Notes on the Vermilion Iron Range, Minnesota: [specimens] 27000-27097, 27757-27761. No. 302 1897

Clements, J. Morgan (Julius Morgan), 1869-
[s.l.]: [s.n.], 1897

U. S. GEOLOGICAL SURVEY

FIELD SECTION BOOK

9-891

LAKE SUPERIOR DIVISION.

INSTRUCTIONS.

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

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

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

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

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

Notebook # 302.

~~[illegible]~~ Book #302

Ser 27000 – 27097
also
Ser 27757 – 61

No 1

Notes

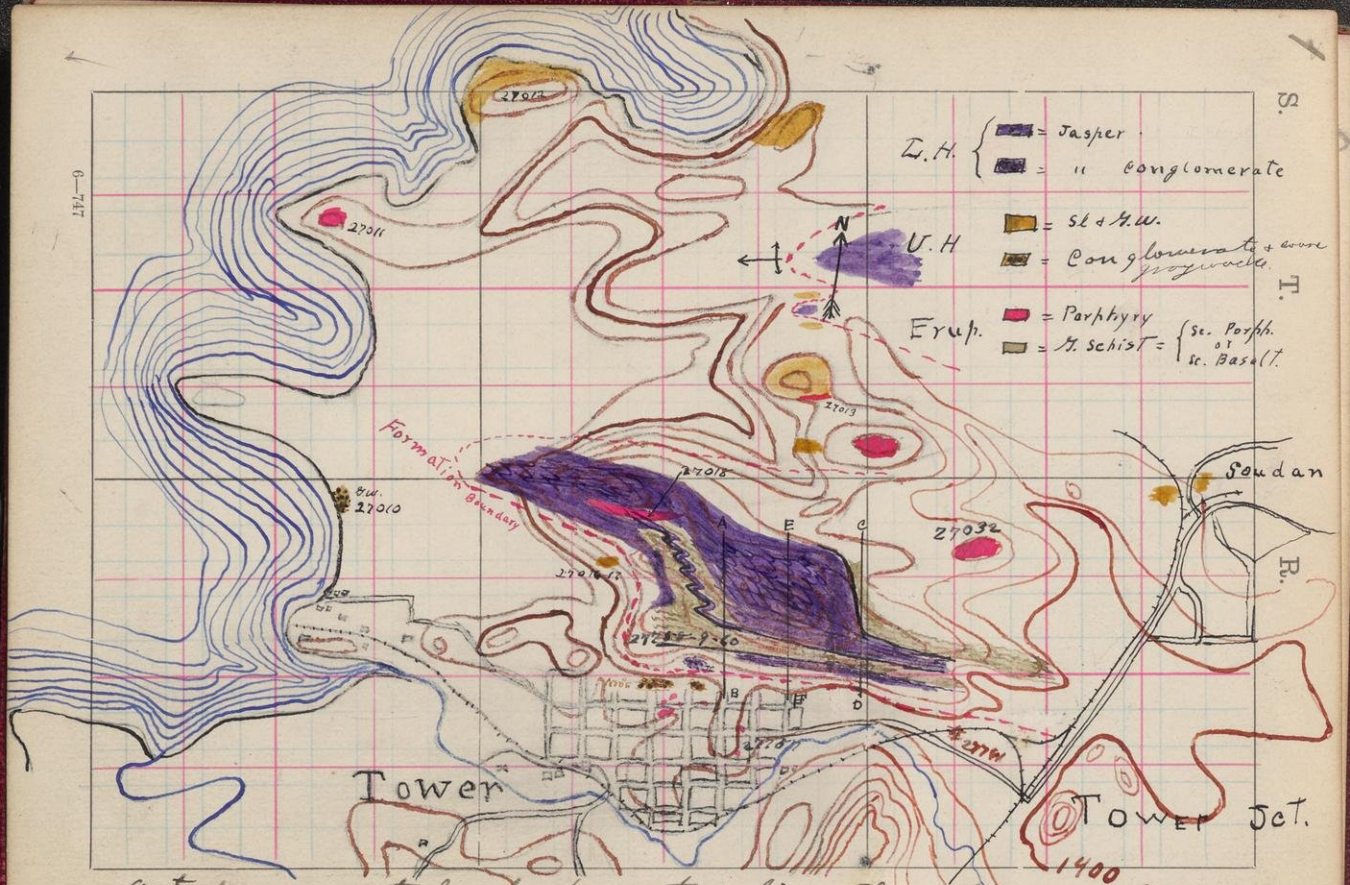
on the

Vermilion Iron Range

Minnesota.

J. Morgan Clement

1897



Outcrops were not located by section lines. The rectangular lines on page are therefore to be neglected on this sketch.

July 1, 1897.

Began work on the Vermilion Iron Range at Tower, Minn., to-day. Started from hotel with Prof. Van Hise to study Lee hill, the hill just north of the town. In alley back of Iron Range store an exposure of a porphyritic eruptive rock was seen. The same kind of rock outcrops again just W. of Presbyterian Church on 2nd st. N.; on 3rd st. N across the block & NE from schoolhouse; in Pavillion Park; in several places on 3rd st. N. between 1st & 2nd sts. E., in front of some ~~warden~~ Archie Phillips' house also in front of Dr. Barretts house on his yard.

Starting N. from corner of 1st. E. & 3rd st. N we go 95 paces and reach foot of exposure of (Stuntz) conglomerate composed of fragments of jasper, black & white chert, green schist & white quartz porphyry in a graywacke matrix of medium grain. Has been washed & is

27956 A
~~27957~~ A
H6.P

Page one thousand five hundred and eighty-seven.

Blank Odd Pages

3-9

Skipped

somewhat schistose. Schistosity agrees with long direction of pebbles & strikes N 80° E. Exposure is practically continuous for 40 paces N-S. and grades to N. into finer grained fragmental with here & there large pebbles.

Going E. along N. edge of exposure we see at 35 paces lenses of black chert in the fragmental bed. Exposure is not good here.

At this point, along the N. edge of the conglomerate bed, we see small exposures of jasper and a white & brown discolored chert within a distance of about 10 paces N-S. Strike of jasper bands varies very rapidly but is about N 80° W, dip 80° S. Continue to east along the terrace formed by conglomerate. The rock is exposed in places, the last exposure of it that was seen is just behind, N. of Dr. Noble's house.

Going N. from this exposure we find no outcrop until we reach a point N 165 E 145 paces from starting point at stone corner.

Here there is a fair exposure of

a good conglomerate, quite different in appearance from that to the south of us. This conglomerate is composed chiefly of jasper and chert boulders, very coarse, in a rotten greenish matrix which is present in very subordinate quantity. Many of the fragments of jasper + chert are quite angular and look as though they had not been transported far or else have resulted from the breaking of larger boulders near where they now occur. It looks as though we have passed over a continuous fragmental bed; farthest south a conglomerate with small jasper pebbles, these increased in quantity as we came north until we reached this point where all fragments are of J & chert with some doubtfully of a green schist. The next exposure N. should be the jasper beds from which this conglomerate was derived.
The conglomerate is exposed for 3 or 4 paces N-S. but covered to E & W. of this one outcrop. Can not determine a bedding in it but the trend of the flatter

pieces of jasper is E-W.

Immediately N. of this conglomerate there is no exposure until we reach a green schist at N 275 E 145 paces from starting point. The intervening space is covered with drift. To the last about 200 paces and in the southward continuation of this covered interval an E-W striking jasper is found. If this continues to the west it should be found below the surface between the jasper conglomerate and the green schist.

D.S. 27756B 27758B This green schist is very fissile, strike of schistosity N 70° E. Schist is much crumpled in places + shows minor faulting with bending of lines of fissility. Faults cut across fissility at angle of about 45° + trend N W - S E.

The schist is impregnated with iron ~~from~~ in irregular masses, especially along south side of exposure, nearest the jasper. A great deal of vein quartz has been infiltrated and

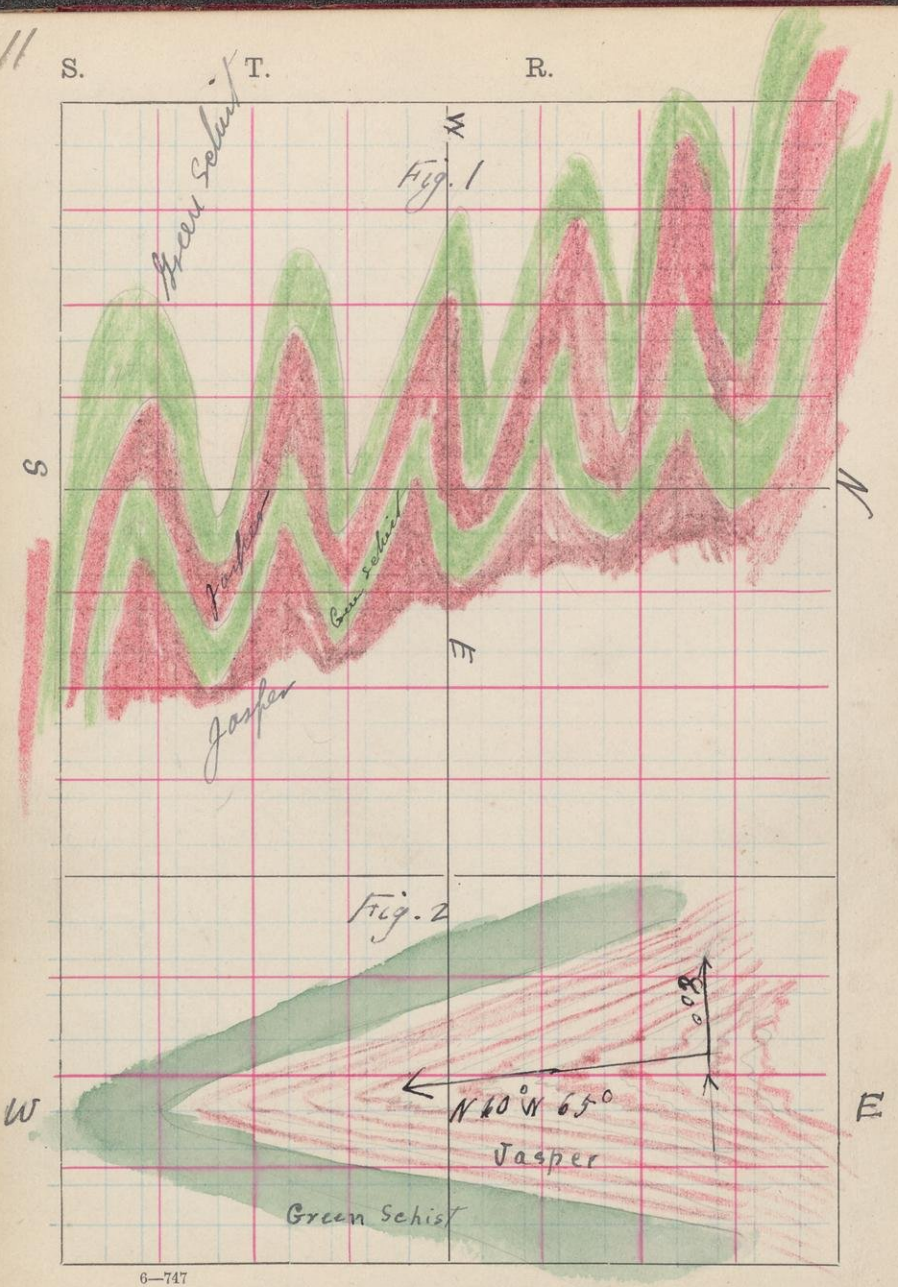
is found in thin sheets marking the schistosity and also in a fine system of rectangular veins cut by schistosity. Considerable masses of vein quartz and some ferruginous chert masses occur in the schist. The schist continues to N 363 paces in a practically continuous exposure. About 250 paces east however the schist narrows down until it is only about 25 paces wide N-S. Strike of schistosity still E-W.

Starting from the previous location, N 365 S 145 from starting point, we go east along N edge of the schist and soon begin to find small masses of jasper pinched in the schist & surrounded on all sides by the schist. Jasper owing to differential weathering usually stands up above the surrounding schist.

