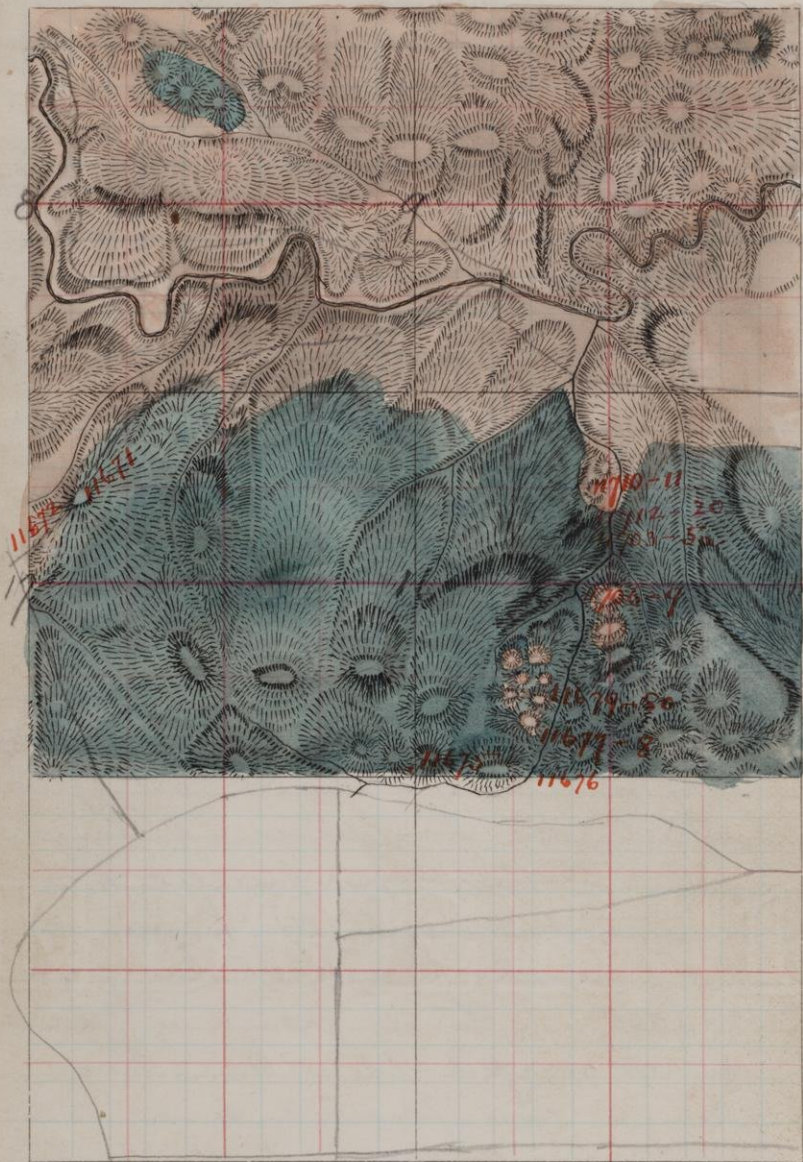
11667

11668

map B

T. 48

R. 25-



Under the old bridge the ledge in the middle of the stream is greenstone both schistose and massive as parts of a continuous mass - This is all altered gneiss - Only one specimen (11670) -

11669 (11669) A block of coarse epidiotic trap was found here - Not seen in situ. Much fine fresh trap occurs about here in blocks.

There are no rocks exposed along the road between here and Collins Furnace which is also on the Dead River. There are rapids and falls just as at the Powder Mills. These are schistose greenstone with a sharp diamond parting & a nearly vertical dip. In this is much red granite, generally with a sharply defined contact line, tho' sometimes with intermediate transitions. Above the Furnace at the Falls the rock is almost wholly granite.

Some distance along the road running west from Collins Furnace, in middle of Section 17,

is a high ridge of schistose and banded
greenstone. The dip is steep to
the north. The strata are banded
light & dark green - These are
green bent and twisted but strike
generally E.W. (11671)

11671 Just where this road en-
ters the road from Bancroft (in
the middle of §97) there is a fine
exposure of coarse massive greenstone
11672 on the right (W) of the Bancroft road
(11672)

On the south side of the road
from Bancroft to Marquette, at the
"Lake Superior Muriatic Spring" the
iron shales (Romer's "Eureka
Series") are well exposed, striking
E.W. and dipping steep to the south!

