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## **Geology of the Vermillion Iron Range: [specimens 26745-26942]. No. 198 1897**

Bayley, William Shirley, 1861-1943; Van Hise, Charles Richard,  
1857-1918

[s.l.]: [s.n.], 1897

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U. S. GEOLOGICAL SURVEY  
FIELD SECTION BOOK

9-891

# LAKE SUPERIOR DIVISION.

## INSTRUCTIONS.

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

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

3. Collect a specimen from every ledge, or wherever there is a change of rock on any one ledge, taking care to get fresh material, unless for a special purpose the weathered surface is desired. In case of trips made on foot or in canoes, for long distances, neighboring ledges, unquestionably of one kind of rock, need not be specimened. The position and extent of the ledges not specimened should be marked on the map, with notes that each is of a rock identical with specimen so-and-so. Under the same conditions small-sized specimens, trimmed to a uniform size of  $2 \times 2\frac{1}{2} \times \frac{1}{4}$  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.

198

Geology  
of the  
Vermilion  
Iron Range

— . —

Season 1897

Book No 1.

W. S. Bayley  
C. R. Van Hise

— . —

Compassman

Wm. Flint

Leonard Hoffman

July 18-27

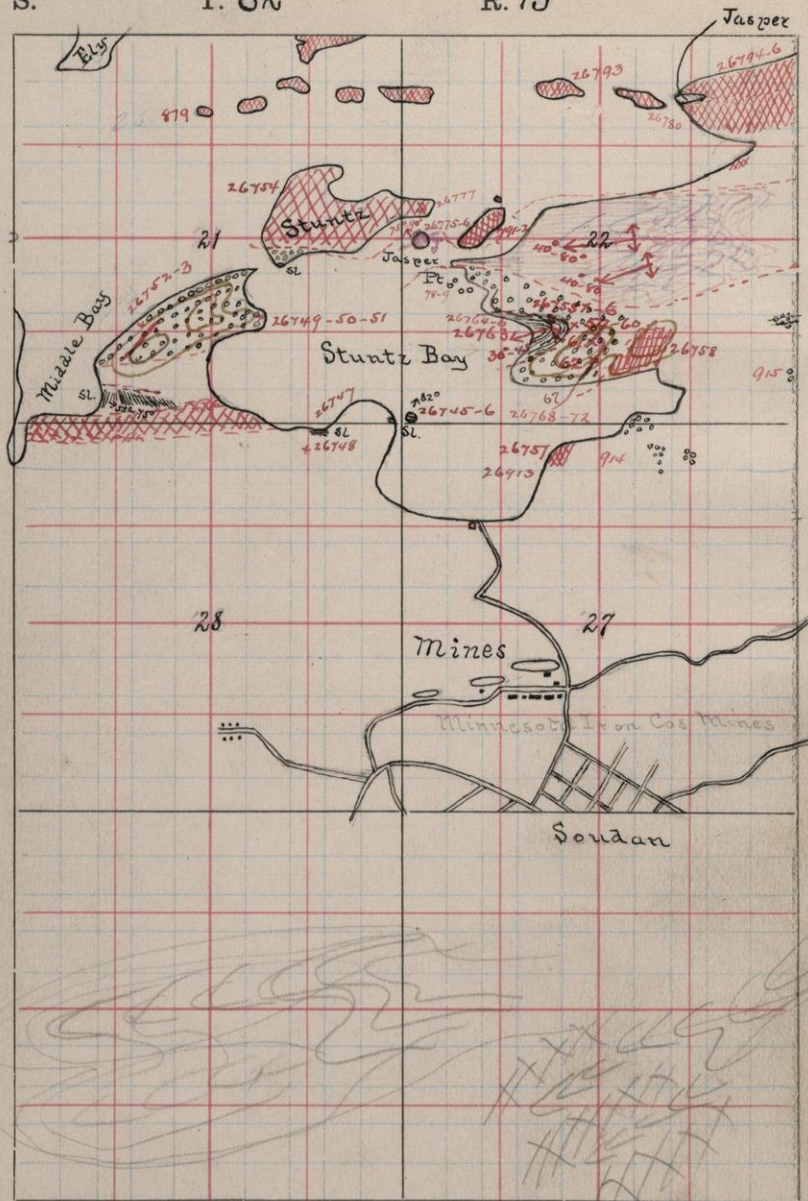
" 27-31

Both of Tower.

S.

T. 62

R. 15



Much field work during July, was done in company with Prof. C. R. Van Hise in Lake Vermilion.

Locations are plotted on topographical map, and are made irrespective of Sec. Corners.

### Note

The maps in this book, unless otherwise specified, are tracings of the topographical maps made by \_\_\_\_\_ and by Robt. T. M. Brown, with the contour lines omitted, except in special cases where the contours are indicated in brown ink.

Explanation of Colors and Symbols.

Red cross hatched = porphyry  
= granite, when with Gr.

Purple = Jasper

Green = greenstone, basalt

Schist?

Black: parallel lines = slate

: Dots = graywacke

: circles = conglomerate

June 30.

Made camp.

July 1.

Coasted from Stuntz Bay westward  
Examining all ledges noted along  
the shore.

On the little island at the S.W. corner  
of Sec 22, are intercalculated Dark  
gray and light gray slates, whose  
strike is  $N. 87^{\circ} W$  and whose dip is  $82^{\circ} N$ .  
The cleavage seems to correspond with  
the bedding; at least the two structures  
cannot be discriminated.

sl

26745 Dark slate from island S.W. cor Sec 22

sl

26746 Light " " " " "

T. 62 R. 15-W.

In the little bay immediately west of  
this island, at the water's edge are  
other exposures of this slate, appearing  
strikingly similar.

sl

26747 From shore of Stuntz Bay in S. line Sec.

21. T. 62 R. 15.

South of this ledge, beginning a few  
feet from the water's edge and extend-  
ing about 50-80 paces is a belt of  
a light gray schistose rock, sup-

lvs.

26748

posed to be a schistose porphyry. The little island in the bay is composed of the same rock.

The bold point forming the west side of Stuntz Bay is composed of a conglomeratic rock, which we have called the Stuntz Conglomerate. It is unquestionably sedimentary, in spite of Smyth & Finckley's statements to the contrary. These authors regard the rock as a dynamically metamorphosed porphyry.

26749 Conglomerate

c 26750 Pebble from conglomerate

In addition to the pebbles like that specimened, the rock contains fragments of black slate and of dark chert.

c 26751 Finer grained phase of the conglomerate apparently grading into coarser variety.

The conglomerate borders the U. and the U.W. shore of this promontory to a point where the land abruptly drops to the south. (The 107°.

ographical map is in error here).

The rock on the N.W. side of the point contains numerous large boulders of porphyry closely cemented by a sparse matrix. In addition to these boulders fragments are also numerous. These comprise:

black and gray chert, large and small sharp edged fragments of slate.

26752 From slate fragment, showing cleavage and bedding. The fragments of chert and slate are notably more angular than those of the porphyry.

OP  
26753 Near this place also the conglomerate is cut by at least one dyke of white porphyry 6 ft wide, which is seen to extend for some distance and where contact with the conglomerate is very sharp. The schistosity of this dyke is by no means as marked as is that of the conglomerate; which is further evidence in opposition to Smyth's view.

This porphyry is very like 26748

and to the periphery of Stewitz Island. There is also here a small greenish dyke with the same schistosity as the conglomerate, but cutting across the latter, and having on the sides the minor corrugations that result from washing.

South of the conglomerate beyond the depression on the East shore of Middle Bay, the slate again appears and is followed for some distance inland.

This slate has a cleavage nearly E & W corresponding with schistosity of conglomerate. Its strike (bedding bands), is nearly at right angles to this cleavage - viz  $N 5^{\circ} E$ . Dip  $50^{\circ} - 75^{\circ} E$ .

Inland at some little distance from the shore the strike is at first  $35^{\circ} N$  of  $U$ . and little further inland  $55^{\circ} N$  of  $U$ .

Immediately south of the slate, constituting the S and the west banks of the South End of Middle Bay, is a broad band of the periphery similar in all respects to 26448. The belt was traced

island for several hundred paces.

From this point turned back and coasted along the west and north shores of Stuntz island.

The S.W. corner of the island is conglomerate except at its extreme, which is slate. The main portion of island is Schistose Porphyry.

F.P.

26754

Make Slide

The high rocky island East of Stuntz and the two adjacent islands, are also of the same rock.

On the larger island is complex fracturing in two directions the blocks between which in some cases have a slightly rounded appearance reminding, resembling pebbles. This is what Smith describes as the beginning of the formation of mechanical conglomerates.

The East point at the mouth of Stuntz Bay, Cur is at the water's edge, of black and gray chert identical in appearance with that later found in Stuntz Conglomerate. The area of chert and jasper rapidly broadens to the East and entirely comprises the two prominent

hills indicated on map. Both Clements and Van Hise found the gaskets to be minutely corrugated into many anticlines and synclines. The axes of the folds correspond with the longer axes of the complex ridges and their strike is uniformly to the west at 40°-50°. This pitch combined with trending to the east strongly indicates an anticline of gasket.

Immediately south of the lowland south of the gasket is the ridge which makes the north part of the East end of Stuntz Bay. This is composed mainly of the Conglomerate in typical development.

C 26785 Conglomerate pebbles

C 26786 " "

July 3.

Coasted along East side of Stuntz Bay. At first little point is a ledge of what was taken at the time for a coarse grained phase of the Oolitic periphyry. Later doubt was thrown on this determination and the ledge was examined again.

500  
26787

when it was thought also

(Cf. No.

On the north side of the East End of the bay porphyry is well developed in two hills separated from the Conglomerate of the Stand with by a slight depression.

The rock is quite coarse, somewhat broken by numerous fractures in two directions, breaking it up into small polyhedral blocks.

put in C  
No.

26458

From East side of Hill overlooking Swamp.