As we reach about N 365 E 300 paces from original starting point on stust corner, we can see the relations of the schist and jasper clearly exposed. They are interbedded

11

S. T. R.


Green Schist
Fig. 1
W
S
N
E
Jasper
Green Schist
Fig. 2
N 40° W 65°
Jasper
Green Schist
W
E

6—747

and then have been very closely folded. Various bands of schist & July 23 '05
jasper have been traced to the E. across Lee hill and are shown on the plat. Here some bands take part in the close folds which can be well seen on the saddle connecting Lee and Lower hills. The position of these two hills on echelon from NW – SE corresponds to the position of
Fig. 1 the plications seen on the saddle. These pitch S W. at angle varying from 65° to about 70°. Strike of axes of plications is N 80° E. In one case at East of sketch Fig. 2 plication is overturned and dip on both sides of anticlinal is 80° N. Since the close folding the folds have been cut off leaving the jasper and schist in V shaped exposures as shown in sketch Fig. 2

The green schist interbedded with the jasper appears in places very much like an amygdaloidal greenstone which has been mashed. N 370 E 335 –

B.S.
N 7756 C
2775 E

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13-19

Skipped

sometimes it is quite light colored and seems more like a sericite schist derived from an acid eruptive. Spec. 27756D ~~27760D~~ 27760 illustrates the character of the sericite schist. The quartz eyes may be either crushed quartz phenocrysts or quartz amygdules. Some of the eyes are at times 1" long on greatest diameter of ellipse.

Going east on S. flanks of Lee hill we were able to trace out three distinct bands of E-W. striking jasper and greenschist

Section A-B. as follows from S to N. jasper, green-schist, jasper. This last band forms main, highest part of Lee hill & is by

(For the widest S. band.) the east side of hill, just where the large dump heap is, a second mass of green schist is exposed which would make the section across here from S-to N as follows

Section C-D jasper, green schist, jasper, greenschist. From the old mine opening (N 7° W?) where the northernmost mass of green schist is exposed there is a small depression leading west and for some distance

divides the main jasper ridge into two ridges. Where this depression ends there are no exposures to connect the jasper ridges & it appears highly probable that the green schist continues along this E-W depression separating the outlying main jasper mass into two bands. In that case a section across Lee hill from S to N. would Section E-F show, if rocks were exposed, following succession, Jasper, greenschist, jasper, greenschist, jasper and then the main valley N of the hill with knobs of green schist & jasper in it. The interbanding of the jasper and greenschist on Lee hill is evident but all the bands could not be traced out.

Several traverses were made through and across the valley north of Lee hill but while jasper and green schist exposures were found it was impossible to connect them.

There are numerous knobs of eruptive rock in the valley. These penetrate the jasper & schist

series of beds.
In one traverse from N-S quite large exposures of slates were found about midway in the valley. These slates are similar to others whose stratigraphical position above the jasper is clearly shown on the point east of Swede Bay. These slates in the valley are believed to be above the jasper also. In that case the valley must correspond to a synclinal depression with the anticlines to north and south represented by the present hills, Soudan hill & N. and Tower & Ice hills to S. These anticlines plunge to the W. with very nearly N 80° E (sticking axes)

The outcrops obtained in the traverses across the valley are plotted forthan on in note book.

It is evident this early in the study of the Vermilion Range that there are present in the

western part of it, two series
1, the jasper + greenschist and
2 the graywackes and slates separated
from the jasper by a conglomerate
(the Stuntz).

Moreover the folding, studied
in the immediate vicinity of
Tower, is in two directions.
The main folds trend N. of east
+ S of west, the general trend of
the range and also of the minor
ridges of jasper. These have super-
imposed upon them minor
folds which have their axes
transverse to the axes of the major
folds.

F.P.
27756 E
~~27761 E~~ Feldspar P
~~Graywacke(?)~~ from R.R. cut ~~on~~ W. of
Tower Junction.
This is to south of jasper belt and
probably corresponds to the con-
glomerate on south side of Gunhill
just at west end of town.

21 S. 32 T. 62 R. 15 E

N 1/4

27000

P. NE Pr.

M.S 27001

M.S 27001

M.S 27001

M.S 27002

C of Sec.

E 1/4

Scale 8" = 1 mile

6—747

Started this morning at NE cor. Sec. 33-62-15- and ran West.

D. P. Passed exposure of porphyritic eruptive rock at 500 paces west of corner and then saw nothing else until reached corner 1 mile West.

D.

27000 N 2000 W 0 SE Cor. Sec. 32-62-15- The north east corner of sec. 32 is on this knoll of dark green basic eruptive rock.

D. S.

27001 N 1950 W 240 SE Cor. Sec. 32-62-15- Rounded exposure of green schist. Schistosity strikes about E-W.

D.

27002 N 1620 W 230 SE Cor. Sec. 32-62-15- On ascending small ridge we pass over green schist like 27001 exposed on north side and then reach broken jasper exposure on crest. This is followed on south side of knoll by an exposure of a medium grained eruptive which is somewhat schistose. Direction of schistosity could not be determined. Appears to be a green stone (or porphyry) interbedded with jasper.

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23-31

Skipped

On account of having been
stopped by clouds and rain
it took two days to make
the partial traverse recorded on
previous page. Began some
canoe work then at a
point on E. shore of Middle Bay.
See Bayley's notes for geology of
shore up to that point. J. Mof. p. 33

Sl
27004 Slates outcrop as indicated on
shore and on hill tops inland.
Bedding in the slates near the shore
strikes approximately N-S + is
cut by E-W fissility. Banding is
in places plicated with folds pitching
high to E.

In other places the banding
strikes E-W and corresponds with
strike of fissility. Strike of fissility
taken as N 80° E, dip 80° N.

Slates have evidently been
closely folded by pressure N-S.

I went in on this point
noted I was in short distance
of Stony Bay, to the east,
and found the slates exposed
in numbers of places. They

unquestionably continue across this point. The slates could also be seen outcropping on the N. slopes of the hills to the south of where I crossed the point.

Q.P. 27003 Beginning at the shore as indicated on the map, and extending inland in an almost E-W line there is found a quartz porphyry dyke 30 feet wide. It is slightly schistose along E-W trending shearing planes but is on the whole very massive.

Por. 27005- In various places among the slates I found narrow dykes of porphyry varying from a fraction of an inch up to 10 feet in width. They have been injected along the bedding planes. They have undergone some faulting to a slight degree but are not very schistose.

A porphyry, similar to 27003 and probably the continuation of that dyke, is found on the west side of Middle Bay but its relations to the slates could not be determined.

The major portion of the point between Middle Bay and Swede Bay consists of the contorted slate like 27004 Banding very commonly found to have a strike N 35° E but varies E-W owing to plication. Strike of axes about E-W with E. pitches 80°-90° Schistosity strikes N 80° E. Porphyry dykes injected parallel to schistosity & also following banding = bedding occur in the slates.

As I follow the shore the slate grade down into a greywacke & conglomerate which apparently corresponds in part at least to conglomerate on east shore of Middle bay. A reef, (Gull Rocks) at the mouth of the small bay on NE side of the point consists of this same conglomerate.

Almost due west of this reef on the shore of the point there is an exposure of plicated jasper about 75 paces across. The distinct anticlines and synclines have their axes striking

E-W and plunging E at angle of 80°.

Some beautiful examples of friction breccias on a small scale may be seen on this exposure.

The point just N of this jasper exposure and also the island north east of the point consist of the (Stuntz) conglomerate. To the south of the jasper the graywacke and slate occur.

Beginning at the jasper outcrop on shore we go inland 50 paces and reach E-W. trending ridge about 20' above lake.

This ridge is composed of jasper, strike of beds N 60-70° E. ~~dip~~ when exposed, but on the highest point about fifty paces from the lake the jasper has remnants of the Stuntz conglomerate still lying on top of it.

This conglomerate is in small patches and consists of fragments of jasper, vein quartz, chert and porphyry in a schistose matrix. Schistosity strikes about E-W.

The relations here are, jasper, folded and folds plunging S east, overlaid by a conglomerate composed of jasper etc. The conglomerate is overlaid by black slate which is not shown above the conglomerate on the jasper exposure but into which the conglomerate grades as we go south.

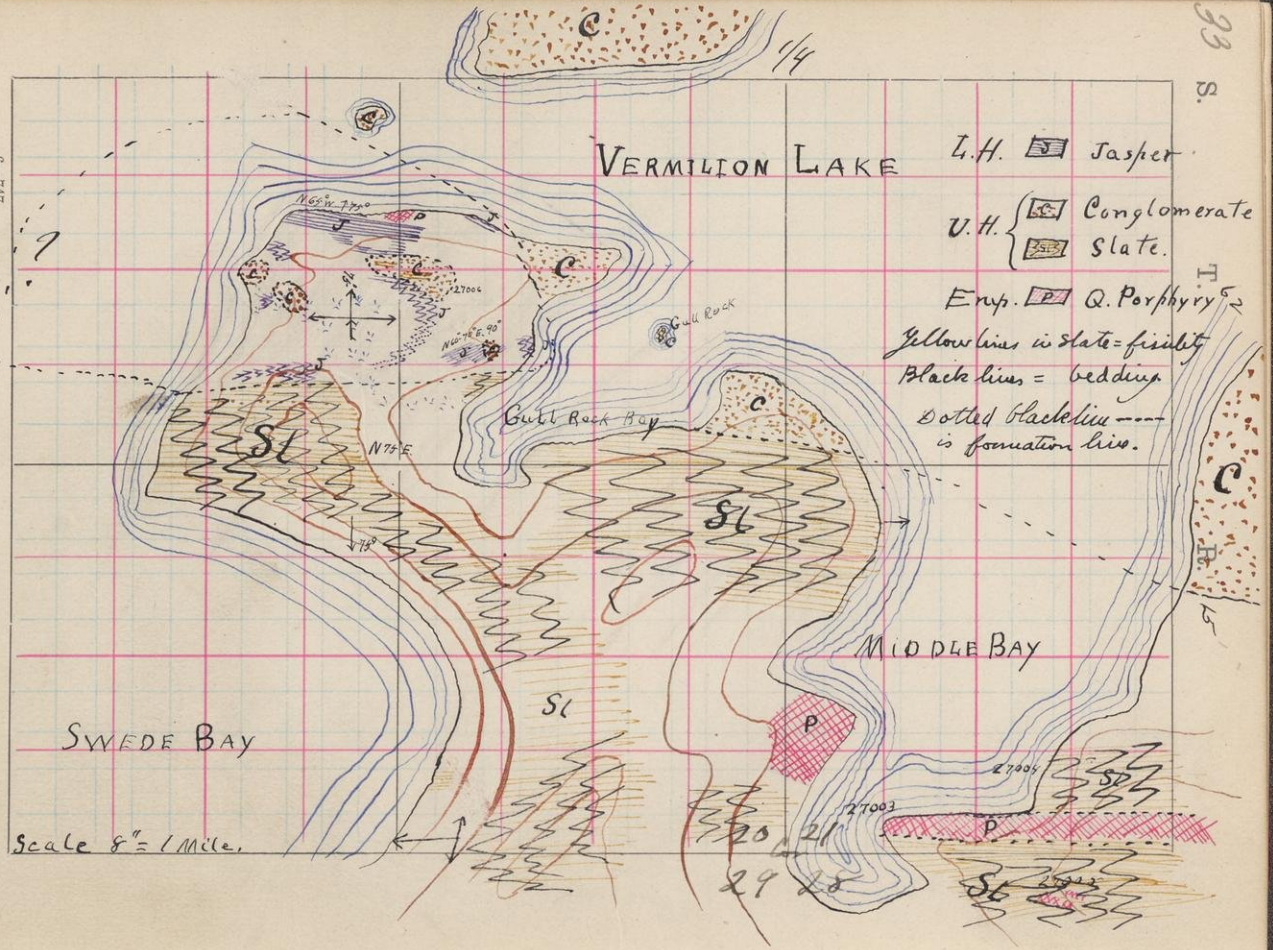
We now go around the shore of the point and note the rocks as they occur on the shore, of. plat.

Beginning about midway the extreme north shore of the point, near a clump of pines, we start S. to get a section.