11673 } Two varieties of these shales.
11674 }

A little east of here on the
north side of the road a huge trap
dyke rises in an almost perpen-
dicular wall. Rominger says
that it is the great dyke of Light
House Point. It contains much
red feldspar (11675)

11675



11698

At a divide in the trap dyke
a short distance ^{east of here}, we made part of
the section described by Rominger
as exposed along the brook

Starting at Stenbrecher's house
on the road, we have, next to the
soft Eureka shales,

1. a ledge of very light yellowish-green
slaty + greasy feeling rocks, seams
with quartz. Finely banded. "Nova-
11676 arcata". Str. E.W. (11676).

2. The great trap dyke -

3. The high belt of intermingled granite
and Schistose greenstone. Similar
to that seen at the Powder Mills
and at Collins Furnace. This is well
exposed on a high ridge rising to the
west of the wood-road. The rocks are
here most confusedly mingled -
11677 Typical granitoid.

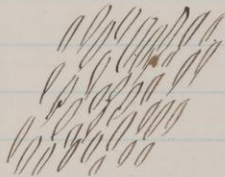
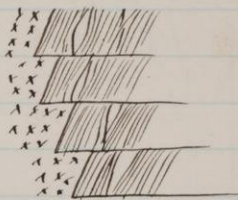
11678 Same banded with red granite.

The granite here has every
appearance of being the latest rock-
intrusive into the schists. It is often
full of schist inclusions exactly like
the Canadian Laurentian. The line

of contact is a sharp one. The granite is not in the least schistose.

The gneisses are my schistose, cross-jointed and full of granitic lenses or "augen". In one place there is a faulting of the schist along the cross-joint planes & the whole filled with late granite.

Sometimes the gneiss is filled with granitic lenses thickly crowded together.



Associated with

these two rocks is a dyke of massive porphyritic trap which cuts across the strike of the schists. It is coarsely crystalline but very much altered. Its structure is apparent on a weathered surface but on a fresh fracture the rock appears of an even bluish color much like the schistose rock in its compact varieties (11679). On the contact of this dyke with the gneiss the trap is very compact & fine grained (11680).

11679

11680

T.

R.

"

"

N.B. The rest of this interesting Brook Section
was worked out July 21st & 22nd -
(cf. pp. 32 -

We followed the wood road northward from here nearly as far as Dead River without finding any other exposure

Later in the day we went out along the Township road which runs west from Marquette & south of Whetstone brook & the R.R. After leaving the high sand hills we came first to a high ridge of rock immediately on the south side of the road. This composed of a light colored massive greenstone. West of this is a small sand hill 14 m. s. of the road, on the southwestern slope of which the red sandstone is in position. This is sometimes a conglomerate composed of large rounded pebbles of greenstone and a finer sandstone with much white quartz. Other varieties are finer grained, red or spotted.

The greenstone in this hill is quite massive but is very light colored and seams into round or oval areas as at the mouth of Whetstone Brook (11681) (cf 11721)

T.

R.

cf. Rominger: p. 29-

Further west there is a cross road leading directly north. On the west side of this where it meets the road from Marquette (just beyond the RR) gneiss is exposed in a massive but much altered exposure. East of here a few steps, where Whetstone Brook has cut a deep bed for itself the soft drab & purple shales are exposed with a northern dip (11682-3).
 11682
 11683 [This is the Old Eureka Shaft, and the rocks part of Reminger's "Eureka Series" - see pg. 27.]

Beyond (east of this) on the road these shales seem to run into very schistose and then more massive gneisses.

Saturday July 17th -

At the extreme west end of Ridge St., Marquette, on the summit of the hill a very light greenish non-vacillate appears in a large glaciated surface. It is felsitic and light gray in a fresh fracture. It is parted into very sharp diamond rhombs, which strike a little S of W. It looks like

11684. No 11676 but is harder (11684) On the north of it are schistose gneisses and the south, gray, schistose, cross-jointed rocks which are hard and splintery.