*Note Correction in topography!*

The magnificent exposures of Conglomerate on the north side of Stand Bay were carefully examined. The conglomerate is filled with rounded well rounded pebbles. In places the rock is a great boulder conglomerate; the pebbles of various sizes being packed closely together, with very little matrix between them. It varies from a phase in which the boulders are 2 ft. or more in diameter to a fine grained grit closely resembling the porphyry. In one place there is a coarse irregular conglomerate.

crati such as is usually deposited near a shore line and in direct contact with this is a 4 ft. wide band of beautiful regular conglomerate such as would be produced by the consolidation of a shingle beach. The majority of the pebbles vary from 1 to 6 inches in diameter. They have not been greatly deformed, although crossed by fracturing into thin board-like pieces. This phenomenon was observed in a large fragment of the rock which cannot be proven to be in place, but which is unquestionably not far removed from its original position [Photograph]

The pebbles in the main mass of the conglomerate are at least 90% a quartz-feldspar porphyry having somewhat different aspects, but probably belonging to the same rock.

Next in abundance are pebbles from the iron formation, comprising white and black chert and ferruginous chert in every respect similar to that in the ridge to the north. No red jasper pebbles were seen at this place.

The pebbles are in some cases rounded, but many others are angular. Their angularity is often increased by fracturing. As a rule the larger fragments are the more angular and the smaller ones the more rounded as would naturally be expected. Here and there are large boulders and fragments of a conglomeratic looking rock that is taken to be a tuff.

<sup>c</sup> 26759 Specimen from boulder 2 ft in diam. Smaller pebbles of this kind are numerous, but being softer than others they have been much distorted and in places appear to merge into the surrounding matrix.

<sup>c</sup> 26760 Matrix of coarse grained conglomerate

<sup>c</sup> 26761 Fine grained, or pebble conglomerate near middle of hill.

<sup>c</sup> 26762 Fine grained conglomerate a little further south.

Interbedded with the conglomerate bed in places is a fine grained white rock that was at first taken for the schistose porphyry 26758. It has

sw  
 26463  
 ever differs from the Porphyry in having a dull gray instead of a greenish gray color. It moreover contains minute chlorite leaflets scattered similar to but smaller than those in the fine grained conglomerate. It is regarded as a graywacke.

July 11.

Re-examined Stuntz Conglomerate. It was found that the coarse conglomerate is more prevalent on the North side of area next to the jasper and then on the South side next to the bay, the Central area between these being occupied mainly by a fine grained phase which is interlaminated with beds of slate some of which are as much as 5-6 ft. thick. These slate beds enable us to determine the bedding and consequently the structure. The triangular area of the conglomerate is thus found to be a westward pitching syncline. At the ends of the minor folds near the middle of the syncline the axis is found to be striking N. 40° E. and pitching 30°-45° to S.W.

but smaller patches are more preva-  
lent. In the trough of the fold the slate  
is handsomely puckerd, as is charac-  
teristic for the rock in such places.  
One of the topmost beds found was a  
nearly pure slate. <sup>There</sup> are here  
the features for westward plunging  
Synclinalium widening to the west.  
Graywacke band resembling porphyry,  
interlaminated with slate.

St. Geo.

2676v

St. Geo.

2676s

St. 2676b

Graywacke and slate interbedded.

Slate into which graywacke grades  
through numerous laminations, the  
last alternating band in this case  
being only an inch thick.

The schistosity throughout the cong-  
lomerate, graywacke and slate series  
strikes approximately E-W. and dips  
nearly vertical without respect to the  
bedding.

h.

2676y

Cutting the conglomerate are various  
intrusives. The reddest is a green schist  
with pink feldspar. These dykes are of  
various widths up to 6 or 8 ft. or more.  
The same dyke varies in width in its  
different parts. The dykes often cut

across the Schistosity, at various angles, but the schistosity, both intruding and intruded rock nearly or exactly correspond.

The most abundant intruding is a gray-white mottled porphyry rich in feldspar. This occurs in dykes from minute stringers in dimensions to large dykes 8-10 ft. across. In case of the larger dykes the contacts are perfectly clear. The smaller dykes and stringers anastomose between the pebbles of the conglomerate in a complex fashion.

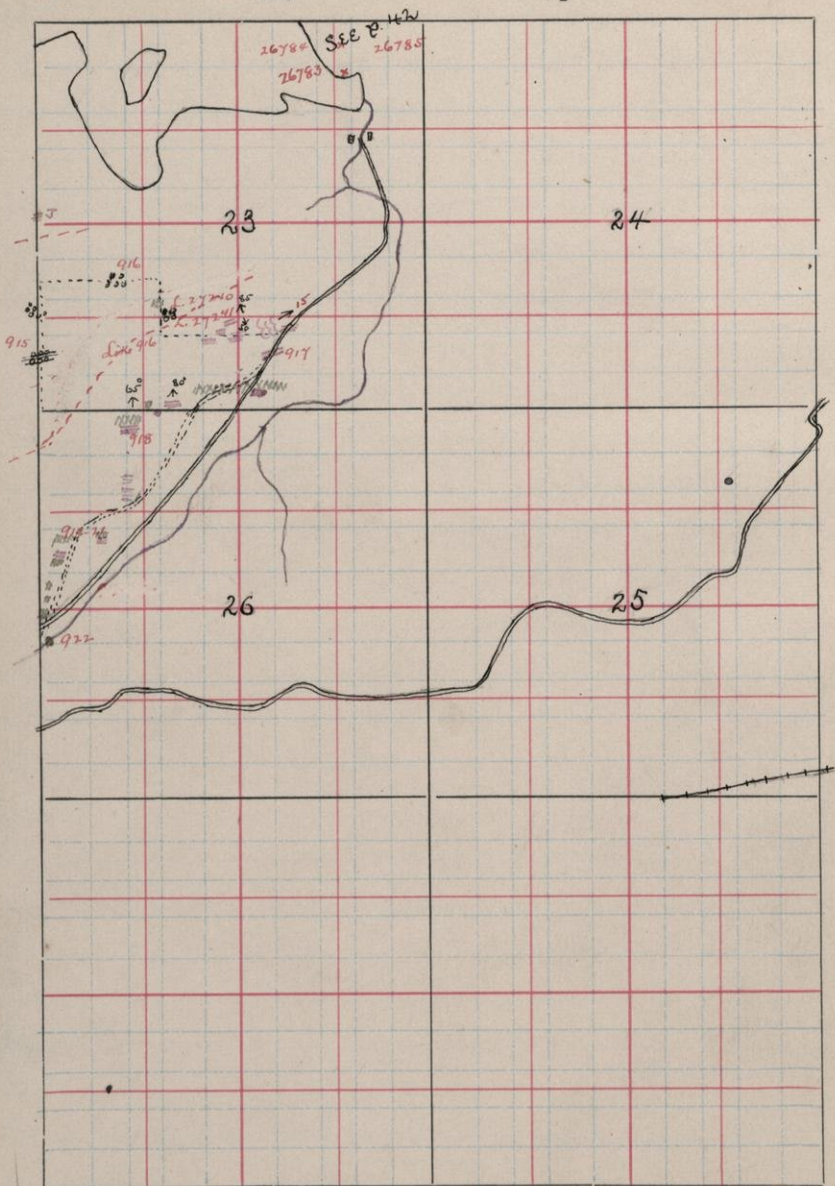
As a general thing it may be stated that the porphyry dykes have a tendency to follow the Schistosity of the conglomerate, but when closely observed the majority of them cut diagonally across this structural feature at a very acute angle. This would indicate that the Schistosity controls direction of intrusion of porphyry to a slight extent.

As has been stated above the gray wacke and the <sup>porphyry?</sup> conglomerate were at first confused. While a close examination of the fresh surface of the rock will give

S.

T. 62

R. 15



seem to discriminate between the two rocks, it is often easier to distinguish between them by their relative toughness. The graywacke is extremely brittle and the porphyry tough and refractory.

26768

The weathered surfaces of the porphyry and of the graywacke are very similar. Furthermore, some of the dykes contain large and small masses conglomerate, sometimes single pebbles from this rock and sometimes complex fragments. Hence externally the porphyry and the graywacke are often alike, and so complex are the relations of the intruding to the sedimentary rock that without close observation we might conclude that the porphyry and the conglomerate represent but a single rock, the conglomerate being but a brecciated form of the former, as Smyth & Finlay declare.

However, it seems almost incredible that alternating bands of graywacke, slate and a rock containing rounded pebbles could be regarded

as anything but a sedimentary series.

The porphyry is younger than the greenstone in the dykes - and probably much younger, for it has no schistosity - merely a rift, whereas, as has already been indicated the greenstone is schistose. In this respect this porphyry differs from the best porphyry west of the Stunt Bay jasper. At one place the porphyry and green-schist come in contact and here the former includes fragments of the latter.

The Conglomerate and the two intrusions above described are all cut across by a fresh dolerite dyke about 1 ft. wide.

- 26768 Coarse porphyry from widest dyke observed.
- 26769 Another phase of porphyry from 4 ft. wide dyke.
- 26770 Finer grained porphyry from dyke 2 ft. wide.
- 26771 Porphyry containing green schist inclusions.
- ✓ 26772 Dolerite dyke.

O.P.

26773

Graywacke from near center of Syncline-  
crinus, having remarkable resemblance  
to porphyry. Indeed may be part

O.P.

of porphyry dike.

26774

different phase of same rock.

The Conglomerate was traced north to  
within 50 steps of the jasper in little  
bay just east of "Jasper point". Here  
as elsewhere near the contact the  
predominant pebbles are of jasper.  
These occur everywhere to a notable  
increase in jasper fragments as the  
contact of the conglomerate with the jas-  
per is approached.

The small islands west of the Conglom-  
erate area, i.e. south of Jasper point  
are all composed of typical material,  
some of which shows beautifully the Shin-  
gle beach formation.