The rocks named over their characters & relations to each other are given in the following notes, of. plat for distribution.

Jasper occurs along the shore and is followed to the south by an exposure of a porphyry. Next comes jasper again with bands showing strike of N 65° W dip 75° N.

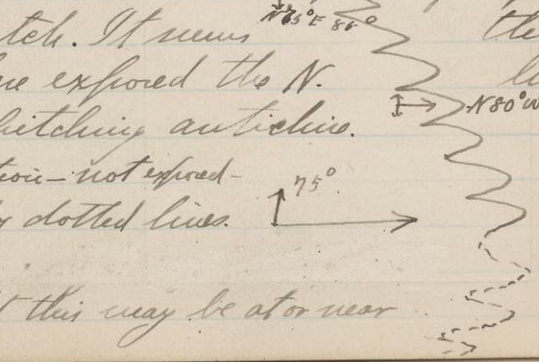
The next exposure to the south is slaty conglomerate – 30 feet –


VERMILION LAKE
L.H. Jasper
U.H. Conglomerate
Slate.
Erup. Q. Porphyry
Yellow lines in slate = fissility
Black lines = bedding
Dotted black lines ---- is formation lines.
Gull Rock
Gull Rock Bay
MIDDLE BAY
SWEDE BAY
Scale 8" = 1 Mile.
N 75° E
N 65° W 77°
N 60° E 90°
27004
27005
27003
T. 52
R. 15
23
S.

which grades down into a grayw-
27006 acke resembling very much a
crushed quartz porphyry. This
is about 30 feet across N-S. Both
the conglomerate and the graywacke
have fine slate bands in them sticking
S-W dipping 75° N.

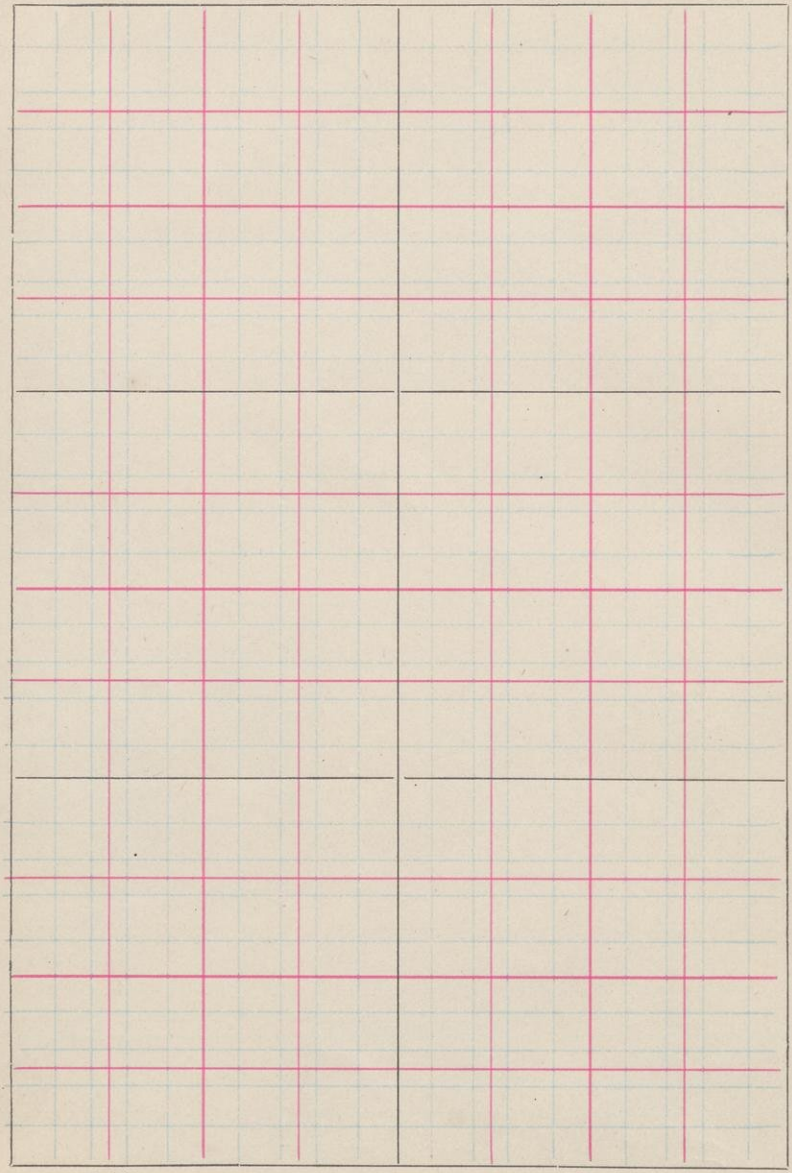
Next we reach the contact between
the graywacke and the jasper. This
is marked by about 10 feet of a
conglomerate of angular chert
& jasper pebbles. Lying below
this & to the South of it there is
a very much plicated jasper.
The plications pitch both to the
E 80°-90° and also there are others
pitching W 80-90°.

It is not
possible to determine the prevailing direction accurately.
The plications show on jasper
as in sketch. It seems that
there is here exposed the N. limb
of an overturned E. pitching anticline.
Continuation - not exposed -
is shown by dotted lines.



I judge that this may be at or near

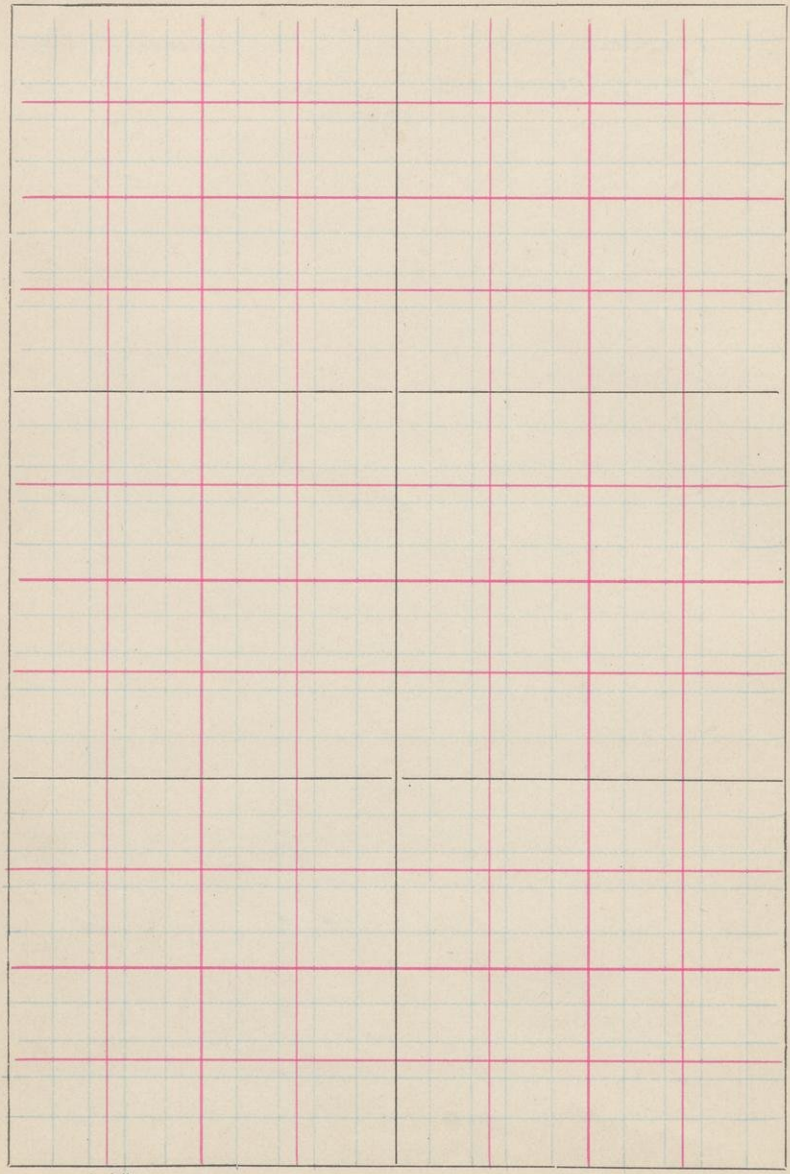
35 S. T. R.



the crest of a small anticline from which the higher lying conglomerates have been removed by erosion. Continuing south we ascend a hill of crumpled slate & greywacke. Along the north edge of this ridge there is a low spot of ground filled with H_2O at times. This marshy spot is surrounded on N by Jasper; E & W by jasper & conglomerate & S. by jasper & slate & greywacke

On south side of this marsh the relations of the jasper and slate can be well seen. There are lenticular and V shaped jasper areas infolded in the greywacke & slates. The strike of the axes of the plications is N 80° E but could not determine pitch in degrees. The close folding of the slate & jasper & their truncation of the plications produces exposures similar to those seen on saddle between Gu & Tower hills & shown diagrammatically in sketch on p. 11 Figs 1 & 2

37 S. T. R.



6—747

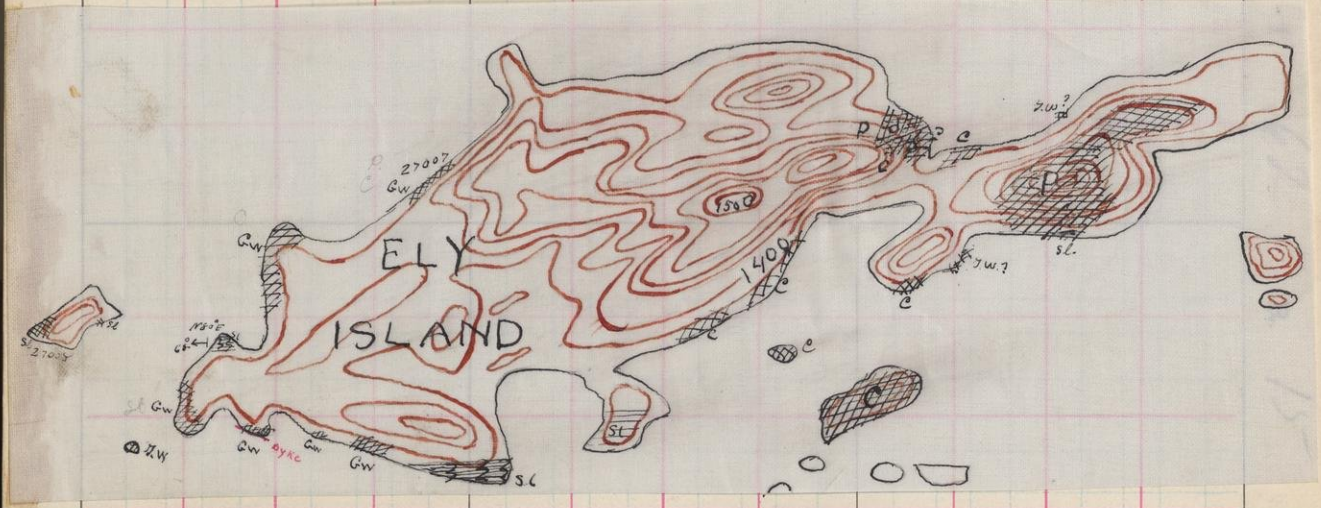
Going south over the slates we find the same well developed schistosity which occurs on point E of Middle Bay. Schistosity strikes N 80° E & agrees in general with strike of axes of plications. The banding of the slates, where it was observed with E-W strike, dipped 75° S.

Outcrop of slate continues for about ½ mile south.

Dr. Hank's hill west of Sec. 20/21 29/28 there is a large anticline in the slates. The anticline plunges W.

About ½ mile south of above corner exposed on east of high hill which is westward extension of Dundas hill I find jasper. The bands dip 60-75° W with in general E-W. Some inclined E 20° N. The jasper area broadens to E & is covered to W. under drift. Apparently this is a westward plunging anticline in the jasper.

Slates are separated from the jasper hill by a deep valley E-W.