Walked from here out along the R.R. track. No rocks are here visible (except a little red sandstone) until our second section line is reached. Here (opposite the pond and quarry) on the north side of the R.R. is a considerable knoll of hard, splintery, reddish and irregularly schistose rocks. (11685) They probably belong to Reminger's "Eureka Series". They dip slightly to the N.

At the head of this road, (where we were yesterday) is the massive outcrop of gneiss mentioned in p. 26 (11687) Evidently this is a dyke in the soft iron shales exposed north of it on the road (11688)

At the small bridge over Whetstone Brook are the slates collected yesterday ('82 & '83). They are much crumpled but may be seen, underneath the bridge & in

The old Eureka shaft to dip slightly northward when not vertical. In the old shaft is a very fine exposure of the shales - green slickensided

11689

11686

NW of here in the wood 11686 was collected; between this road & the R.R. 11690.

11690

Farther down this road (East) are other exposures of more massive looking gneisses which so certainly grade into the schists that there is not much doubt of No 11687 being a dyke.

Monday, July 19th -

Exposed in a cut on the Marquette and Western R.R. N.W. of the sandstone quarries are some very slaty gneisses (11691) interstratified with red argillaceous (11692) and gray shales (11693) which may possibly belong to the Eureka Series. These rocks are vertical and strike E.W. and form rough ridges like the more massive gneisses.

11691

11692

11693

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11689
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11691

11692

11693

Drove from the sandstone-quarries
west along the old State Road until
it became impassable in the woods
(about sec. line 27 / 28.) Returned
to the edge of these woods (about
the middle of § 27) and there
walked south through the fields.
We could see the quartzite plains
in a white ridge but we did not
reach it. In the field 1/4-1/8 m.
south of the road is a small outcrop
of a much seamed greenstone, con-
siderably altered and stained. Its
seams are lighter green, like
the rock at the mouth of Whetstone
Brook (11694) This is the most
southern exposure met with on the
2^d Section. A short distance north
of this is a second larger ledge exactly
like the first.

On the north side of this road
at this point is a high E-W ridge
which, on the map, runs just thro'
the center of § 27. The main mass
of this is a coarse grained diorite
with red feldspar. It seems much
altered and stained with iron (11695)

11694

11695

11696 On the south side a much gashed and brecciated rock adjoins the other (11696) In spite of the glaciated surface at the contact it is not apparent whether these two are portions of the same rock mass or not. They appear to be almost continuous but the rocks are so totally different that it is hard to believe that they were ever identical.

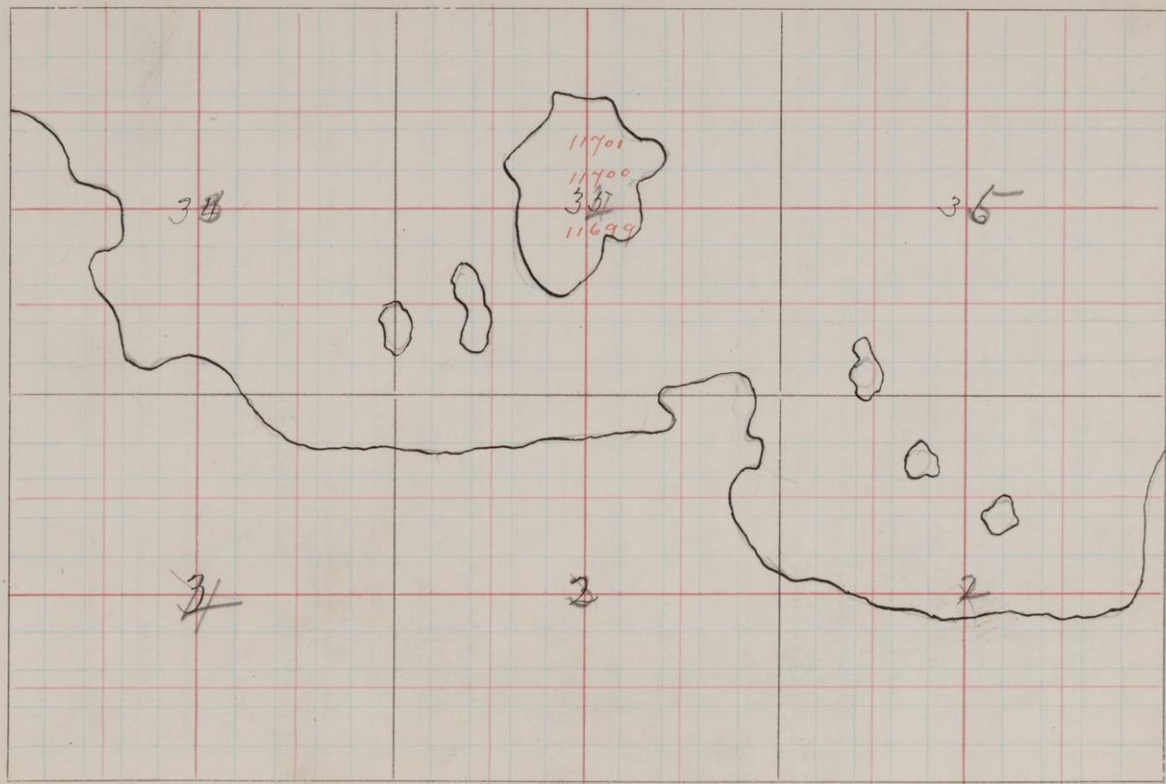
At short distance below on the south side of this hill the iron shales appear on a little ledge.