J. 18

26775-6

The small island a little N. of W. of  
Jasper point is composed of the same  
black jasper as the point itself and  
the hills to the east. It contains narrow  
beds of white or gray chert exactly like  
the material of the chert fragments in

The Cinglamerale?

Strike N. 55° E. Dip 75° 90° N.

F.P

26777

The island in vicinity of Jasper Point  
was next examined and Specimens  
Porphyry Schist in Stimpz island, di-  
rectly N. of Jasper island.

C 26778

C 26779

Cinglamerale Schist from little island  
off the two islands of Jasper Point, an  
Specimen showing pebbles.

Make slide  
F.P 26780

Q.P. 26781

Island in bay North of Jasper Porphyry  
Porphyry from N.W. side of large island  
in S.W. 1/4 Sec. 14.

F.P 26782

Specimen  
think! e.

Porphyry Schist in small island South  
of this are cut by dykes (26782) at East  
end.

July 5

b.s.

26783

The north shore of the little bay S.E. of  
26782 is a green schistose rock that  
resembles a Ogenized basalt amygdaloid

[See further No ]

C

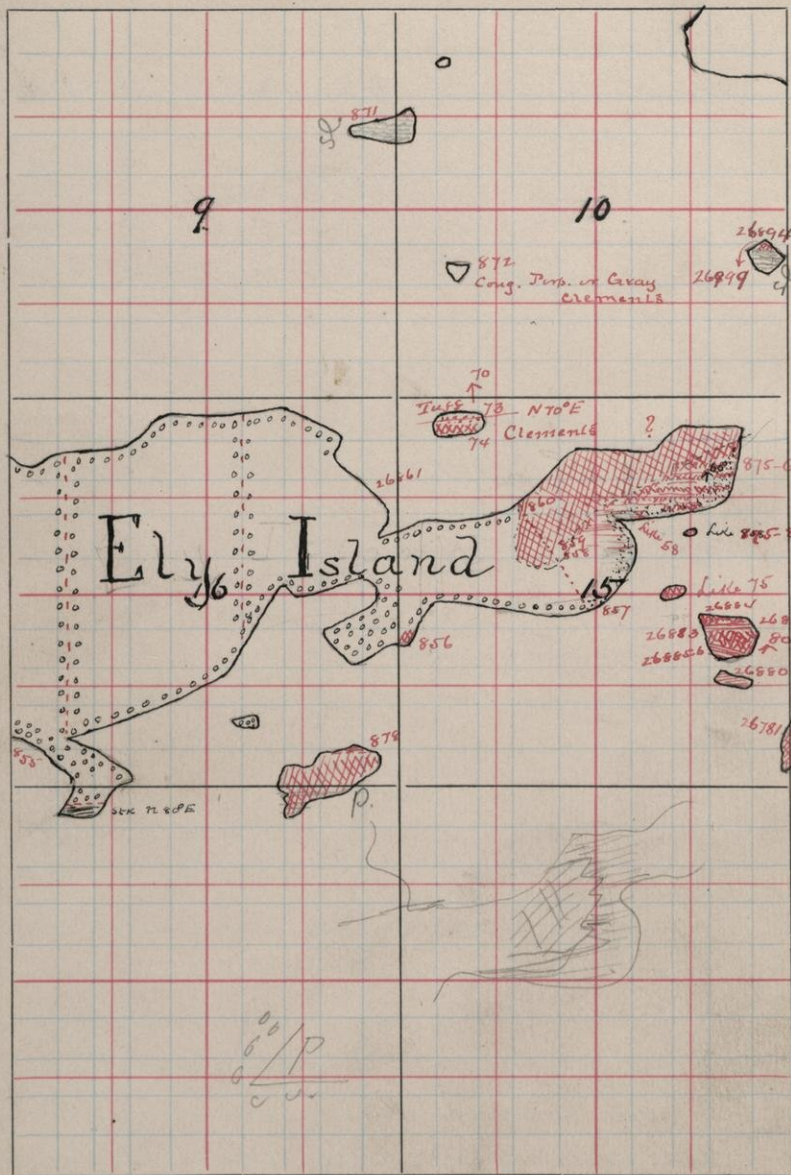
26784

Back of this to the north is a little  
patch of Jasper and north of this  
an area of a white rock forming  
crests and north sides of hills. This

S.

T.62

R. 15



have called a squeezed porphyry, but which may be a conglomerate since a few fragments of red jasper were seen in it.

B.S.A

26786

North and East of this is another green stone belt that is immediately south of mine jasper, and appears to intrude this rock. There is quite a large quantity of this rock, and beyond it to the east is mine jasper. In the north side of the jasper is another belt of schist, two phases of which are represented by

low

26786

Pink

low

26787

Red

[This area was gone over in detail later. For results see Nos 26912 page 42.]

The Shinarump near S. line of 14 and 13 is composed of a white schistose porphyry that is the extension of the white schist to the west. It seems occasionally to contain fragments, but as the whole is Eruptive in character.

Behind this is a little band of jasper, very narrow to the west and gradually

widening to the East, then narrowing again. Along the line between Secs 13 and 14 it is about 200 ft wide. On the North side of the belt the strike is about  $15^{\circ}$  S of W and on its South side  $10^{\circ}$  N of W. Dip on the whole is  $65^{\circ}$  N. Except at the center of the cliff facing the west where it is as low as  $30^{\circ}$  N. The cliff exhibits a good cross section of the Antic belt. The gneiss is in the whole the usual black rock, but occasionally red phases are met with.

- 26788 On the <sup>side of</sup> north face of cliff is the white schistose porphyry, where contact with the gneiss is covered, but where schistosity dips into bedding of the gneiss.
- 26789 On the weathered surface it appears to contain fragments.



- 26790 The little point on shore north of the gneiss cliff is the same white schistose like porphyry in its features.

F.P.

26791 Specimen from Deep rocky island west

F.P.

of Jasper point. Massive phase

26792

Schistose phase from same island

The little island to the west of this is

F.P.

Composed of the same rock.

26793

Schistose porphyry from little island west of 26780. Rock almost like gneiss.

The point east of 26780 is composed mainly of the schistose porphyry, which here has a pinkish tinge

M. H. S. S.  
Op.

26794

From point in NE 1/4 Sec 22. Two

26795

phases of schistose porphyry

Op.

26796

In this rock are numerous inclusions of green schist, which show a sort of transition between the two rocks.

A thin belt of Jasper occurs at west end of point near water's edge, being perhaps 30-40 paces wide at its west end and narrowing eastward disappearing within 150 paces. Porphyry is exposed on both sides of the Jasper

Op.

26797

On the south side of the island in the D.W. 1/4 Sec 14, a dense felsitic porphyry occurs. It contains large crystals of porphyritic quartz in a white matrix. It

is more massive than other porphyry  
 thus far observed. It may be a rock  
 of different age. It resembles more  
 nearly the pebbles in the conglomerate  
 than does the schistose porphyry,  
 and yet by its lack of schistosity, it  
 seems to prove itself younger than  
 the porphyry schist.

May not the explanation be as  
 follows: The Quartz porphyry is  
 younger than the schistose porphyry.  
 Originally the schistose porphyry  
 was like the quartz porphyry and  
 yielded pebbles to the Quartz Conglome-  
 rate. When the rocks were washed  
 the masses of the porphyry were  
 changed to schist, but the pebbles ad-  
 justed themselves to the movement  
 etc produced by the washing, thus  
 resisting squeezing and retaining  
 their original structure to a large ex-  
 tent.

In mapping no distinction has been  
 made in the various note-books between  
 these two porphyries—though an em-  
 phatic distinction should be made.

Q.P.

? 26798

Coarse  
Schistose porphyry from little hill on  
S.E. side of bay in S.W. 1/4 Sec 13.

Q 19

? 26799

Little island off easternmost of two  
points marking inlet this bay from the  
north.

M.W.

26842

Main mass of westernmost point. Schis-  
tose porphyry.

G

26843

The little island off this point of the  
same rock, cut by dykes of 26843

The main promontory from which  
these points extend is made up of ridges  
running nearly E-W with depressions  
between.

{ 26844

Fine grained porphyry from 1<sup>st</sup> ridges.

{ 26845

From small ridges about 10 paces north  
of ridges 26844.

Q.P. 26846

Porphyry containing coarse quartz  
crystals from another ridge still fur-  
ther north.

North of this ridge is a little depression  
in middle of which is small ridge of

C 26847

Conglomerate, bearing numerous

C 26848

porphyry pebbles and fewer of jasper  
and chert.