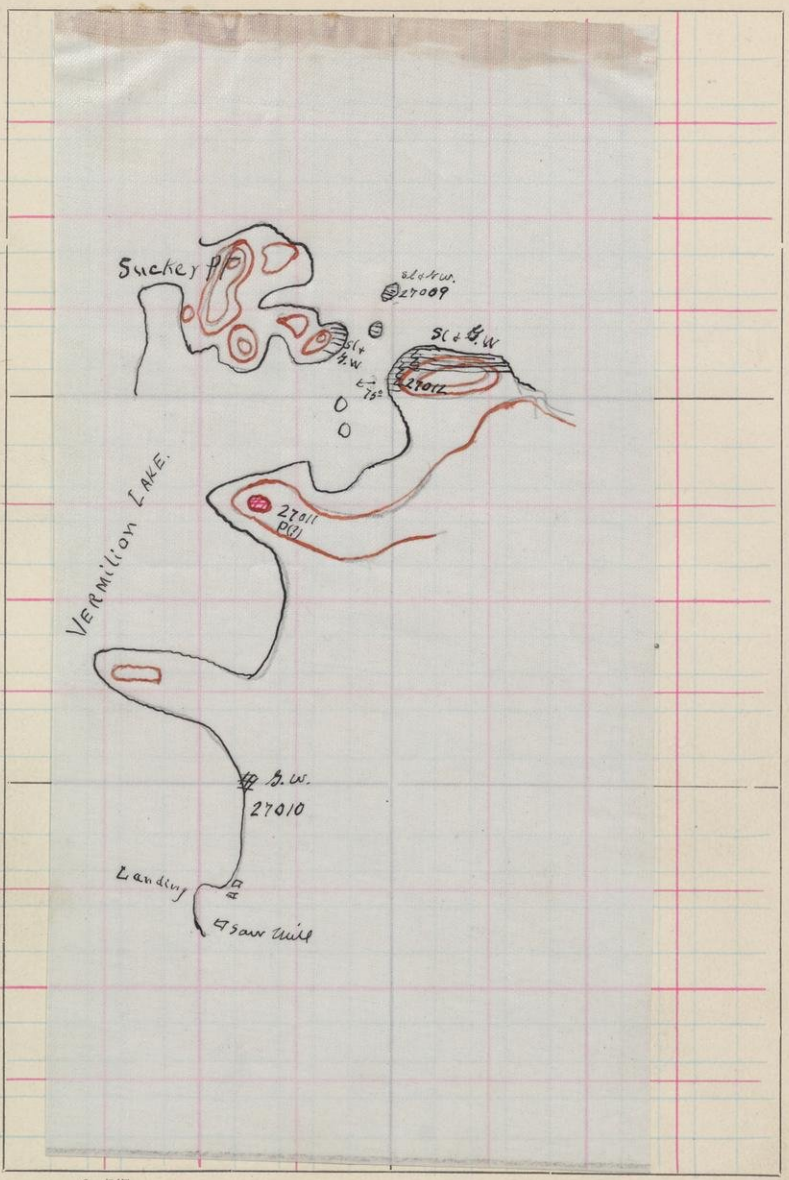
I made a canoe trip with Prof. W. H. and Bayley skirting south and NE shores of Ely island. Each one of us made a traverse across the island. My observations of the distribution of the rocks are noted on tracing. Specimens and notes are in Bayley's numbers and in his note book. S. shore has conglomerate and slate exposed on it. Made traverse across highest point on E. end of island. On S. shore porphyry enclosing + metamorphosing slate bands is seen. Porphyry forms also the major portion of this end of island.

On another occasion skirted west end of Ely island. Slate and graywacke form west end. Graywacke cut by dykes of basic green rock.

sw
27007 Graywacke (?) forming N.W. shore of E. island.

Slate on W. end of island foliated. Plications pitch W. 65°. Strike of
sl axes N 80° E. agreeing with foliation.
27008 Island at west end of Ely island is composed of foliated slate.

47 S. T. 6W R. 15



6—747

Gw + Sl
27009 East end of Sucker Pt. + the small islands off the point are composed of interbedded slate + greywacke. Strike of bedding little S of E.

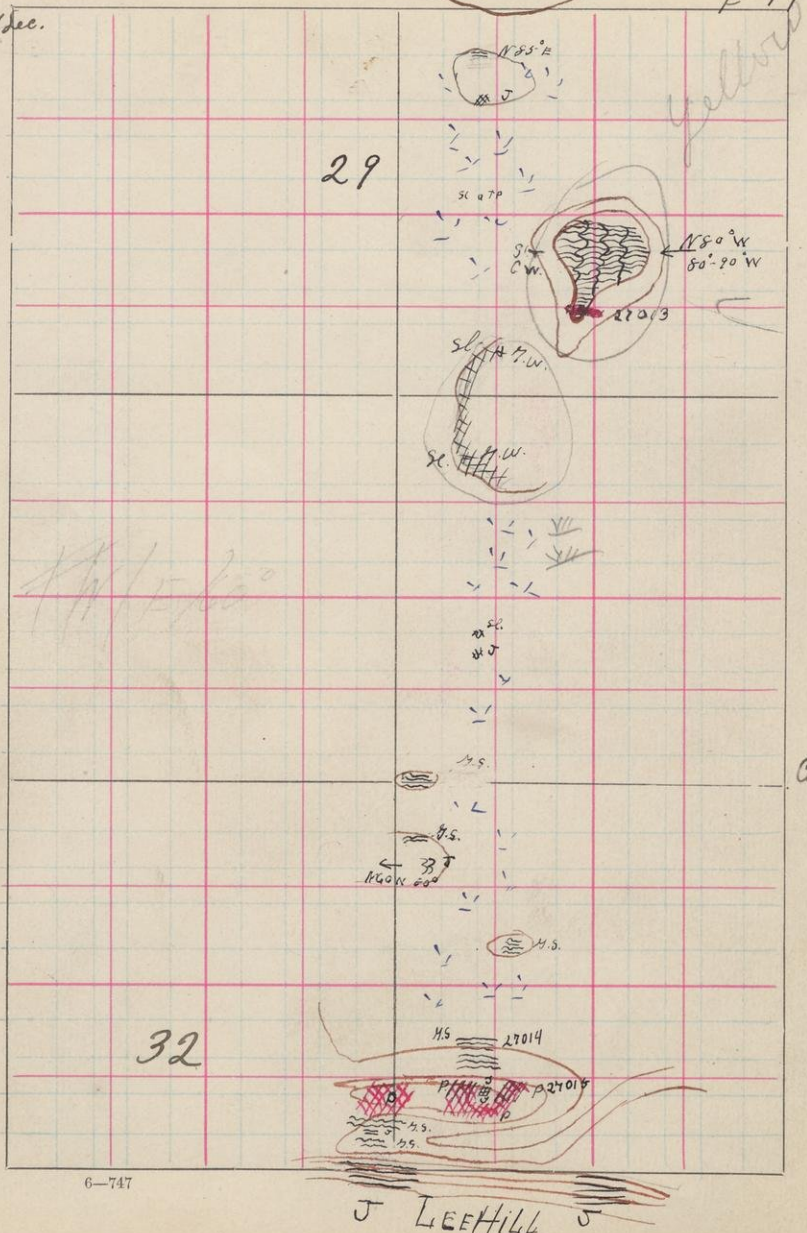
C
27010 As shore just short distance N of saw mill at Tower Steamer landing. Medium grained greywacke corresponds exactly to 27009. Fragments of porphyry + bluish black slate occur in it.

F. P.
27011 Forms high ground on 2nd point on shore N.E. of Tower Landing. Called by Smyth porphyry. Seems to be a fine grained greywacke with clay tentacles in it.

Gw. (Sl)
27012 Greywacke interbedded with slates on point S.E. of Sucker Pt. Beds strike N 50° W. Dip 66° S.W. Slates much plicated. Strike of axes of plications N 80° W. pitch 75° W. Rock broken into perfect rhombs by 2 sets of joints. One strikes S 30° W + other W 10° N. agrees with best finality.

43 S. 29 T. 62 R. 15 E 1/4

Coffee.



6—747

1/4

Cor.

From hill forming westward continuation of Soudan hill ran south across valley to Lee hill. Crossed a number of small knolls in the valley. In almost every instance small exposure of rock was seen, but usually so poorly exposed so that no observations, other than character of rock, could be made.

About 200 N W 250 SE Cor. 29-62-15 a large knob of contorted U. Huronian slates are exposed. Strike of schistosity N80° W. Plicated. Axes of plications strike N80° W + plunge W 80-90°

Sw 27013 On S. end of exposure there is (E-W) curbed of sidenitic gtyb. or a basic dyke in the slates.

R. Awgd.

27014 N 1650 W 400 SE Cor. Sec. 32-62-15 Green schist. Strike of schistosity W 5°S. This schist is followed to the south by a porphyritic eruptive rock at

27015 N 1600 W 400 SE Cor Sec. 32-62-15 This forms main part of hill. Just on top of hill is a large mass of Jasper. Badly broken up. May be in situ as inclusion in eruptive rock. Could not trace it E or W.

Specific + Joyce Corroboration of any detail + illustration by me am of agreed with Coleman as to Boundaries as yet.

H.B. P

45 S. 32 (NW 1/4) T. 62 N R. 15 W. Ulm.

6—747

1/4

C of Sec

To the west of this place the eruptive rock, 27015, is seen without the jasper. Going south we come at N 16 75 W a narrow E-W band of greenschist followed by narrow E-W jasper exposures and it is followed by greenschist. This brings us to the foot of the steep jasper cliff which is a part of the highest portion of Lee hill.

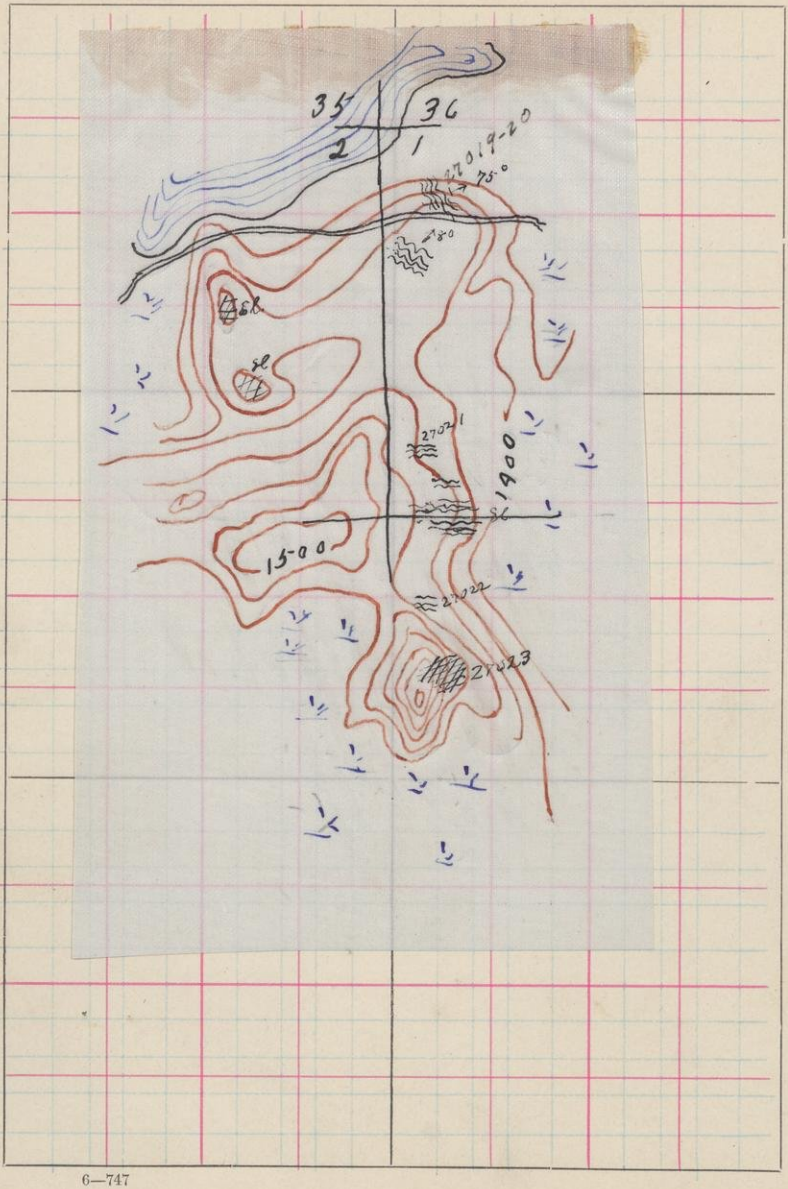
From here I went west to locate the part of the saddle between Lee + Tower hills on which the closely folded jasper is so well exposed. The exposures occur in the neighborhood of N 15 50 W 950 SE Cor. Sec. 32-62-15

From here Crain went to determine limit of the jasper, location of the black slate outcrop and of the eruptive on S. flank of Tower hill.