11697 (11697)

1/2 m. east of here we crossed the drift covered plateau, south of the M. & W. R. R., to the foot of Mt. Mermaid wh. we climbed. The summit is composed of white quartzite.

11698

(11698) The dip is not clear but it appears to be more to the north than to the south. However this could not be determined to our satisfaction.



T. 48-49

R. 25

Handwritten note: *Handwritten 4925*

Tuesday, July 20th Made a trip to "Partridge" or "Middle Island", north of Pequea isle, to examine the relations between undoubtedly eruptive granites & gneisses, described by Reminga, in hopes of obtaining additional light on the same rocks nearer Marquette. The exposures on this Island are very remarkable. We first see a very coarsegrained, dark green rock composed almost wholly of hornblende and traversed in every direction by bright red granite.

11699 Beyond this (north) the granite becomes the prevailing rock but is everywhere banded by a schistose hornblende rock (11699). Wide bands composed of alternating layers of schist and granite occur with other bands of nearly pure granite. Still farther north this hornblende schist acquires more and more the character of a massive rock (i.e. is porphyritic, &c) without changing its mode of occurrence. Still farther north both of

these rocks look as though they had been plastic at the same time.

11700 is a gray, intermediate gneissic variety from Middle Island -

11701 is a fine hornblende schist from Middle Island -

On a small island north of Middle Island the relations are the same. The same alternations of hornblende schist and granite (11702) here a huge trap crosses the strike of the schist, wh. is here N.W.

Many of these impregnated rocks seem to resemble those in Ogish Point.

Wednesday, July 21st Continued an examination of the Brook Section, between §§ 15 & 16 (cf. pp. 23 & 24) We started where this stream crosses the road from the Marquette Race Course to Collins Furnace & traced it southward - We walked for some distance through the brush before any rocks were seen. After a considerable distance had been traversed we met

a fine rounded surface of greenstone-schist full of superb "Augen", mostly of feldspar but with some epidote.

Stk E.W. Dip N. Specimens showing

11703 cross-sections of the Augen (11703)

Specimens parallel with the grain

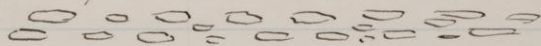
11704 showing my large Augen (11704)

11705 Same with only small augen (11705)

These resemble some of the porphyritic Middle Island schists.

Farther south is another similar exposure with one narrow band of parallel white "augen" which closely resemble much flattened pebbles! (???) (11705^a)

11705^a



Just south of here on the brook begins the high bluff exposure described by Rominger. This is very fine - It consists of light and dark colored, nonporphyritic schists like those on Light House Point and to the north of Marquette (11706). These are cut by conformable granitic dykes (11707) and sericitic bands.