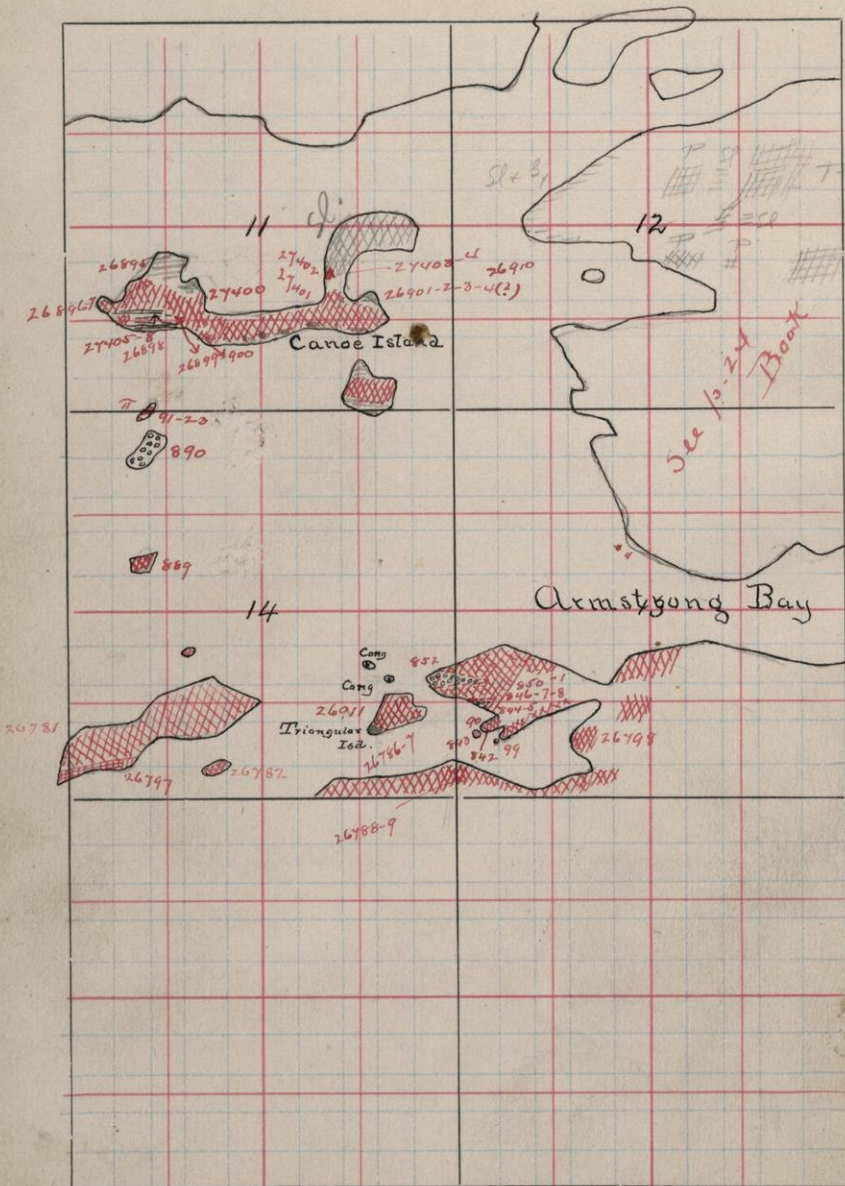
C 26849

On the north this conglomerate is suc-

S.

T. 62

R. 15



succeeded by a banded graywacke.

QP 26850

This little depression, which is about 100 paces wide, is again succeeded by a ridge of coarse porphyry with which are associated finer

QP

26851

grained phases with smaller crystals of quartz. A rock similar to that of the large island to the west (26797)

This porphyry is succeeded to the north by another conglomerate belt, 50 paces wide, widening to the west,

QP

26852

and this again by the porphyry numbered 26852.

The conglomerate belt contains very numerous pebbles and boulders of porphyry which are identical with the porphyritic rock containing crystals of quartz. These fragments are well rounded and appear to be clearly water-worn. There seems to be no escape from the conclusion that the conglomerate is a later formation than the porphyry. The most probable explanation is that the porphyry belongs to the Vermilion Iron-bearing series and that the conglomerate is

unconformably above this at the base of a younger formation - perhaps Animike.

According to this view the conglomerate in this formation is in two synclinal fingers with the porphyry as anticlines.

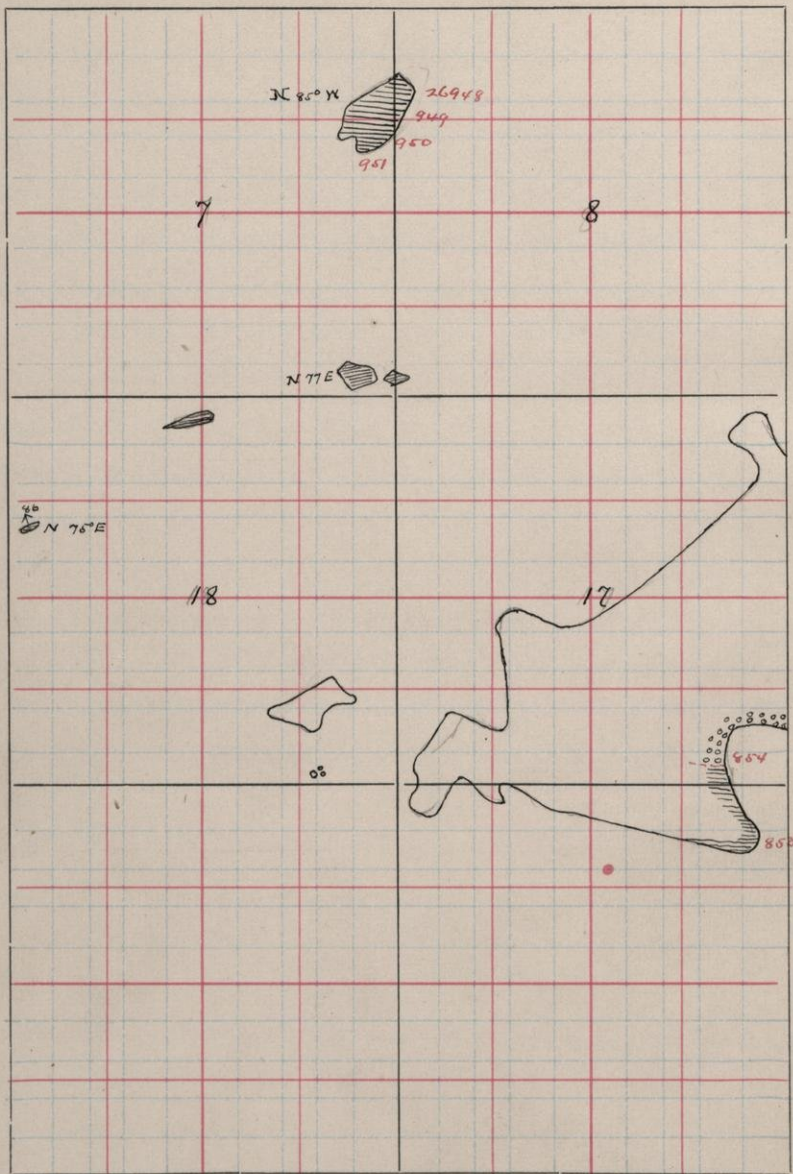
The conglomerate contains also rather numerous inclusions of chert and jasper. These give further evidence that conglomerate is later than Vermilion series. The only point of doubt here is as to the age of the porphyry, which might be an Upper-Huronic (Post-Vermilion) and thus that yielded fragments to the conglomerate [C. R. V.]

Or there may be two porphyries the quartz-porphyry being the younger and younger than conglomerate, and the schistose being older, and yielding pebbles to conglomerate. In this view the pebbles in this conglomerate did not come from the porphyry now now exposed in the point - these latter being intrusive. See Ault p. 21.

S.

T. 62

R. 15



July 6.

sl

Ely Island.

26853

Slate in west side of westernmost bay of Ely Island. Cleavage almost vertical, slightly to the South at  $75^{\circ}$ - $80^{\circ}$ .

c

26854

Strike of schistosity - N.  $10^{\circ}$  E.

Conglomerate in west side of bay. Contains numerous grains of quartz and fragments of green schist. If other fragments are present they are scarce.

c

26855

At the head of the bay bluffs of white schist conglomerate occur. These are cut into polygonal blocks by cleavage cracks, that produce a very different structure from that of the solid slate ledges nearby. The rock is very fissile. At first it was doubtful as to whether it is conglomerate or porphyry, but it is now thought to be the former.

The same rock extends west along the north side of the bay. It contains little pebbles of gneiss and fragments of porphyry. At short distance. In places it is interlaminated with slate beds.

A little further south, on the East side of Bay is a definite Conglomerate and South of this again slate. The cleavage of the Conglomerate here is about  $80^{\circ}$  to North.

In the Extreme point, East side of Bay the slate strikes N.  $80^{\circ}$  E.

Made several sections across Elly Island - one being N. from head of Bay and the other from  $\frac{1}{2}$  mile East - very Conglomerate being found.

In the Western traverse the following observations were made -

At 62 and 100 paces from Shore large Exposures were observed. In latter were numerous, large Jasper fragments.

At 125 and 155 are other ledges and at 225 a more slaty and gritty phase than the normal. Its schistosity - strikes  $10^{\circ}$  S of E.

At 300 N. to 500 N. a very large Exposure containing again large fragments of Jasper.

In Northern side of island the Conglomerate contains fewer chert and Jasper fragments, but so many porphyry

pebbles as to suggest the dynamic origin.

Along the East End of the island the conglomerate is exposed as far as the E. line Sec 16, and in the island off this coast.

Q.P.  
26856 In the little point at East side of the promontory over which E. line of 16 passes is porphyry (Clements) and beyond this for  $\frac{1}{2}$  mile is again conglomerate and graywacke.

At many places the graywacke is well banded.

st  
26857 Graywacke (Clements) from center line of Sec 15, on S. shore of Ely Island. From this point Clements made a traverse across the island in the direction.

Q.P.  
26858 The high hill crossed in this traverse is composed principally - and especially on its South side - of porphyry like specimens.

At top of the hill it is much coarser than elsewhere, weathering rough and much jointed into polygonal blocks.

Q.P.  
26859 Small specimens showing weathering.

Q.P.  
26860

On the north side of the ridge near the water's edge is a white schist that may be schistose porphyry. Along the shore at the East end of the island the banded graywacke occurs.

(See 75-76-77)

On the north side of the eastern half of the island conglomerate occurs as far as little bay near East line of Sec 16. West of this is a fine grained dense rock that may be porphyry but which is indicated on maps as were probably a part of the conglomerate series.

C  
26861

July 7

Made a trip northward through the Narrows between Pine Island and Main land.

P.P.  
26862

The point at East side of Narrows is a light green, coarse crystalline rock that took like a schistose porphyry or a granite? A later examination seemed to indicate that it is greenstone schist. Green schist from little island behind (north of) Pine Island.

gl  
26863

[Nos 862-870 mapped by Van Dine, Bayley, &

S.

T.

R.

The mapping of 26862-70 is in correspondence with Gules.