Sl. 27016-17 N 16 00 W 1530 SE Cor. Sec. 32-62-15 Exposure of foliated graywacke (27017) and black slate (27016) full of pyrite. Strike of foliation N 75° W.

H6.F.P 27018 N 1675 W 15 00 = Sec. 32-62-15 Eruptive rock facing S.W. cliff of Jasper on Tower hill.

47 S. T. 62-1 R. 16



6—747

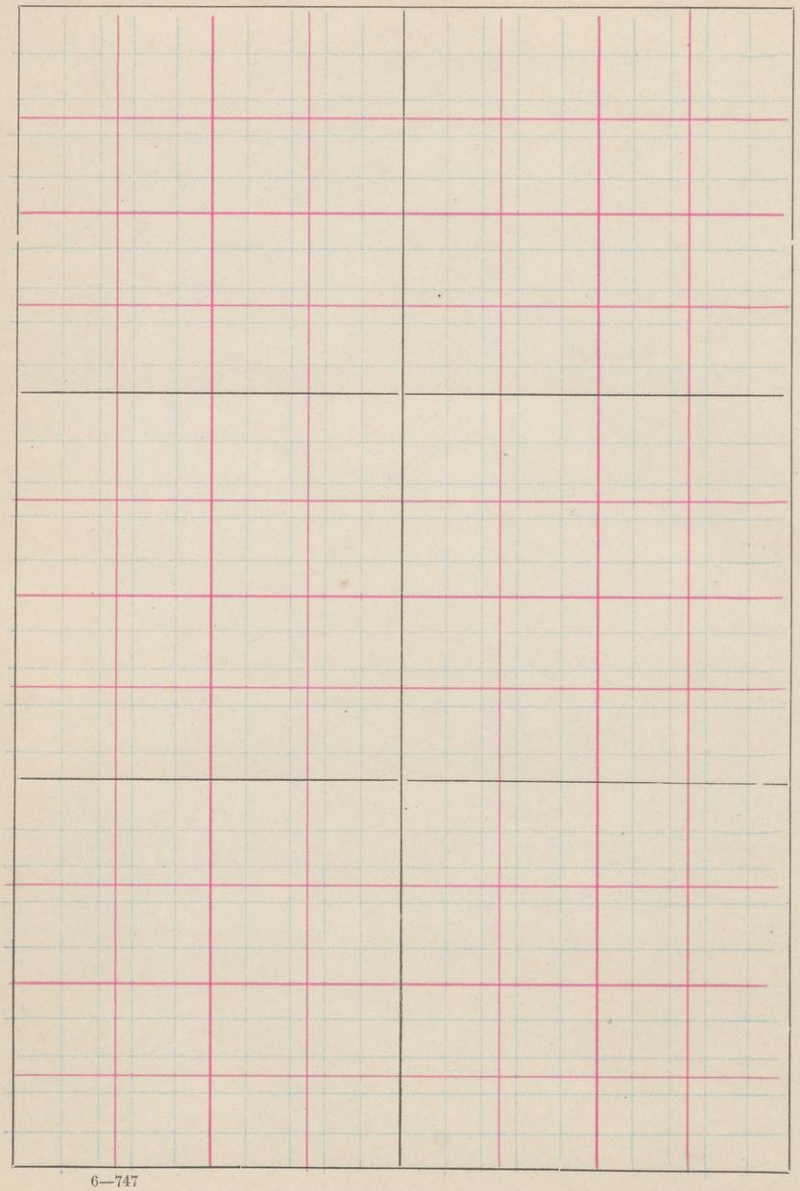
Started out run south at point on lake shore just east of Sec. Cor. $\frac{35/6}{2/1}$ 62-16 61-16

Tried to locate exposures by topography but after going about 3/4 mile found it impossible. From there on the exposures are very frequent and occur on small low knolls which are not represented on map. As far south as I went the outcrops seemed to be of rocks of the same general character. They apparently became more altered to south and are micaceous slate and quartzite instead of the normal U.H. slate and graywackes which occur near the lake.

51.
27019-20 Graywacke and slate much plicated and outcropping N. of wagon road on top of hill south of N. Cor. Secs. 2/1-62-16
Banding strike in general SE-NW.
Plications pitch 75° NE.

Across the road, to the south, from above exposure there is another one

49 S. T. R.



6—747

in which graywacke and slate (chiefly graywacke) are found. Banding strike in general letter s of E. Dip of larger folds seems to be 80° and to E of N.

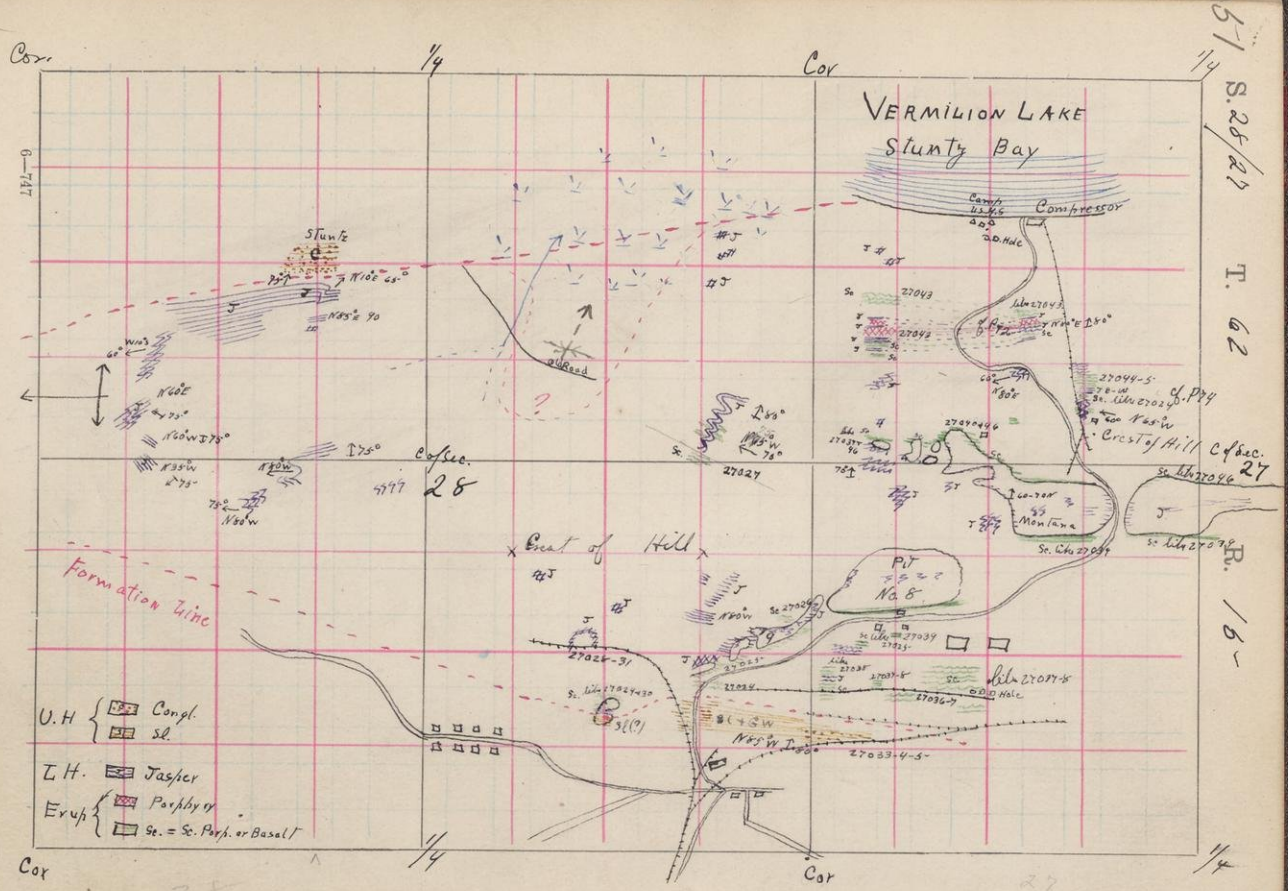
In another place find flutings whose axes strike NE-SW by magnetic needle and pitch NE 80°.

sl. m
27021 This is a specimen from exposure on south side of a knoll in midst of jack pines. Black, micaceous quartzite or slate. Strike of foliation E-W

sl m
27022 Micaceous slate or quartzite

sl. m.
27023 Micaceous graywacke. This was as far south as I went.

Turned and went west then back N. Paned over same kinds of rocks in return but was unable to locate them by the topography.


VERMILION LAKE
Stunty Bay
Cor.
1/4
Cor
1/4
S. 28
T. 62
R. 16
Compressor
Camp
Stunty
Crest of Hill
C of sec. 28
C of sec. 27
Pit No. 8
Montana
Formation Line
U.H
Congl.
Sd.
L.H.
Jasper
Erup
Porphyry
Sc. = Sc. Porph. or Basalt
Cor
1/4
Cor
1/4

Begin the study of Soudan hill to-day and shall make N-S. traverses across it.

Start N on line 250 paces west of SE Cor. Sec. 28-62-15.

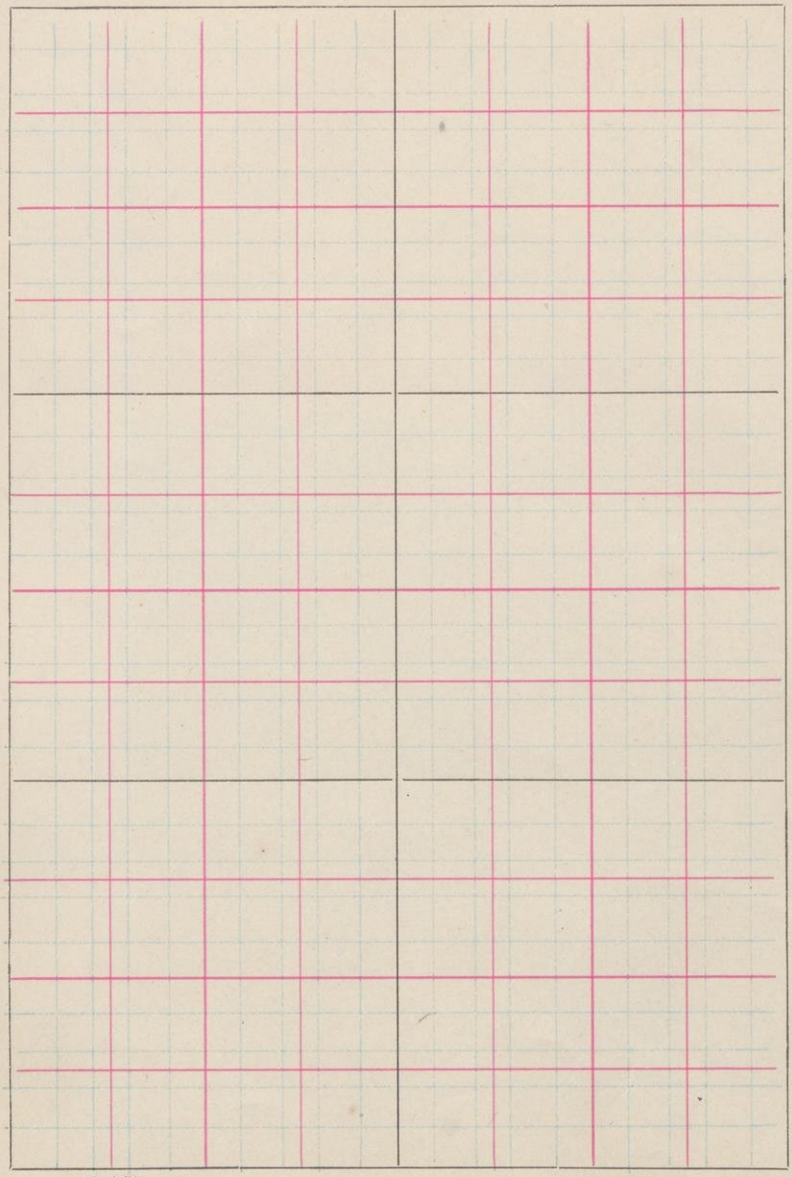
Sl 27207-11 There are exposed in the road just after passing the warehouse N. of Minn. Iron Co. office, interbedded slates greywackes + ~~Tuffs~~ (?). See Leith's notes for specimen numbers & descriptions.