11706

11707

The great trap dyke which

- 11708 Rominger describes & figures, is well displayed at this point. (11708) The southern, branching arm is wholly in granite. There is apparently a fault in the schists along one arm of this dyke as shown by a granite band.



Summit further south to the next very high ridge which affords a view of the whole region.

- 11709 The schists here are the same as the others - 11709 from the summit of this ridge.

Thursday, July 22^d - "Brook Section" con.

- 11710 The granite knob 400 steps S of the N corner of § 15.16 (Rominger) is considerably gneissoid in its structure with a E.W. strike.

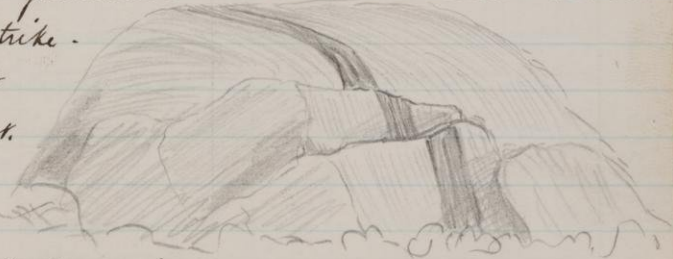
Dip not apparent.

It is

jointed

nearly perpendicular

probably parallel to its gneissic structure.



This knob is intersected by a greenstone dyke, which runs all the way across it, nearly, but not quite parallel to its gneissic banding. This dyke is perfectly schistose parallel to its walls, which is important as there can here be no doubt whatever about its eruptive nature. (11711) The dyke strikes 15° N of E, so as to intersect the gneiss banding at an angle of 15° .

11711

Went around & entered the Brook Section from the south. First traced the brook down to the great divided Gap Dyke seen yesterday. Went down on the west side of stream. Curious belt of coarse dioritic rock (11712) - exposure not so good here as on the east side. Traced the section back again at the foot of the bluff on east side. Rocks mostly schistose - greenstones with northern dip are conformable. These beds alternate with the schistose ones. (11713) Very much "cross-gashed & jointed". Some beds are

11712

11713

- 11714 very slaty (11714) - The granite is common in conformable dykes of varying thickness. This is sometimes quite schistose to
- 11715 + sericitic (11715) One occurrence of this in minute lenses
- 11716 is very much decomposed (11716)
- Just south of this there is wide conformable dyke of granite (11717) enclosing a diabase dyke (11718) which is slightly schistose and resembles exactly the normal slaty greenstone. (This last specimen (11718) is not from the dyke but from an outlying greenstone block)
- 11719 from the dyke with greenstone on its north & granite on its south
- South of this is another ridge composed of a schistose gneissic rock, i.e. coarser grained with white feldspar plainly visible. Strike & dip as usual.
- 11720 (11720)

South of this to the end of the section is the same fine grained greenstone as above.

knob

P.M. First small ^{knob} N.W. of the Sandstone Knob on the Township Road. This is very light green and quite massive. It is scamed with schistose veins which divide it into round areas on the section across the strike. They are schistose enough to cleave and show a cross gashing due to tension perpendicular to the cleavage. (11721)

11721

Bayley followed the section-line from the Eureka Mine Road to Township Road and only found rock on the north edge of the latter.

11722

(11722) Out on high drift hills.

The high ridge just south of the road and NE of the sandstone knob is greenstone in which a shaft has been sunk. The rock here is lighter green, much shattered & slickensided. It is filled with

11723.

calcite & pyrite (11723)

Friday, July 23^d. The high rocky
hike in the S.W. corner between the
road & Whetstone Brook is quite massive
throughout. Its freshest variety from
near the top is dark bluegray &
shows traces of large original cupules.

11724 (11724) Other varieties are pale greenish

11725 Gray and quite aphanitic (11725)
These latter appear to grade into the
former & look like more altered va-
rieties. They are much broken,
gashed & jointed, especially on the
north side of the hike.

A short distance west a
mass of this rock has been laid bare
where a slaty band runs through
it. Evidently only an alteration facies
of the other much broken & jointed

11726 (11726)

Curious boulder found here looking
like quartz enclosing angular fragments
of specular iron ore - Nothing like it
found in situ. Only one specimen

11727 (11727)

The rocks exposed in the
most southern ridge of the coast
section, i.e. in that back of the

T.