Dr Clements made a later visit to this portion of the District and has, as a result, this winter mapped many of these rocks as glaciers. The specimens will probably decide which determination is correct.

W. L. B.

Hb. M.

26864

Clementine Concert. See note opposite page 4

Homblerde granite from Remicircular hill, a little inland from shore north of Narrows behind Pine Island. The shore line is composed of green schist.

St.

26865

On the East side of Pine Island, about midway from N to S is a shelving rock composed of black slate whose schistosity strikes N. 45° E and dips 35°. The bedding planes make a series of sharp folds whose axes strike SW and pitch very steep to the west.

St.

26866

In the little island west of this point the rock is a green calcareous schist. The long narrow point N. of 865 is again green schist like 26866, with light and dark bands weathering rough. The strike is E-W.

South of this greenschist continues for some distance

St.

26867

Here the rocks are well banded, light green, calcareous schist, with bands striking N. 80° E and dipping about 80° N.

Specimen from lighter band

Hb.

26868

St.

26869

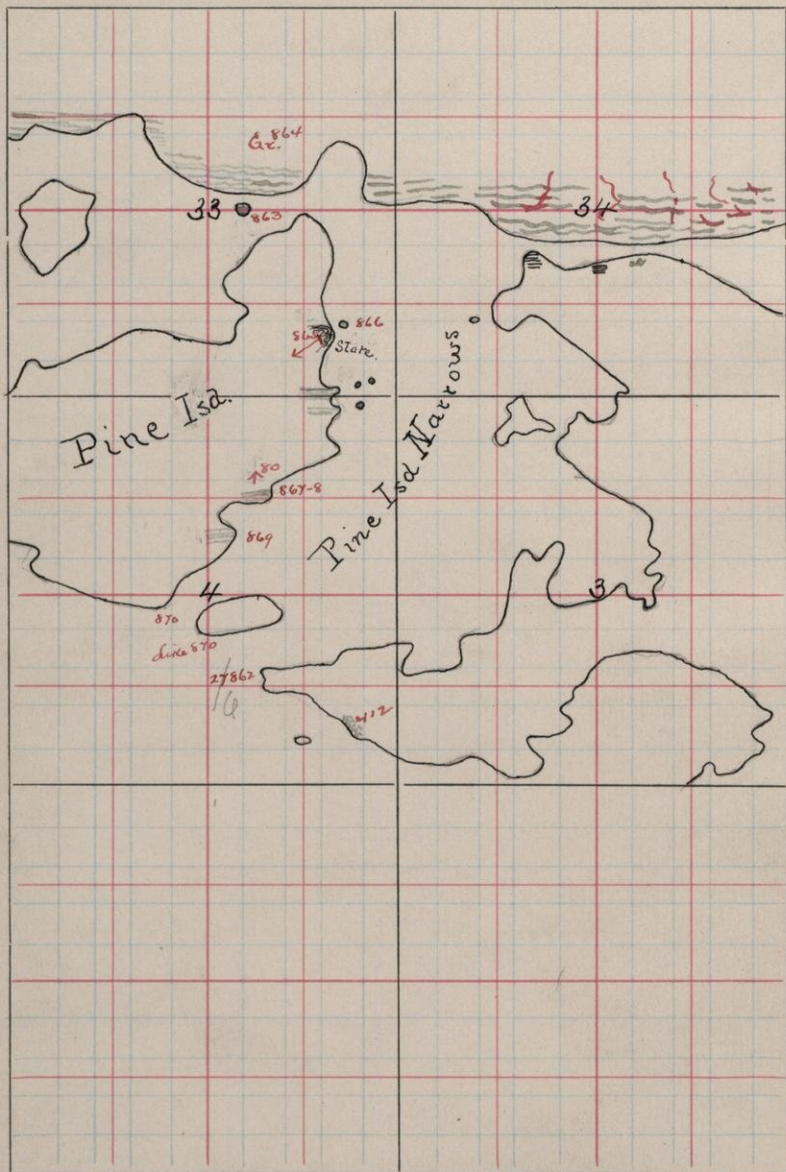
More granular phase.

The rocks represented by this specimen are more granular and apparently more calcareous.

S.

T.  $\frac{63}{62}$ 

R. 15



careno than those described above. Dip  
and strike the same.

26870 <sup>q</sup> Munette looking rock from point  
north of west end of island near center  
Dec 4. [Clements has mapped these as slates]

26871 <sup>sl</sup> Strongly banded green schist from 2"  
island between Pine and Ely

26872 <sup>qp</sup> Conglomerate or schistose porphyry from  
west island Oorok.

not the  
same as  
above

The rock is much broken by joints - into  
polygonal blocks. It is intricately veined  
by white quartz and has a peculiar ridge  
weathering when worn by the water re-  
mains like that noted in case of undoubted  
porphyry. Inclined to believe rock gray-  
wacke (Van Hise and Clements)

26873 <sup>sl</sup> Tough banded rock of dark greenish  
gray color. Strike N 40° E, dip 70° N.  
Weathers into ridges corresponding to  
finer and coarser phases. Believe to  
be dike. Forms N. side of island (V.H.)

26874 <sup>sl</sup> Porphyry, schistose. Cut by joints - into  
polygonal blocks. Forms south side of  
same island (Clements)

26875 <sup>sw</sup> Porphyry (cf. 26859) forming ridge run-  
ning through E. end of Ely Island. The

st. + NW  
26876

South side of the ridge is made up of alternating bands of rock which may be red slate and fine grained dense gray. It appears to be a porphyry. Passing toward the center is the gray bands become wider, slate bands less frequent until at last only films of slate are seen. However when slate bands are seen distinct the gray bands have become unmistakable porphyry. Represented by 26875.

st  
26877

Shows interbedded slate and porphyry. Slate bands strike E-W. dip 60° N.

### [Clements]

If these observations are correct as to the petrographic character of the banded rocks, it is clear that the porphyry is as young as the slate. Hence belongs with that porphyry which intrudes the conglomerate as dykes, in of Steno's Bay and is different from porphyry that yielded pebbles to the conglomerate. [W.S.B.]

W.S.B.

26878

Narrow strip of this banded rock from N. side island in S.E. Sec 16. Main mass of island is porphyry.

2

At first island west of E. end of Smith's Is-  
land the rock consists of a double  
Conglomerate showing beautifully the  
phenomena described by Smyth as evidence  
of dynamic origin of all of the rock. Called  
Smith's Conglomerate. This rock is studded  
with slightly rounded fragments of per-  
phyry, a vast number of which have ter-  
minations approximately in same direction,  
thus making them in slightly rounded  
lozenge shaped blocks. Between the peb-  
bles is a scanty, greenish schistose ma-  
trix which Le (Smyth) regards as the  
more marked and sheared parts of the  
original perphyry. No fragments were  
seen of any other rock whatever. If ledges  
here examined without reference to any  
other, Van Hise would probably agree with  
Smyth as to his conclusions with res-  
pect to origin of Conglomerate. In other  
words it is believed that Smyth is correct  
with respect to this rock, which however is  
not believed to being with the Smith's Con-  
glomerate.

The next two islands are like this one.

on island marked "B" in this group the cherting interesting material between the blocks has about disappeared and the rock consists almost exclusively of the lozenge shaped blocks with angles very sharp, or but slightly rounded. It is intermediate in character between the ordinary porphyry which is always broken into polygonal blocks and the peculiar rock having the features described above.

This confirms the conclusion that the peculiar rocks of this island are pseudo-conglomerates instead of true conglomerates.

Qp  
26879 Coarse porphyry from westernmost island.

[Observations recorded for specimens from 26872 to 26879 were made by Van Hise and Clement. On the map the East end of Ely Island is indicated as being composed of slate, and in the margin graywacke? is inserted. The dense gray rock is probably indicated by graywacke. In notes it is said to grade into porphyry. It is especially

unimportant to determine whether or  
not this rock is porphyry. If it is,  
slate is older than porphyry. If it is  
not the porphyry may be older than  
slate and conglomerate -

W.S.B.]

cl.  
26880

From little island in S.E. of Sec 15. A rock  
banded somewhat regularly with a  
strike N. 80° E and an almost perpen-  
dicular dip. Specimen slate, phase  
Massing phase

no  
26881

no 26882

Intermediate phase.

As usual the rock is broken by 2 sets of  
cross joints into polygonal blocks, one  
set of joints being acutely inclined to  
the banding and the other nearly a right  
angle to it. The rock may be a dense  
micaceous or a dense porphyry. Since  
however, the densest parts of the rock  
are very brittle and break with a con-  
choidal fracture it is probable that  
it is a sediment. It moreover shows  
no porphyritic crystals.

The next island to the north is largely  
composed of material identical with  
that just described. A bed of porphyry

F.Q.P.?

26883 from 10 to 15 paces wide runs length-  
wise through the center of the island. On  
the northwest point is also a typical  
exposure of porphyry, contain large por-  
phyritic quartz crystals. Immediately  
adjacent to this porphyry are  
slate

26886 Novaculite? or dense porphyry like 26881.

Between the two belts of porphyry is  
a coarse grained phase of the bedded  
rock, represented by

26887

26888

Besides the large porphyry belts in this  
island, there seem to be narrower intrusions  
of various sizes, some of the smaller ones be-  
ing difficult to distinguish from the  
belts of the bedded rock.

Van Stie thinks that the bedded rock  
is surely slate or novaculite? Bayley be-  
lieves that all may be porphyry, the  
slaty phases being sheared portions.

26889

Porphyry similar to Stump's porphyry.  
From small island NE of last island.  
Typical white? porphyry with quartz phen-  
ocrysts

Fine grained conglomerate from island  
 1/2 mile East of Ely island. Weathers  
 with an even schistosity - unlike that  
 of porphyry. It also contains small  
 jasper and chert pebbles.

Q.P.