Col S.S. 27024 Pass over these and reach at N400 W250 Sec. 28-62-15 a mass of schistose porphyry (sericite schist) exposed along road side.

Col S.S. 27025 N425 W260 - 28-62-15

No exposure until reach above location. This rock (27025) seems to grade into a ferruginous soapstone which lies next to the ore body. This soapstone is on SE side of an open pit trending NE. Jasper forms all of N + NW side of pit. Jasper broken + faulted. General strike N 75° E, dip 90°. To the east of this pit there is a

53 S. T. R.



6—747

very large one which is very irregular but trends in general little N of E. Jasper is usual kind but locally shows beautiful friction breccias. Strike N 80° E. dip 90°

Gr. B.S.

27026 N 600 W 75 Sec. 28-62-15

Small exposure of schistose porphyry. Strike of schistosity N 85° E.

A little farther N. and on 250 W. the jasper outcrops begin and are practically continuous as shown on plat for 100 paces. at N 680 W 200 bands much plicated. Strike of axes of plication N 30° W. pitch 20°. Pass crest of hill and begin to descend.

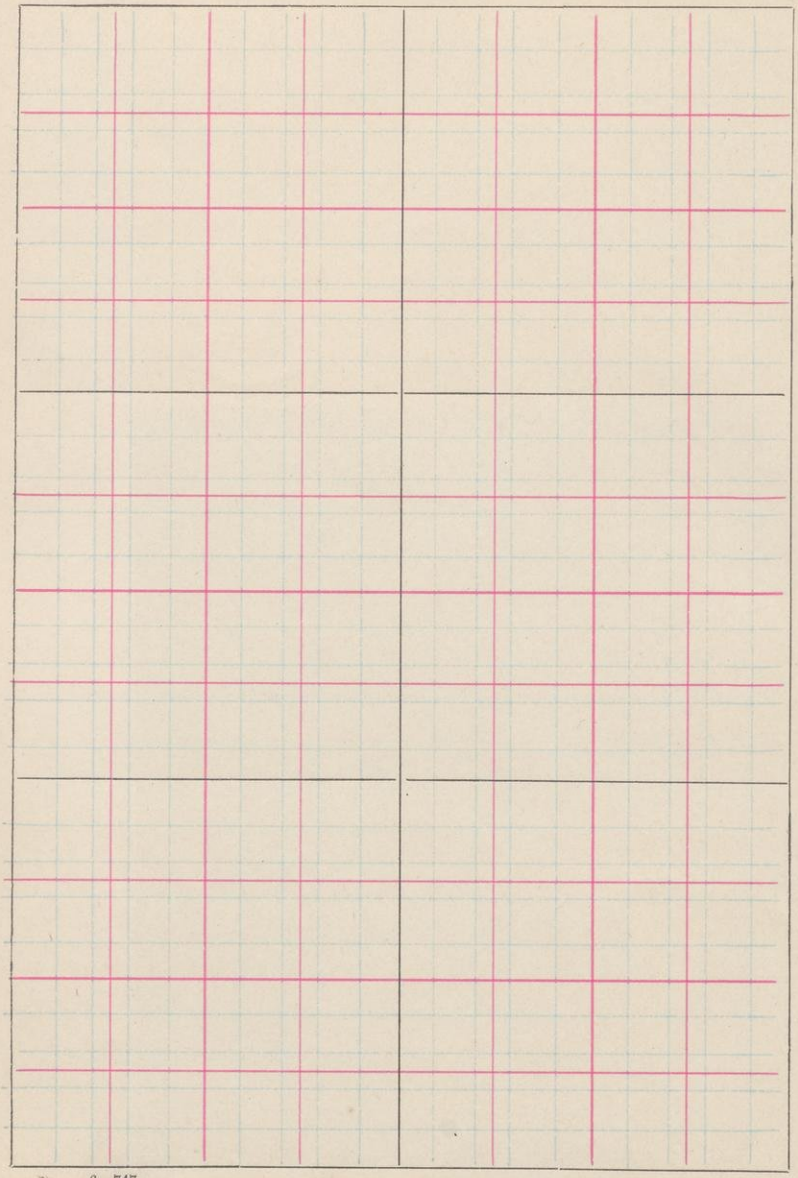
Gr. B.S.

27027 N 1040 W 330

At this point on N W. flank of hill there is an almost vertical exposure of sericite schist 27027. Strike of schistosity N 80° W. This is followed to the north by plicated jasper. Apparently the schist and jasper are interbanded.

Strike of contact between schist & jasper, N 80° W., agrees with general strike of bands in jasper and of schistosity in schist.

55 S. T. R.



Just below this exposure and practically a continuation of it the relations of the schist and jasper are shown and also a clew given to the structure of the hill. The schist and jasper are closely folded just as on the saddle between Lee and Tower hills. The plications have their axes striking N 75° W and pitch west at angle 70°. Dip of the beds seems to be 80° N.

It seems that we are here on the N. limb of a westward pitching anticline.

Continued on down hill, well into swamp which connects with Stuntz Bay, but found only broken jasper exposures which were small & showed no structure. Went west five hundred paces and south on line as indicated. Found no exposures on N. slope of hill but just after passing crest found jasper (could get no structural observations) exposed in a mass of large boulders. Descended hill to R. R. track and examined open pit [illegible] of line.

27028-9
27030-1

N550 W550 SE Cor. Sec. 28-62-15 — 57

This pit is in very much contorted jasper and is now full of H_2O. 50 paces further E. is entrance to shaft. Material on dump consists of ore, jasper and a rock 27028 like a quartzite. This shows a chlorescent. 27029 shows either a coarser conglomeratic phase of this quartzite or else a quartz porphyry. In either case rock is badly crushed.

27030 shows what may be a dense porphyry with quartz eyes.

Associated with these I find schists and slaty rocks like 27024 & 5 and believe they are but finer grained and more schistose forms of 27029.

27031 is ordinary jasper.

The hill south of this open pit is made up of schists like 27024 & 30 and ore and jasper. A small pit has been opened on E side of hill.

Now ran west five hundred paces and made another traverse across Soudan hill. Ran north on 1250 W. 28-62-15

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58-70

Skipped

Studied a number of silicated jasper exposures. Q. flat.

N 1510 W 1300 S E Cor. Sec. 25-62-15-
At this point on the steep N. face of this hill typical Stuntz conglomerate is exposed. Conglomerate consists of fragments of jasper and porphyry in graywacke matrix. To the north of us - across the deep valley here - the N. Huron slates, similar to those on point between Middle + Swede Bays, are exposed.
Jasper dips to N. under the conglomerate.
Now go west working along N. slope of hill and up on crest. Pass over jasper nearly all the way, there is practically a continuous outcrop of it here. at
N 1380 W. 1650 the jasper is seen to have been folded by E-W. pressure in addition to the numerous silicifications due to N-S. folding. Axes of the folds here strike N 10° E and pitch 65° to E of N.
On this north flank of the

hill the beds strike on the whole N 75°-80° E and dip 65°-90° N. As we follow around our end of hill the plications seem to become more numerous. Axes strike W 10° S and pitch 60° to S of west.

Seem to be near the end of an anticline, pitching west, with numerous minor plications upon it. In places among these exposures beautiful friction breccias can be seen where the brittle jasper has given along minor fault lines. The jasper fragments are cemented by vein quartz.

When we reach the south flank of the hill the prevailing strike of the jasper bands seems to be decidedly to the N of west.

Reference has already been made on pg. 38. to observations made on jasper exposures west of this last traverse. Jasper bands at this locality-w but in places were decidedly inclined to N of E. They differed N 60°-75°. Owing to fact that jasper area was seen to broaden to E. Conclusion was then reached that the J. was folded into a W. plunging anticline.

Hb. P.

27032 Porphyritic eruptive rock occupying top of hill projecting from low ground between Loudan and Lee hills. Q. Top. Map.

Sl

27033-4-5 N300 W 0 SE Cor. Sec. 28-62-15- Interbedded slate 27033 and graywacke 27034 (further Sec. 27035) grading into a coarser phase that in places can be called a conglomerate. Strike N85°W. dip 80°N. No jasper fragments noted in graywacke. Seemed to be composed of eyes of quartz (secondary ?) and pieces of slate and porphyry. Compare 27035 with 27029.

These slates and graywackes outcrop along rail road track on S. slope of Loudan hill and conesfound to Leitis Nos. 27209-11 further west.

Lgt. S.

27036-7 N380 W 1770 SE Cor. Sec. 27-62-15- Higher up the hill than, and to E of, the slates and graywackes there outcrops just west of the Mimi. Iron Co.s stocks pile, a dark greyish to greenish sericite schist 27036. Strike of banding agrees with schistosity, is E-W.

Lying to N of this fine schist band and interbedded with other bands of same sericite schist, there is a dark green chloritic schist 27037.

S. S.
27038+ like 27036-7

N 420 W 1920 SE. Cor. Sec. 27-62-15
Farther west and higher up the hill side we find a schistose porphyry 27038 (cf. 27024) a chlorite schist like 27037 and jasper mixed inextricably. Where most folding there the ore bodies are. Exposure does not admit of tracing out relations in detail. The schistose porphyry 27038 appears, near the ore bodies, to pass into the ferruginous schist (Soap rock?) like 27025.

Just east of the stock pile, and at times partly covered by it, there is a large exposure of rock like 27037 + 8. Forms face of cliff out of which spring flows from diamond drill hole at foot of stairs.

Higher up hill to west of stock piles jasper, strike S-W. followed to N. by schist (Soap rock) like 27025, outcrops.

Gd. S
27039 N 56° W 1770 SE Cor. Sec. 27-62-14

At this place, just below plateau on which the shaft & power houses of Ulmin Iron Co's mines are situated, there is a caved wingé which has exposed a red and yellow sericitic schist 27039. Looks like it might be an altered phase of a porphyry. Compare section with that of 27024-5+35.

Large E-W. trending open pit No. 8 shows on south wall, which is foot wall, a sericitic schist like 27039. Same schist forms N. wall of pit with jasper and ore body - removed - between. Pit No. 9 shows same schist forming its S. wall and same is true, as already shown, for pits still further west. N. wall i.e. hanging wall of N. 9 is not exposed. Where jasper is exposed in the pit the bands in it are very much crumpled but average strike seems to be about E-W trending slightly N of E. Sun under cloud so could not get exact strike.

N 900 W 1800 Sec. 27-62-15
Near top of Soudan hill on N. slope just west of open pit of Montana there are good exposures of plicated Jasper. Strike of bands about W 5° S. dip 70° N. Strike of axes of plications is N 15° E, pitch 70° N.

N 980 W 1800 Sec. 27-62-15
Open pit partly filled by sides caving. Part of hanging wall of N. side of pit seems to be a green chlorite schist. Lies 220 37.
Jasper bands strike E-W, dip 70° N.

U.S.
27040 N 1000 W 1500 Sec. 27-62-15
Large open pit of Montana with green chlorite schist forming hanging wall and Jasper the foot. Strike N 65° W, dip 70° N.

U.S.
27041 N 1300 W 1800 Sec. 27-62-15
Continuing to descend N. slope of Soudan hill I ~~cross~~ Jasper exposure and then at above location come to exposure of a green rock 27041. Next to this, that

is to N, but with contact covered, there comes an outcrop of jasper about 10 paces across N-S. Jasper strikes in general E-W and dips 85° N. It is folicited however and some foliations pitch slightly S of N and others pitch and of course axes stake slightly to N of E, but two directions do not agree. Points to perhaps to sets of folds due to E-W & about N-S pressure.