R.



trap

schist-

11728

Gast Works are slaty (11728)

They form the northern edge of the sandstone worked in the quarries and belong to the series exposed on the M+W R.R. (691-2-3) These two ridges here separated by the drift (i.e. that of the Gast Works & Whetstone Brook) join a short distance west. South of the former is only drift as far as the quartzite.

Saturday, July 24th Exposure at the extreme western end of Marquette between Michigan & Ohio Street. Well bedded bluish gray stone, as on Light House Point. Dip N. Slaty-

11729 }
11730 }

11729 - more massive (11730)

The trap dyke appears again here. On the north side of Ohio St are other rocks darker than these but hardly less schistose; tho' they at first glance appear so. (11731)

11731

There are also cut by a trap dyke - just north of here & slightly east near fourth street, the same iron siliceous bands crop out that are seen on Pine St. Well exposed

- 11732 and very thinly bedded (11732) Not
over 10-15 ft wide here. The quartzite
on its north side is comparatively
massive (11733) + coarse grained.
11734 from the exposure at cor. of Front &
Ohio Sts. (S.W. corner)

T. 48

R. 26

Granite

Granite

737

738

739

740

Baldwin
Kilns

21

21 S

749

11749

11748

11745

11744

11741

736

29

28

28 S

C A R

RIVER

11761

11735

Quartzite

Quartzite

332

32

033

R. R.

33 S

H. R.

11743

742

M.

Monday, July 20th. NEGAUNEE
P.M.

Drove on the western road to Baed-
win's Kiln (charcoal) in §21, through
§§31 + 29. The quartzite begins in
the center of §31 + forms a high
and almost but narrow ridge
trending E.W. through 31, 32 + 33.
Where the road first enters it the
quartzite is pure white but spot-
ted by curious oval dark areas -
somewhat like Shepard's "leopard
11735. rock" from South Carolina (11735)
Dip to South.

Beyond the quartzite is gran-
itic area is entered. This rock
does not seem to occupy the belt
continuously but crops out in
isolated rounded ridges or knobs
which appear above the uniform
level of drift. These are not
often continuous with each other.
The rock appears a pale green +
quite massive. It is extremely
jointed in every direction but
not often schistose.

11736 From the high ridge on the west side

of the road in the SW quarter of the NE quarter of sec 29; between the Capt. River & the source stream next north of it.

From the Baldwin Kilns we NW through the brush swamp of the flat intervening before the granite ridge rises to the north. Frequent low rounded masses of greenstone appear here. We climbed this ridge of granite and followed it east until we were opposite the Kilns. Here (11737) granite.

The ridge descends here more sharply than further west. At its foot a fine contact of granite & greenstone schist is seen. A large granite dyke of coarse grain here penetrates the schist. In another place the two rocks are mingled in irregular patches as at Collins Furnace. Both rocks rather nearly white; the granite pinkish & the diorite gray or pale green. The schist here dip nearly vertical, & strike 25° N of W. They are very fine grained & aphanitic - schistose.

Just after the hook is crossed this fine grained rock appears to contain fine bands of a coarser one & this latter quickly excludes the other altogether. It is a wholly massive diorite (11739) Before the Kilm are reached the fine grained rock again reappears. In one place it is curiously mottled with white spots round or oval but is not schistose (11740)

At the Kilm is a high ridge of rather fine grained, wholly massive but very much jointed gneiss (11741)

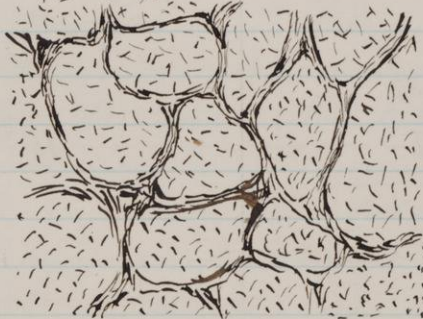
Tuesday, July 23rd South End of our 3rd Section High hill of argillaceous slate south of the R.R., where this leaves the road. SE gr of NE gr § 32 Two varieties

11742 light gray quartzite

11743 decomposed slaty one.