26890

represents the true massing phase. This  
 resembles most closely the porphyry  
 and yet is distinct from it.

On the small island North of this one  
 the rock is supposed to be porphyry  
 though it may be graywacke or horn-  
 shale. A fine grained dense material  
 is interbedded with beds of slaty mate-  
 rial sometimes as much as 3/4 in thick.  
 The more slaty layers resemble the well-  
 laminated layers which in the more  
 southerly island (680-82) are supposed  
 to be slate. This however seems to grade  
 into coarser layers with some of the  
 character of porphyry. The coarser bands  
 are broken up into polygonal blocks  
 having thin layers of chert and  
 slaty material between them.

A comparison of modes of weathering of  
 the banded rocks studied that those of the  
 undoubted porphyry and the undoubted

Conglomerate favors the view that a larger part of the banded material is porphyry, which because of the inter-lamination of slaty layers has the appearance of a sedimentary rock. Van Stice suspects a case of complicated intrusion of porphyry into a sedimentary series. This explanation corresponds with Clement's observations at East and of Ely island, which in center is unmistakably porphyry, and on the sides, especially the south side, the peculiar interbanded material already described, and beyond this on both sides the unmistakable conglomerate. Coarse porphyry from center little island  
 Intermediate material from band about 2 in. wide.  
 Fine material from band an inch wide.

July 8

Examined Big Island in P.W. of Sec. 11 in company with Prof. Van Stice, beginning at west end and running east along the south side.

The little island at the west end of

the big island is mainly a slaty green  
Schist, with an E-W. Schistosity, posses-  
sing a vertical dip.

F.P.

26894 A little strip of schistose porphyry was  
observed on its north side.

st

26895

at west end of the big island is a green  
schist which occupies a portion of the point.  
This is interlaminated with porphyry  
in several beds. Sometimes the porphyry  
immediately adjacent to the schist  
is itself very schistose breaking up  
readily into acute angled blocks made  
of the intersection of two sets of planes.

st

26896

This rock can be traced with undoubted  
gradations into ordinary massive por-  
phyry.

F.P.

26897

The hurried examination of these rela-  
tions seem to show that the porphyry is  
intruding in the schist and that sub-  
sequent to the intrusion both rocks were  
washed together.

In coasting along the south side of  
island found porphyry at first salient  
and at first re-entrant - a considerable  
mass of greenish-black slate striking

sl  
26898

nearly E-W and dipping high to north  
slate.

FR  
26899

This slate is flanked on both sides by  
what is taken to be schistose porphyry.

sl  
26900

Within the porphyry areas are narrow  
ledges, or rather layers, of a greenish  
chloritic slate, closely resembling the  
greenish schist. 895.

The occurrence suggests that the chlor-  
itic slates are but the black slate altered  
by the porphyry. If this is so the ques-  
tion immediately arises whether or so  
the green schist belt north of Vermilion  
Lake is an ordinary sedimentary slate  
modified by intrusions into green  
schist, or whether it is an older series  
as Irving supposed.

The presence of slate in Pine Island  
gives support to the metamorphic idea.  
However it being true that some of the green  
schist of the northern belt are really  
altered sediments, it would not neces-  
sarily follow that all are [V. H. and B]  
[Latest investigation of Pine Island shows  
unaltered slates interstratified with

gneiss. This phenomenon indicates either that the green schists are Algonkian or younger, and that intruding in the slate, or that there has been a most remarkable instance here of selective metamorphism. See 27400-408.]

At northern extremity of bay at East end of island, is a belt of chloritic slate 25 steps broad, flanked on both sides by porphyry. The contact appears to cut across the slate cleavage at very small angles.

26902 Porphyry from north of slate at contact. The slate near the porphyry contains hard gray interlamination, varying from fractions of an inch to 2 or 3 in. in thickness. The hard layers seem to be entirely distinct from the porphyry but their gradual appearance in approaching the porphyry suggests that they are due to its influence.

26903 Dense material from south side of slate belt.

26904 Thin layer of slate material about 6 ft. wide flanked on both sides by porphyry. North of main slate belt.

[For more detailed examination of island see  
Nos 24400-408.]

QP  
26905

26901-4, prob. East End of Curacao de-  
scribed under 24403-4.

?  
NW SL  
26906

Specimens from <sup>to 26909</sup> 26905<sub>1</sub> are from shore be-  
tween Armstrong Bay and Pine Island  
Harbor. Cannot locate more accurately.  
As all this territory was worked over  
in detail, specimens from this shore were collected.

SL  
26907

West point west by 50 paces composed of  
numerous alternations of a dark gray  
rock taken to be a graywacke and  
of a light gray rock supposed to be por-  
phyry.

NW.  
26908

The porphyry bands vary in width from an  
inch or two to 10 or 15 ft. The slate bands  
or graywacke bands are for the most  
part narrow but some of them are sev-  
eral feet wide. The porphyry bands are  
most numerous to the south near the Salid  
porphyry and the slate bands more abun-  
dant in center of point.

SW  
26909

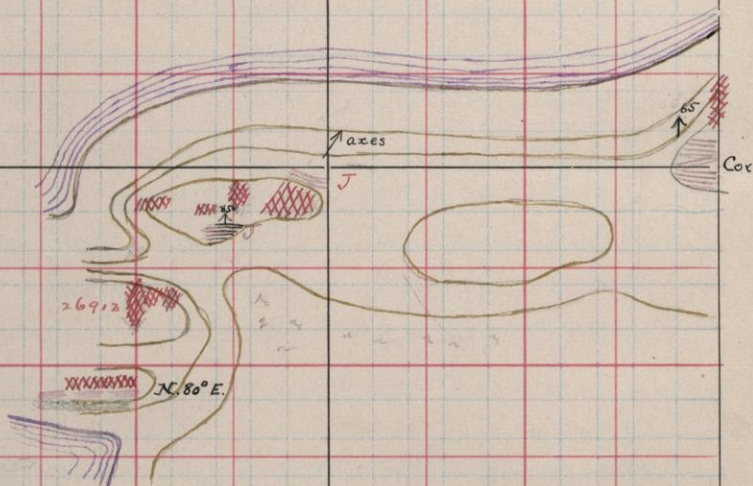
See under 26905 above.

S. 23

T. 62

R. 15

$\frac{1}{4}$  S.



$N \frac{1}{2}$  of  $NE \frac{1}{4}$  Sec. 23

50 paces bet. blue  
lines

C  
26910

Fine grained conglomerate from little  
point west of same point by which  
909 is located.

Q.P.  
26911

Coarse quartz porphyry, weathering  
schistose. Makes northern portion of  
Triangular Island. Southern portion of  
Island is greenstone (Diabase)

July 10

Examined carefully the point on line  
between Rees 14 and 23 for purpose of  
mapping.

Q.P. 21  
26912

C

at 750 W. 180 S of NE Cor. Sec 20. no  
little hill behind the jasper is a white  
schistose rock that may be porphyry or  
conglomerate. No strike is about E-W. The  
rock contains great quantities of green  
schist pebbles or fragments.

C  
26913

Porphyry from East side Stuntz Bay, near  
compressor.

Draw U<sup>1/4</sup> post. S.

July 11

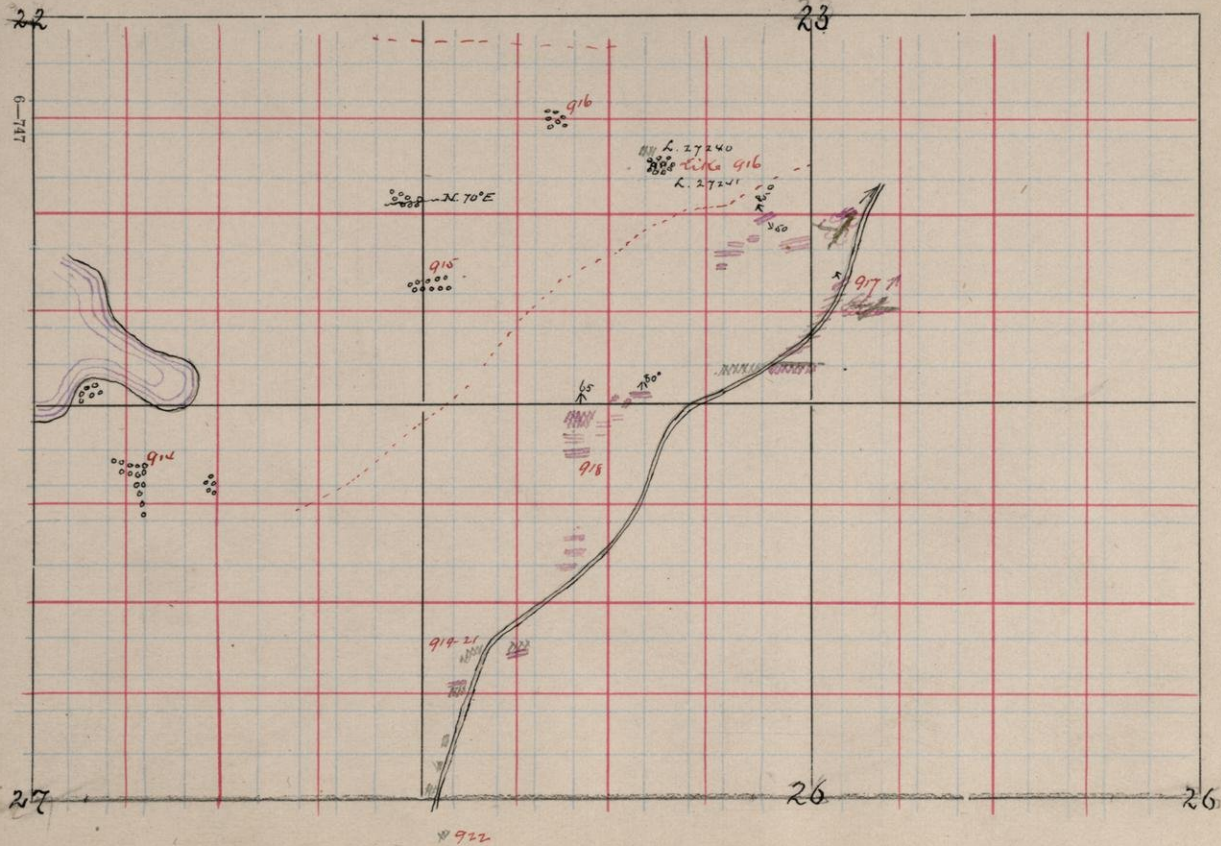
Draw U<sup>1/4</sup> post. Sec 27 run East 250,  
then S. 200, E. 250, U. 200, E. to Corner,  
U. 450, E. 600, S. 350, E. broad at 500.  
Further E, then S.W. along road with  
additional traverses as indicated by  
dotted line on map.