In contact with jasper and following it to N. S'ward 2 paces of of green schist like 27041 then 12 paces of jasper again; then 30 paces of 27042 eruptive rock; then 2 ft. of jasper; then 4 ft. rock like 27042; then exposure ends with 3 ft. of jasper.

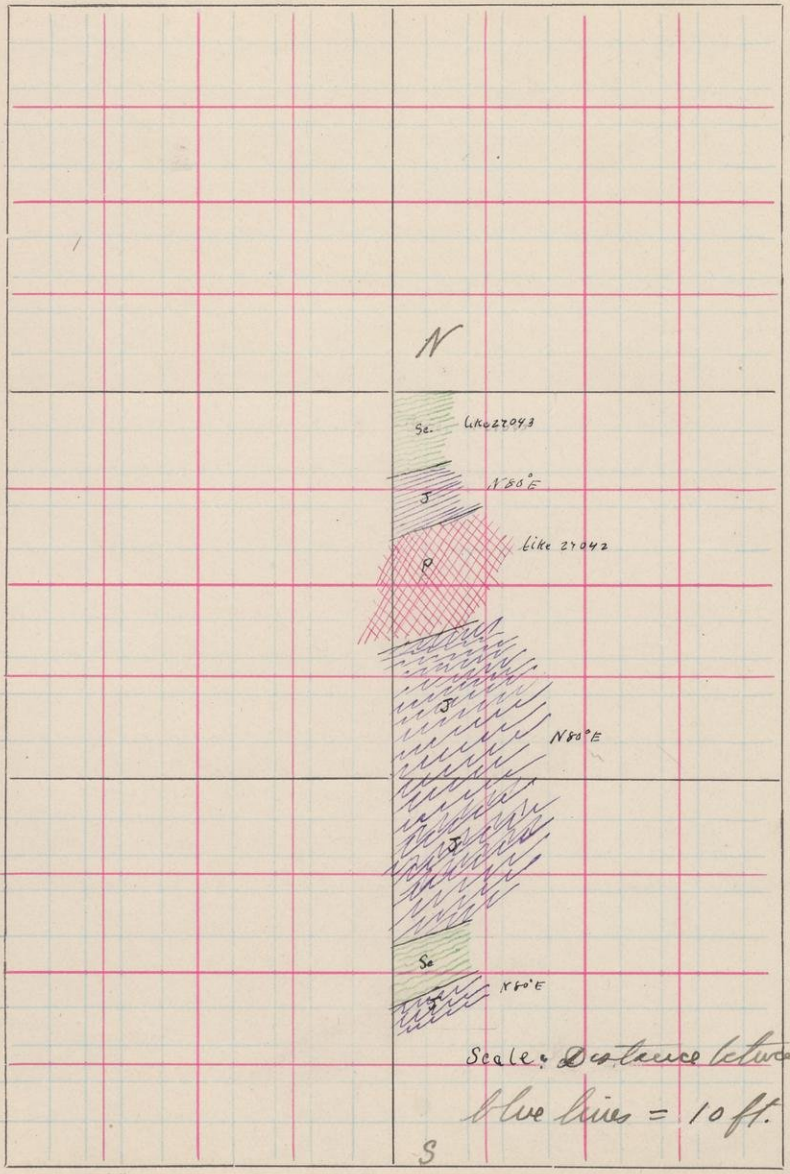
Gr. Sec. ? S.

27042 N 1320 W 1800 Sec. 27-62-15 — Eruptive rock interbedded E-W banding, with jasper.

Gr. S. S.

27043 N 1390 W 1800 Sec. 27-62-15 — Beginning of exposure of sericitic schist with quartz eyes. Schistosity E-W. Exposures is 30 paces across N-S.

72 S. T. R.


N
Se.
Like 27043
N 80° E
J
Like 27042
P
J
N 80° E
J
Se
N 80° E
Scale: Distance between
blue lines = 10 ft.
S

6—747

N 1375 - W 1400 SE Cor. Sec. 27-62-15

From last outcrop located on previous page run ~~North~~ to, passing jasper exposures, to the lake shore. Then run east to the compressor and south up the hill to above point where exposures begin. They are found in the cleared incline leading to top of hill and along the side of the inclined railway. The exposures are not in all cases sufficient to enable structural details to be determined but the succession seems to be as follows with estimated thickness of each bed of rock. Bands of rock strike about N 80° E.

N

Following is section from N - S.

20 ft. Green schist like 22043

15 ft. Jasper N 80 E.

30 ft. Eruptive like 22042

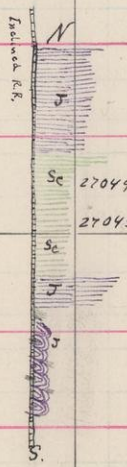
30-75' Jasper (Corresponds to thick bed of jasper to W.?)
Plicated but general strike N 80° E. dip 80° N.

15' Green schist.

10' Jasper

S

74 S. T. R.



Scale: Distance between blue lines = 10 paces

27044-S N 1250 W 1275 SE Cor. Sec. 27-62-15

On the east side of the R. R. cut on inclined railway there is exposed for about 400 paces the following rock sequence.

N
30 paces Jasper
30 paces Green rock like 27044 which grades up into 27045.
8 paces Jasper Strike bending E-W.
15 feet Rotten rock like 22024 trends NW-SE cutting across strike of other rocks.
24 paces Jasper.
S

At this southern end of exposure at east of hill it is seen that the jasper is intricately folded & schist like 22024 is infolded. Truncation of folds makes it appear to cut across strike.

Axes of plications trend N 65° W. Bands apparently on edge.

N 1240 W 1400 SE Cor. Sec. 27-62-15

Exposure of plicated jasper on east side of dirt road. Axis of plication strikes N 80° E. Pitch 60° W.

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76-80

Skipped

Gos. S.
22046 N 1080 W 1600 SE Cor. Sec. 27-62-15
Green chloritic rock with quartz eyes forming N. wall, hanging wall of Montana pit. Jasper forms east, west and south sides of pit near the shaft. Dip 60°-70° N.

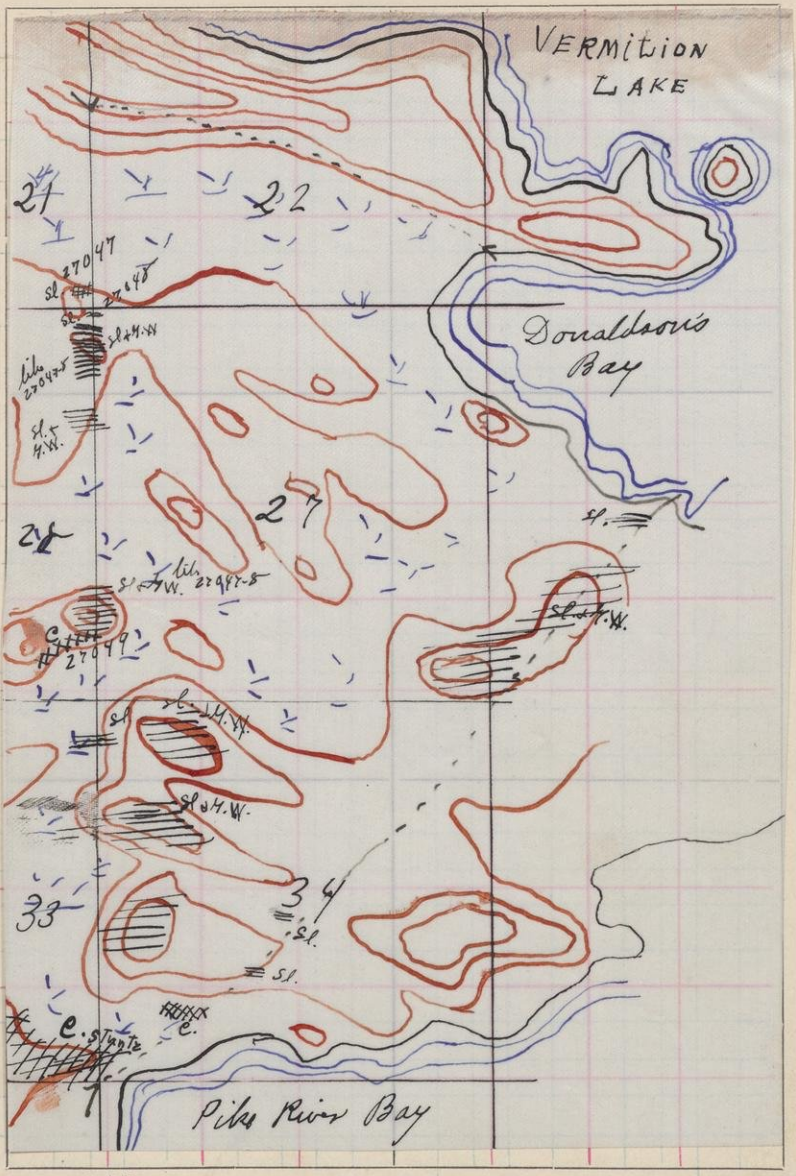
Some schist is seen forming the north wall of the large open pit E of Montana, across the road. Extreme south walls of both Montana & pit to east of it are formed of a schist like 22039. Does this wall schist bend to south and form southwall (foot wall) of No. 8 pit or does it run west along the apparent strike and separate the pits into two series one set Montana north of it & other No 8. to South. A level has been run recently I am told from No. 8. to the Montana. Record of this level should show relations. In the Montana

There are many pillars of Jasper standing and extreme plication of the jasper bands is beautifully shown on these exposures and on the bore pluvius in side of pit. Tried to get photographs of some of the plications last day was so cloudy that could get no contrasts.

Paddled from camp on Pine Island to Donaldson's Bay and began work on N.W. shore of bay. Left canoe and followed ridge extending N.W. across sec. 22-62-16. No exposures seen. Went S. along section line between sec. 21/22; 28/27; 33/34. About 3/4 of the distance was in swamp which was flooded by the lake water and except when standing on a log was in water up to our knees most of time. Few knolls & ridges covered with jack pine rise out of the swamp. Exposures occur on the tops of these. Rocks are slates and graywacke like the Up. Huronian slate and graywackes to the East around Swede bay. Slates grade as we go south into the Stuntz conglomerate which is exposed around Pike river bay.

51
27047 Specimen from knoll near S. corner of Sec. 21/22-62-16. Appears to be a sedimentary but can get no strata readily.

782 S. T. 62 R. 16



6—747

Sl
27048 Hill just S. of S.Sec. Cor. 21/22 is composed of slate. Fissility strikes N 80° W. Ax edge in places inclined slightly to the N.

Lith 27047-8 Hill 1/4 mi. SW. of above corner formed of interbedded slate and greywacke lith 27047 & 8. Large exposure in jack pines. Strike of banding N 80° W.

Lith 27047-8 N 5.00 W 0 Sec. Cor. 28-62-16
Hill with patches of interbedded slate & greywacke lith 27047-8 exposed all over it. Strike E-W. dip 90°

SW
27049 N 4.00 W 0 Sec. 28-62-16
On south side of above hill a rock 27049 like a coarse quartzite appears in numerous exposures.

Continuing south pass slate and greywacke outcrops as indicated. Stunty conglomerate appears on hill, overlooking Pike river bay, just N of SE Cor. Sec. 33-62-16.
From here run NE. to Donaldsons bay.

784 S. T. R.

For location of specimens

see map opposite P. 108.

6—747

Started off this morning to work the shore of the east half of Pine Island.

Sl.?
S.S. Locations of specimens can be seen on accompanying Opposite p. 105 map.

27050 Green schist outcropping on east side of bay on which we are camped. Schistosity strikes N 85° W, dip of schistosity 80° - 80° N.

Sl

27051-2 Good exposures of these rocks can be seen on point on E side of entrance to bay. Exposures show alternating bands of medium grained (gneissic) 27051 and fine grained slaty rocks 27052. Bedding strikes E-W, dips 75° N. Strike of fissility agrees with strike of bedding.