SW gr of NE gr § 28 is a high diorite hill composed of the same fine green rock very much much broken & cross gashed. It is only

- slaty or schistose in places where it is slickensided + this structure evidently results from slipping pressure (11744) -
- 11744 NE gr of NW gr of §28 near the road are the next exposures. The rocks here are just as at the mouth of Whetstone brook but are not schistose. They are minutely jointed +
- 11745 scamed (11745)



- This rock is here cut by a wellmarked dyke of a much coarser rock - (11746) Slightly west of here Bayley collected a massive (11747) and somewhat
- 11747 schistose (11748) greenstone both forming a portion of the same rock mass.
- 11748

We next drove NE into §21. Near the end of the road - probably near

T. 48

R. 26



July 27th 1886 -

11749. The NW corner of §21 is a knob of the coarser dyke-diorite. (11749)

Throughout all this area the greenstone has the same character and occurs only in isolated rounded knobs.

Drove with much difficulty over the rough road to the Kilus in the SW gr of §17. From here we walked out along the line of the old tram-way as far as Dead River in §8. No rocks in sight along this route. It lies in the arenaceous slate of Rinninger. This same rock is also to be found at the Kilus of §17, tho' Rinninger gives quartzite here - (11750)

On the road back to Baldwins Kilus on the south side of the granite ridge there is a fine contact with the granite exposed
 11751 granite much seamed & fractured
 11752 greenstone schistose & slaty
 11753 contact of the above

at the contact the main granite mass sends out many dykes into the schist. These enclose fragments &c

R 27

26

11789
11988

T.
48

36
TEAL LAKE

11786
11789
11783-4-5
31

Race Course

NEGATIVE

M. H. + O. R.

M. + W. R. R.

T.
47

12

11755

At Baldwin Hills there is a fine dyke of this pink granite thickly veined with white quartz.

Wednesday July 28th - Iron range
+ intrusive greenstones S. of Ne-
gawnee.

11754 A beautiful coarse green diorite
11755 line of greenstone in the middle of
north line of §7. (47-26)

In the middle of §6 just
behind the Hotel Breitung is a
greenstone line of small dimen-
sions. The rock is dark bene-
coarse grained + massive. It
is, however, much broken + shal-
low sided + traversed by veins wh
strike E W + dip south.

11756 massive }
11757 schistose }

The bluffs fringing the south
side of Seal Lake are for the most
part a massive crystalline
greenstone. Coarse + light green on
a fresh fracture. Entirely
11758 aetna (11758)

On the the north side of the

ridge, near the head of the street
on which the hotel stands, it is
very schistose. E.W. with vertical
dip.

11759 schistose green

11760 more schistose. gray wholly al-
tered.

11761 Greenstone schist from first small
hill north of the quartzite ridge on
the west side of the road to Bald-
win's Mills.

See page 19.

Thursday, July 29th - Marquette
with Phys. Irving & Van Dine.

Road south of Carp River
along the Lake Shore. Quarry

11773. of garnet quartzite intrified with
enlargements (11773) Farther
south. Greenstone - when schis-
tose dipping south. Near the
quartzite dipping north. Schistose
greenstone north side of bluff

11775 (11775)

11774 massive ditto

Below the greenstone are banded
schists which are cut by con-

11776 fennabee granite dykes (11776)

11777 Greenstone schist from beside the granite -

11778 Before the quartzite is reached we have a band of porphyritic greenstone also cut by granite

The quartzite is introduced by much puckered greenish slates

11779 (11779) all dip to the north -

Northward along the section beyond the typical quartzite come

11780 very fissile slates (11780) and no-

11781 vacuolite (11781) like that of the Eureka series - To these suc-

ceed more quartzite & then come
11782 calciferous rocks (Rauinger's
marker) (11782)

(Specimens 11762-11772 incl. Pine St.
section, Marquette - see pg. 19)

Friday, July 30th 1886. Fourth
 & most western Section, through
 the centers of §§ 36, 25, 24 & 13
 T 48 - R 27 - north of Deale Lake -
 Along Johnson's old road.