On north side of Jordan Hill near  
the top is a ledge of white rock that  
was taken to be a porphyry. Its lo-  
cation is 450 W. 150 S. of U.E. cor. Sec. 27.  
The rock extends as plotted, the over-  
lying portion of the ledge looking more like  
conglomerate than like porphyry.

300 paces U. of same corner, 2.5. 300  
U. of S.E. cor. Sec 22, is a bare knoll of  
white rock containing grains of quartz.  
It resembles a porphyry, but may  
nevertheless be a fine grained con-  
glomerate.

The knob at 550 U. of same corner is  
more conglomeratic than the rock further  
south. It forms a bare rocky south-facing

Stk line N of E



cliff in which the strike of the schisto-  
sity is  $N. 40^{\circ} E.$

The little knoll near the  $W\frac{1}{4}$  part of  
Sec 23 is mainly drift covered. Near  
N.W. side of this however is what ap-  
pears to be an exposure of Jasper Strik-  
ing a little  $N$  of  $E.$

for  
26916

At 750 N. 350 E of O.W. cor Sec 23 is  
a ledge of dense rock like that which  
have thought to be porphyry because  
it contains eyes of quartz. It how-  
ever in this place contains in ad-  
dition many inclusions of jasper and of  
what looks like black slate. It is  
probably a dense fragmental.

At 650 N. 600 E of O.W. cor Sec 23 on side  
of hill near top is a large ledge of the  
same kind of white rock as have been  
finding. Here it is cut by quartz veins  
in great profusion and by a green-  
stone dyke (Leith.)

About 1070 E. 400 N of O.W. cor Sec 23 are  
great ledges of jasper with faces being

ing N.E. The fossils are small and numerous. The pitch at various angles, the general pitch being as indicated. This jasper is the black variety. It is cut by a greenstone dyke.

The little hill East of the road at 1100 - 1200 E. 250 N. of Sec 23 is composed of irregularly contorted jasper striking in the whole, N.E. and dipping N. at high angle. At the apices of the folds there are brecciated. The general pitch of the major folds is N.E. In place the rock is red, but the general color is black. It is cut by a greenstone dyke 4 ft. wide running about E.W.

The road in Sec 20 is very jasper striking generally N.E. as far S. as South Section line. Just north of the Section line is a small ridge of greenstone.

Specimen of red jasper from near 1050 1050 W. 300 N. of S.E. Cor Sec 20.

At 400 E. 1000 of N.E. Cor Sec 27 the jasper which is abundant here, is cut by a dyke of porphyry along its strike.

J  
26917

X. D.  
26918

on west side of road near point indicated  
by the numbers, viz. at about 6003.

1505 of NW cor Dec 26, is a mass of  
greenstone, in places schistose and in  
other places light colored, like a per-  
phyry. These rocks are believed to be  
different phases of same magma.

h

26919

Normal phase, South 3

F<sup>P</sup> 26920

Light colored phase

h. 26921

Schistose phase, North-west.

On the east side of the road is the  
same <sup>greenstone</sup> ~~jasper~~ which here seems to  
intrude jasper.

On the south side of the road just E. of  
the E. 1/4 p. Dec 27 is a small smooth  
ledge of schistose rock which is white  
on its north side like schistose conglom-  
erate, and on its south side is dark  
like greenstone. The contact between the  
two rocks is sharp and stringers of the  
white rock are found in the dark one.

h. s. ?

26922

Specimen of the white schist.

[See also Keith's notes 27240-41 and thereabouts]

Note abundance of greenstone dykes in  
jasper in this vicinity. These are proba-

by apophyses from great greenstone  
mass to S.E.

July 12

Ran S.E. from Pike River Bay to  
County road then S on road to cross  
road running to Pike river. Then re-  
turned and went East on road to  
Saw mill. At this point took canoe and  
examined shore line at west end of bay  
island in it.

4W  
26923

The flat ledge on S. shore of bay at point  
where landed is a white rock that is  
apparently graywacke.

51.  
26924

360 paces S.E. of this point is a mass-  
covered ledge, from which could get but  
a single small piece. It seems to be  
graywacke and slate? Practically same  
rock occurs on spur of hill as far to the  
S.E. as 520 paces. At its Southern end

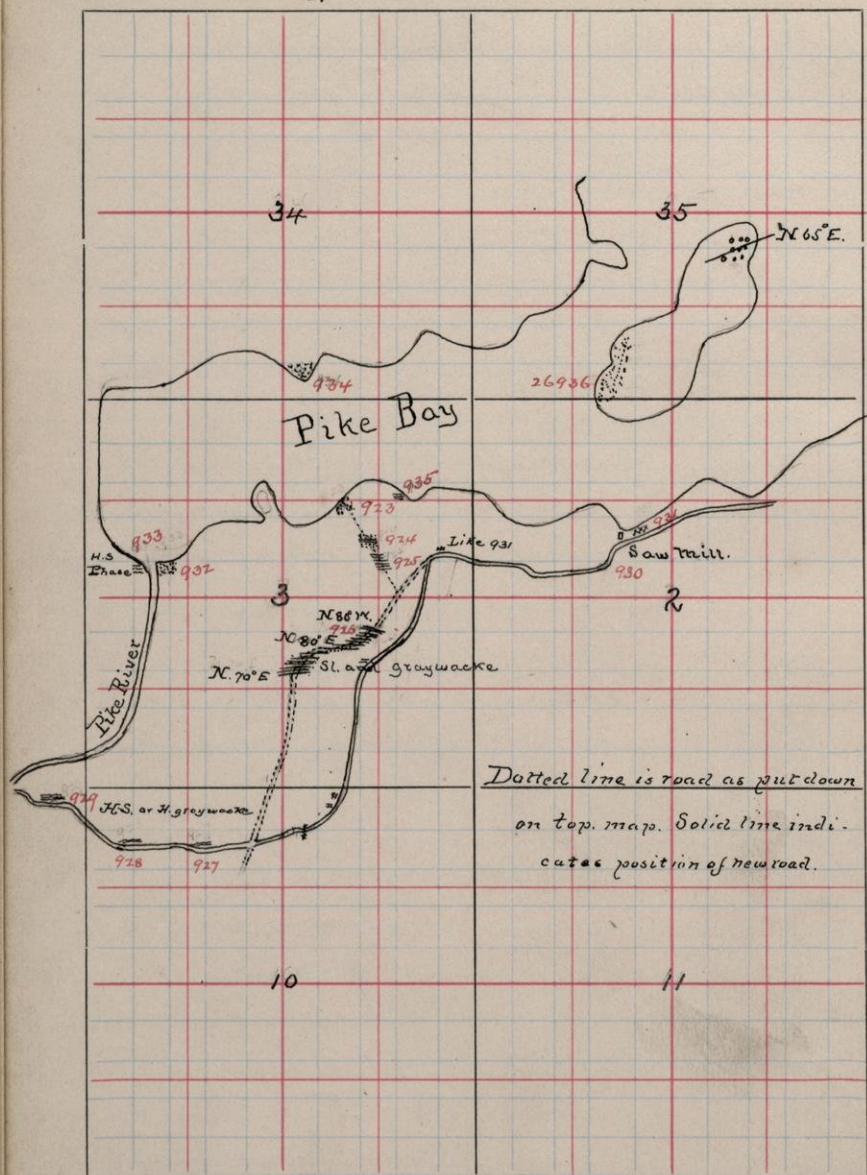
4W  
26925

the rock appears to be more quartzitic.

S.

T.  $\frac{62}{61}$ 

R. 16



After struck the road at 650 S. W. went  
325 paces to slope of hill where found a banded  
rock striking  $N. 80^{\circ} W$  and dipping  
almost vertically. In places it is banded and  
crinoid. In other places the rock resembles  
a fine grained greenstone, and still again  
it seems like a graywacke.

St  
26926

Graywacke phase from Kivala south of  
road.

A little further south the rock is beau-  
tifully banded the bands varying in  
width between 6 and 8 inches, and striking  
south west rather than north of west.  
Further south the strike is even more  
southerly, being for the southern portion  
of the district struck about  $N. 70^{\circ} E$ .

Many of the banded rocks are cut by chert-  
quartz veins.

The same rocks with numerous outcrops  
extend all the way to Pike River. Great  
cliffs are beautifully exposed all along the  
road. They are banded as described a-  
bove and strike  $15^{\circ}-20^{\circ} S$  of  $W$ . The gener-  
al tendency observed in the rocks as passed  
south is toward increase in thickness  
or breadth and consequently an increase

in their resemblance to hornblende schists. These rocks are regarded as Irving as belonging with the Archean, being indicated as a green schist belt. From what have been considered them all fragments

Hb. M. S.

26927

Hornblende phase

Hb. M. S.

26928

Hornblende schist phase

Hb. S.

26929

Graywacke phase from about 400 paces East of bridge in Pine River.