Sl

27053 Greywacke, showing its fragmental character very well, from south side of above mentioned point.

Sl

27054 Granitic gneiss of slate intricately ~~mixed~~ with other fragmentals. Can find no very distinctly conglomeratic phases of the sedimentaries though in places the greywacke has

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86-106

Skipped

what appear to be patches of slate in it. Could not get specimen showing fragments. Slate and graywacke (like 27057) interlaminated in beds from fraction of an inch up to 30 feet in thickness. In general character the rocks are strikingly like those seen in exposure on S. side of Soudan hill at N 800 W 260 SE Cor. Sec. 28 - 62 - 15 (Leith's nos. 27207-11)

sl
27055 A conglomeratic facies of graywacke with patches of slate.

sl
27056 A conglomeratic(?) facies with nodules of chert.

sl
27057 Specimen of fresh graywacke from near E. end of Pine island. It is associated with slates but these are in less quantity than further W and N.

sl
27058 Greenish gray slate similar to that on Pine island. Strike of foliation N 70° E. All along

the south side of Pine island the strike has been nearly E-W varying slightly to N or S. Dip has been S the N. Fissility agrees with the bedding or differs from it so slightly as not to have been noticed.

sl
27059 Pinkish rotten sericitic schist forms reef and also found along N. shore of Pine island. Strike of schistosity N70° E.

H.S.
27060 Greenschist (27060) found occurring to S. of the pink schist 27059.

For descriptions of the specimen numbers 64-80 cf. Bayley's notes taken on canoe trip when he, Prof. K.H. and I were together. The rocks are slates and graywacke on SE end of Pine island with green schist on main land near NE. end of island. Only coasted around east end of Pine island.

b.s.

27061 Started in to coast along mainland around E ½ of Pine island. Green schist on N. shore of Vermilion lake just north of narrowest part of Pine island. Strike of foliation N80°E.

b.s.

27062 Small exposure of green schist without relations. Foliation strike N80°E.

b.s.1-A

27063-4 Hill west of lumber camp and just back from shore little ways is composed of a dolerite 27063 including fragments of green schist like 27062, which it thus evidently is intrusive in. In places on the hill one finds a dense amygdaloidal rock 27064 but can not get its relation to the dolerite or schist.

b.

27065 East point at mouth of stream is formed by a fine grained metabasalt. Weathered surface is very irregular owing to cracks which traverse the rock in all directions showing no regularity.

Gr. Gn

27066-7 We saddled up this stream, which flows in from the N. for about ½ mile and found at first sharp bend to the E. a broken outcrop of hornblende gneiss 27066 cut by dykes of pegmatitic granite. These dykes are from a few inches up to 1½' wide. Spec. 27067 shows contact between gneiss and granite.

Gr. + Gn.

27068-70 Small exposure showing coarse grained eruptive rock 27068 including rock like 27069. Spec. 27070 shows contact between the two. Along the contact the eruptive rock seems to have acquired a slight schistosity as though the magma had flowed around it when it was included or else that pressure subsequent to inclusion developed movement along the planes of weakness i.e. around the inclusion and produced schistosity.

S.Sf.
27071-2 Point east of, and further South than, above rock is made of green schist most intricately included by and included in a dense basalt 27071. Along the saalbands a variolitic facies has been developed 27072. This basalt is possibly an offshoot from 27068.

S.Di
27073 Dolerite forms a knoll on point directly N. of island of Sl. + gw.

To the east of this, along the shore, there are two ledges of schistose greenstone from one of which a specimen (cf. No. 65 of Bayley's number) was taken by Prof. V.H. It seemed to be a tuffaceous facies.

Still further east on the mainland a massive dolerite outcrops and further east still there was seen a long E-W exposure of a basic eruptive rock varying in character from a dense basalt like 27065 to a dolerite of medium grain like 27073. In places in the exposure

there are areas of irregular shape and size which are schistose and appear to be but facies of the eruptive. Possibly parts of a lava flow which have been sheared along cracks. This exposure can be followed by the topography for a mile to the E.

I could not get to the shore from Rice bay on account of the marsh being flooded but am quite sure from its appearance that the rocks bordering the N. shore of the bay is the same as the eruptive greenstone dolerite to the west.

sl

27074 Just on south side of narrow entrance to Rice bay, which runs E-W for about one mile, there is an exposure of a bluish slate with fissility striking N80°W. Does not this slate correspond to No. 66 of Bayley west of this location and on E end of Pine island?
Does not Rice bay and stream flowing into it from E. mark contact between sed. slates and eruptive rocks (greenstones) to N.?

S.S.
27075 Green schist apparently corresponding to Bayley's Nos. 67-8.
Schistosity strikes N 80° W.

S.S.
27076 Apposite E. end of Pine island the mainland shows numerous exposures of a green chloritic and calcareous schist. This quite frequently has a tufaceous or fragmental appearance on weathered surfaces as shown by Spec. 27076. Schistosity strikes E-W.

S.Di
27077 South of place where 27076 occurs the hills are composed of medium grained massive dolerite 27077 which is schistose in places along shearing planes and grades into a basalt. Massive form of rock predominates though along the shore the outcrops are much weathered and show a somewhat schistose character.

Sd
27078-9 Beginning at the formation line down south of the above hill and continuing to the south

there are exposures of interbedded graywackes (27078) + slate (27079). Strike about E-W magnetic. No sum. These appear to be the same as the slate + graywacke exposed all along the south shore of Pine island and are presumably the eastward continuation of them.

sl
27080 Specimen taken from next point south is granular on weathered surface and may be a graywacke. Possibly a volcanic sand?

sl
27081 Slate and graywacke with strike N80°W.

s.
27082 Greenstone forming E-W ridge. No relation.

s.
27083 Green schist. (In places however it is massive.) Schistosity strikes E-W. Has what in places appears to be ellipsoidal parting. May not the graywackes + green schists form a series of interbedded lavas and sediments? In this case the green schists are of U. H. age.

F. P.
27084 Schistose porphyritic rock. Schistosity strike little S of W.

S.
27085 Greenstone, for most part massive but with subordinate schistose portions. Has in places a spotting very similar to Ellipsoidal spotting.

S. F. P.
27086-7 Hills on N. shore of Mud Creek bay are formed of greenstone (27086) which varies from fine grained rock like specimen to coarse dolomitic facies and also to schistose facies. In places also some of the rock is distinctly tufaceous. I could not detach a piece of this tufaceous rock from the flat surface exposure. These facies are found so mixed that no definite relation could be determined. It seemed clear however that the schistose rock was but a sheared form of the massive eruptive. Still the schistose greenstone seems to predominate.

F. P.
27087 Near top of the hill formed of the greenstone + plainly visible from the bay there is an

of E-W trending mass of a granular gray rock like 27087. Dyke (?bed) is 30' thick. Seems to be interbedded with the greenstones which seem to be volcanic.

sl.
27088-9-27090 Pink micaceous schist 27088 found on south shore of Mud Creek bay associated with a grey slate 27089. They form a low ledge at base of hill. Strike is about E-W, magnetic. As we turn point and start south we get a section across the schistose graywackes & slates showing here conglomeratic facies 27090 but they are all excessively sheared and very schistose and badly altered.

sl.
27091-2-3 On sw. side of the point I find a slate 27091 associated with a graywacke (or porphyry) 27092 and a very dense banded rock 27093. If 27092 is a porphyry then I am inclined to think that 27093 is a hornstone derived from alteration of slate like 27091. Cannot get exact relations of rocks here.

e.

27094 A coarse graywacke, perhaps a porphyry. Forms N. shore of this bay trending little S of E.

QP.

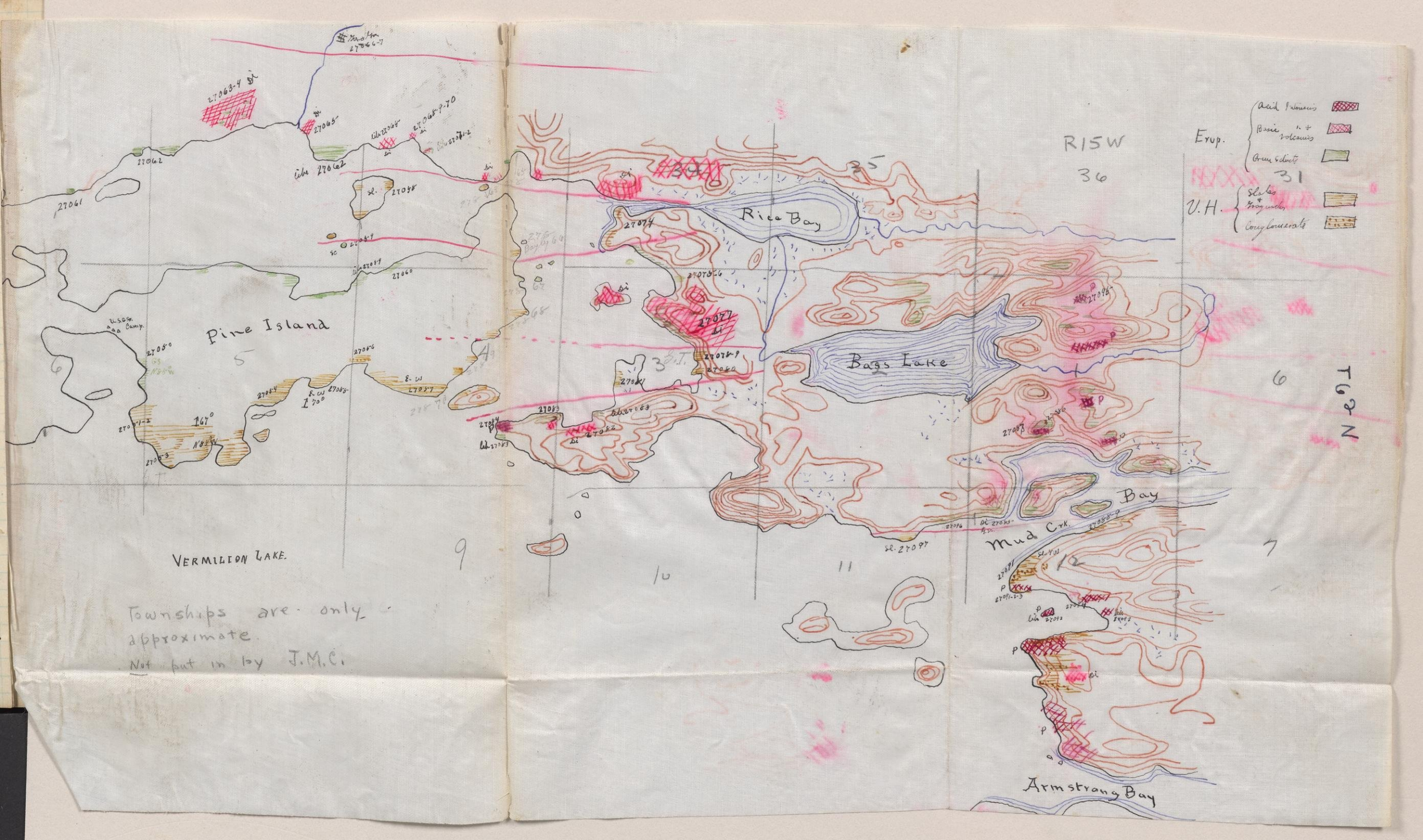
27095 Bed of porphyritic rock (dyke) interbedded with green schist. trends E-W.

G.S.

27096 Green calcareous schist.

SL.

27097 This seems to be a fragmental slate grading into a graywacke in places. If it is a fragmental then possibly it corresponds to 27089 and the line between the acid porphyries and stuff fragmentals on one hand and the basic green schists (and fragmentals?) on other should be drawn just N. of here E-W.


Pine Island
Rice Bay
Bass Lake
Mud Crk.
Bay
Armstrong Bay
VERMILION LAKE.
Townships are only approximate.
Not put in by J.M.C.
R15W
36
31
6
1
12
7
9
10
11
T62N
Erup.
Acid Volcanics
Basic & Int. Volcanics
Arm. Schists
V.H.
Slates & Graywacke
Conglomerate