Road runs along the east end
 of the Lake between the Water Works
 & Slaughter House, then turns east
 & crosses the quartzite ridge - On the
 north side of this ridge is a thick
 series of slaty novaculite like those
 seen yesterday south of Marquette
 They all dip south - They are well
 exposed here in a deep cut made for
 quarrying them - They are almost alike
 in all except color

- | | | |
|-------|-----------------------|--------------|
| 11783 | light greenish yellow | } novaculite |
| 11784 | drab | |
| 11785 | black | |

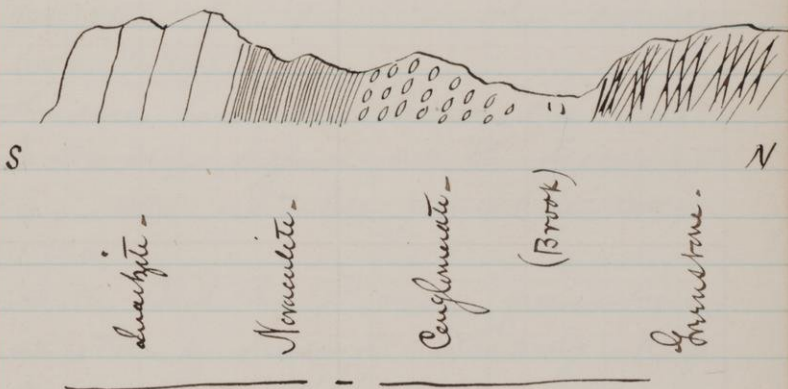
- A few steps beyond here
 a quartz conglomerate is exposed,
 underlying the novaculite (11787)
 Just across the creek brook is
 greenstone in position - massive
 but sometimes schistose by pressure
- 11786 The layers are vertical (11786) This
 line was followed eastward all

the way to the road to Baldwin's
Kilns but nowhere was the actual
contact exposed - High up on the
hill is a superb glaciated sur-
face of very coarse conglomerate
with a green matrix and rounded
pebbles entirely of quartz. (11788)

11788

Adjoining this is a fine black slate
a few paces north is typical green-
stone - vertical where it is schis-
tose and striking NW. (11789)

11789



Left the horse at 10:30; reached the
Camp River at 11:15 and the camp
in sec 13 at 11:50 - Here there
is only greenstone weathering white.
A short distance further north, how-
ever, is a coarse gray porphyritic

granite. Rather white. This occurs first in dykes & then in mass including the adjoining greenstones

11790

(11790)

11791

massive fine grained greenstone from core beside the last.

11792

schistose do.

Left the camp at 12:30 - 1300

11793

steps south of here is a glaciated greenstone ledge (11793) - just north of this is a reddish granite with

11794

green streaks (11794) perhaps a block?

11795

900 steps from here is another similar ledge (11795)

The road here turns toward the east - Ca 500 steps beyond at the fallen tree is another schistose greenstone ledge

11796

(11796)

at the Camp Riv. is more greenstone schistose by pressure striking W of N & dipping W! (11797)

11797

South of the Camp on the west side of the trail is a massive greenstone schistose by pressure & vertical. (11798) It is filled with red granite (?) inclusions of all sizes. They are scattered through the rock & often

11798

11799

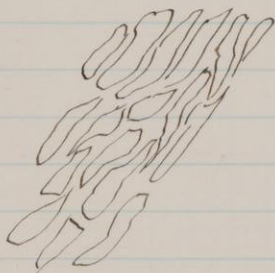
appear partially discolored (11799)
 The green rock is free of sharp
 new feldspar crystals which
 may have resulted from the
 discolored granite substance
 Both rocks are much cross-gashed
 & broken - Tracing this ridge S+E
 it develops into a light green
 massive rock mottled with
 white, the mottlings being sharply
 defined white feldspars. (11800)

11800

This rock has a wide distribution
 Its true character shows best on a

11801

weathered surface. (11801) It is
 sometimes broken into irregular
 areas which are joined by vein
 material of a much finer schistose
 nature. These areas are often



filled out with
 lenses & trace
 the other rock in
 bands.

11802

11802 vein
 material

11803

A rock exactly like this vein material
 is also free of white feldspars (11803)