All in N.E. 1/4 Sec 9. T. 61 R. 16

M. S.

26930

Near the Saw mill, near center Sec 2. T. 61 R. 16, where road turns East is a well banded hornblende schist or hornblende graywacke striking E-W. This is so far north that there seems to be no question that the schist and graywackes are interlaminated.

C

26931

Near Saw mill, on its East side great exposure of white schist that I take to belong with the conglomerates.

A new road has been opened S.W. from Saw mill to overcome hills in road indicated on map. This was located as shown opp. p. 48.

While investigating the schists and banded rocks in road by Hammond bay to west and took following specimens.

<sup>rw</sup>  
26932 White rock resembling schistose porphyry, but probably graywacke from mouth of Pike river, East side.

<sup>m.s.</sup>  
26933 Hornblende schist phase west side, mouth stream.

<sup>g. w.</sup>  
26934 Schistose graywacke, from knob on north side of bay near U.S. post Dec 34

<sup>g.w.</sup>  
26935 Thin small ledge in shore in bay (2nd west from Saw-mill).  
Dark hornblending rock, containing spots that look like fragments of slate.

<sup>C</sup>  
26936 In island in Pike bay is wholly conglomerate. In the S.W. corner of island are ledges of fine grained white rock that are probably fine grained phase of conglomerate or graywacke.

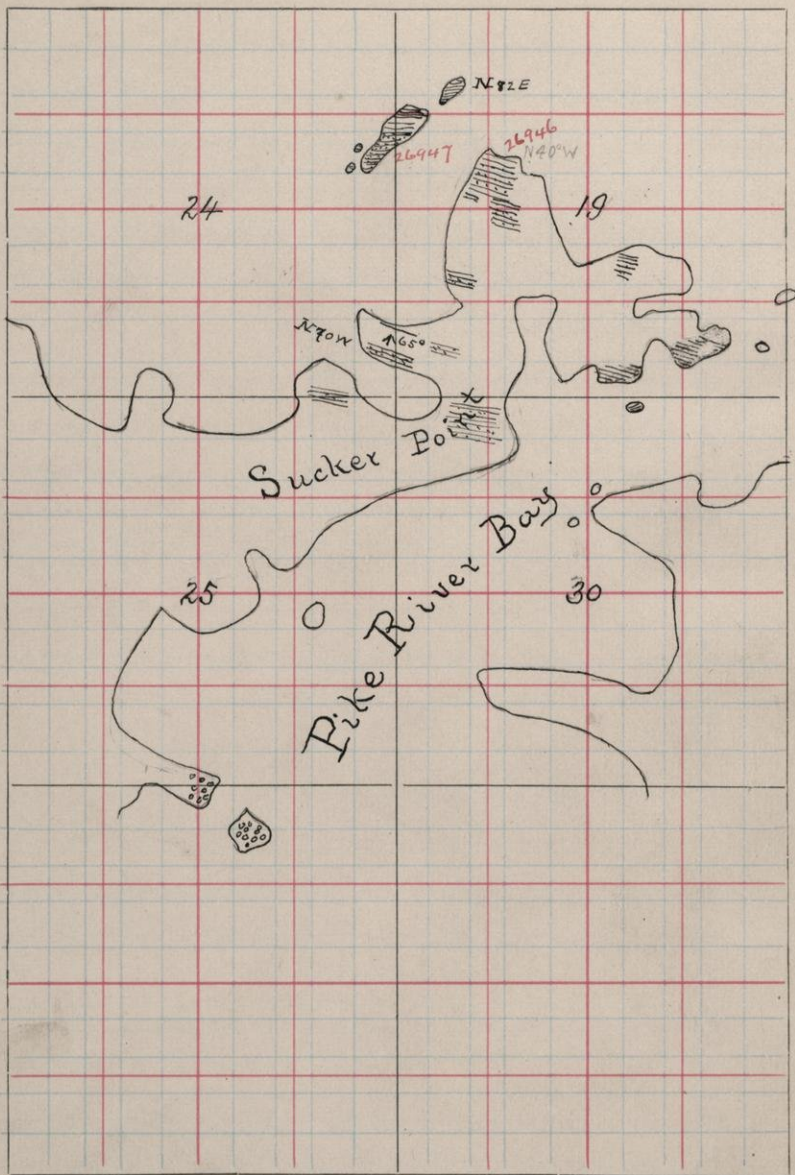
In N.E. corner of island near the house is a splendid exposure of conglomerate in which all kinds of fragments and pebbles are imbedded. The strike is west

S.

T. 622

R.

16/15



defined at N.  $65^{\circ}$  E.

The extreme N.E. part of Licker Point is composed of graywacke and slate striking N.  $40^{\circ}$  W., and all the rocks on South side of point is the same in character.

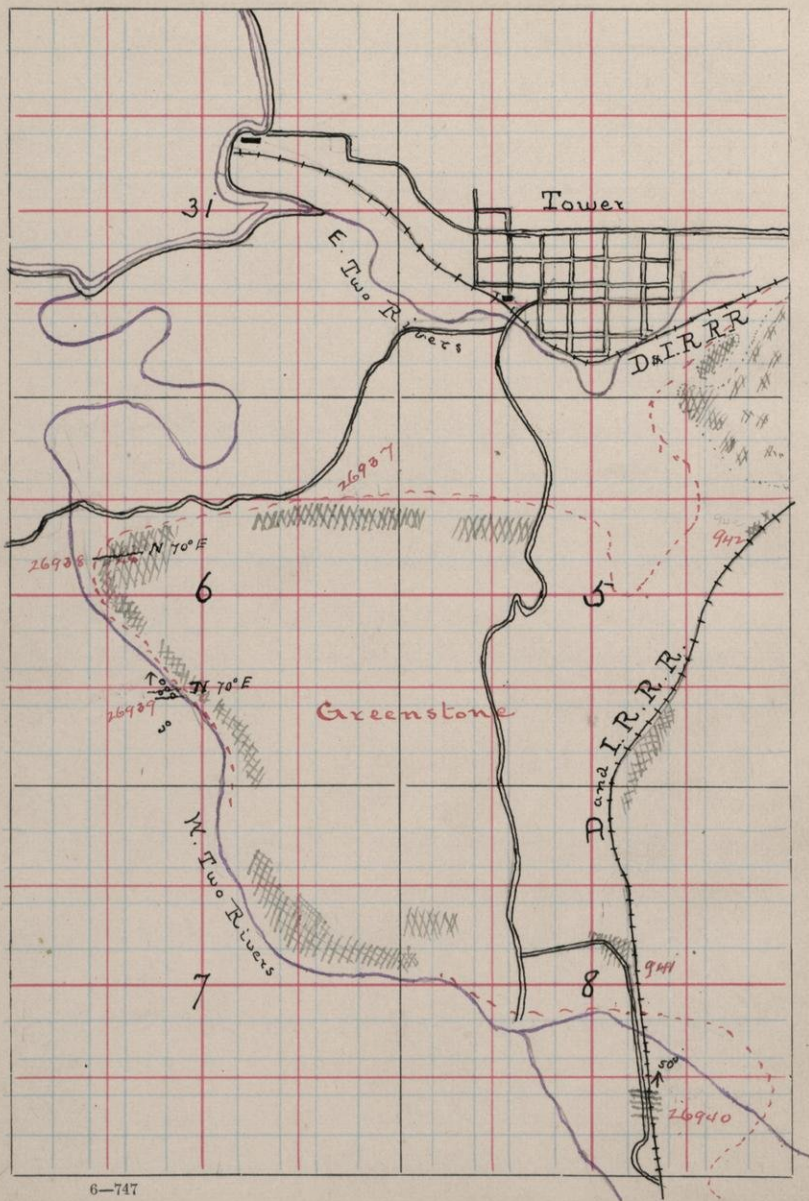
It seems as though here as elsewhere the big finger of Vermilion, in this case known as Pike Bay, is eroded from the graywackes and slates lying above the conglomerate. This series seems to be younger than conglomerate and the so-called hornblende-schists are schistose and somewhat altered graywackes and slates.

This means that the upper Vermilion stretches south over Irving's green-schist belt. How far south it goes we know not. Whether its Southern limit is the north side of the Quica schist belt of Irving or whether it is at the Mesabi range and whether this range is composed of a younger granite than here long believed is questionable.

S.

T.  $\frac{62}{61}$ 

R. 15



July 13.

Examined country S. and S.W. of Jones going along road that crosses west two rivers then S.E. across hills approx. parallel to the stream to the rail road. Then down railroad to crossing of S. branch of W. Two rivers and north to Jones Junction. From this point west across hill S.W. of Jones to the city.

26937 The rock on the north side of the big bluff south of road at about 500 W. of E line Sec. 6 is a dark colored gray-wacke or greenstone which in some places appears like free of Jasper fragments. The bedding and schistosity not so well defined as typical measures.

26938 On the west facing bluff overlooking the river are great exposures of the same rock with a well defined schistosity striking about  $20^{\circ}$  S of W. At this place the rock looks much more like greenstone than like graywacke.

On the west side of W. Two rivers approx. a greenstone ledge is a large exposure.

ure of thin-bedded conglomerate containing long drawn out fragments of green schist and porphyry. The schistosity strikes a little S. of W. ( $15^{\circ}$ - $20^{\circ}$ ) and apparently dips high to the north. The rock forms quite a little cliff overlooking the river.

26939 It is intermixed (probably interfolded) with a dark graywacke.

The knots S. and E. of this point are all composed of greenstone.

M.S.  
26940 On rail road, midway between the crossing of the two branches of West Two Rivers is a deep cut through a well bedded gray or nearly black rock resembling a hornblende schist or a hornblende graywacke. It strikes a little S. of E. and dips  $50^{\circ}$  N.

b  
26941 From same hill left (west) side of rail road 300 paces N. of North crossing of Two Rivers. Greenstone

Q.P.  
26942 From first cut south of water tank near Tanager Junction. The greenstone here is very coarse. Its relation to the

less coarse, crystalline greenstone could  
not be discovered.

