Keweenaw, and Penokee-Gogebic Region, Michigan: [specimens] 14512-14711. No. 73 August, 1888

Van Hise, Charles Richard, 1857-1918; Bayley, William Shirley, 1861-1943; Boss, C. M.
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U. S. GEOLOGICAL SURVEY

FIELD SECTION BOOK

No. 73.

August, 1888.

Keweenaw and Penokee-Gogebic Series.

Notes by Van Hise, Bayley and Boss.

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

INSTRUCTIONS.

1. Ordinarily at least two pages of this book will be devoted to one section. On the left hand page place a map of as much of the section as has *actually been seen*. Denote rivers, lakes, marshes, etc., by the usual topographical signs. Denote the ledges of rock, when no structure is made out, by cross-hatching, making the cross-hatching cover as nearly as possible the areas occupied by the exposures. If the rock is a massive one, but still more or less plainly bedded, use the same sign with a dip arrow and figure attached, showing the amount and inclination of the dip. Denote slaty or other very plainly bedded rocks by lines running in the direction of the strike, with figures and a dip arrow attached as before. In all cases where there is the least doubt about the true bedding directions, indicate it by a query. To each exposure on the face of the map attach the number of the specimen representing it. In mapping the section count each of the spaces between the blue lines as 100 paces, and twenty of these spaces as one mile, or 2,000 paces. Usually the southeast corner will be placed at the bottom of the page, or at the first black line above the bottom of the page, and at the right hand side. If, however, for any reason, it is desirable to show portions of an adjoining section, the southeast corner may be shifted up, or the map may be turned around and the north placed at the left hand side of the page.

2. On the right hand page place the notes descriptive of the exposures. Begin in each case with the number of the specimen, placing the number on the left hand side of the red line, after which give in order on the right of the same red line the position of the ledges as reckoned in paces from the southeast corner of the section, and the dip and strike when observable, for instance: 4025 250 *N.*, 300 *W.*, *Strike*, *N.* 6° *E.*, *Dip*, 50° *E.* Then follow with as full a description of the ledge as possible.

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

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

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

#73

(Notes by C. R. VanHise & Dr W. S. Bayley)

Beaver Bay, August 7th, 1888.

From Beaver Bay we coasted northeast along the shore of Lake Superior to about the middle of the palisades — that is, five miles from Beaver Bay, at which point we turned about and followed the coast from this place to Two Harbors. The palisades here consist of flows of red looking rock which resembles Irving's augite-syenite, and of quartz-porphyries and felsites. At the most northeasterly point reached, the rocks are in thick flows, coarse-grained, red and massive, with a well-marked vertical columnar parting. The only place in which the dip was measured with the compass, the rocks dipped a little west of South, magnetic. A little to the West of the most eastern point reached, and interbedded with the red-rocks, is a flow of some 20 to 25 feet thick of a different character. That this rock is a flow is well shown by the fact that its base is amygdaloidal, the amygdules being very abundant. They are composed of a soft white, well crystallized minerals in some cases; in others, of a chloritic-

looking substance; and, in others, with red and white minerals, which are probably in part thomsonite.

14512 This is amygdaloid where the amygdules are not as thick as in the variety just noted, but where the rock is fresher. 8 to 10 inches from the bottom of the flow.

14513 A little farther from the base of the flow. The rock is now of a purplish red color and free from amygdules.

14514 A coarse, massive rock, from like that in which 14513 grades, in passing still higher up. 14514 is from a point a little to the southwest, along the coast, from 14513, and is taken to be a portion of an underlying flow.

At a point a little to the west of 14514 is a curious conglomeratic rock, which is interbedded or at least included in a red felsitic rock, and which is composed of round and angular pieces of the red felsite of all sizes, up to one and two feet

14515 in diameter. 14515, The pebbles are cemented together by a whitish material, which appears to be of much the same nature as the felsitic pebbles, except that they are much decomposed. Calcite veins are common in the vicinity, cutting the conglomeratic rock, and sometimes running over into the felsite. Some little distance farther to the west, on the west side of a bay, is a cliff of felsite, which shows beautiful flowage structure. The cliff presents the appearance figured by Irving in Monograph V, page 313. The flowage bands vary from parallel to very contorted. With the best of care, the hand-specimen does not show this flowage structure with anything like the beauty observable in the cliff.

14516-17 Felsites from this place

14518 Quartz-porphyry. A short distance west of the location of last specimens. The rock here is not banded, and does not show the flowage structure as well as the

previous specimens.

14519
14520 Another type of felsite still farther west. This is a fine-grained pink rock, but shows no banding. It contains numerous small dark areas resembling the crystallites of the Aaron pitch-stone.

14521 A dark fine-grained rock, resembling black Animike quartzites. West of 14519-20.

14522 Coarsely crystalline red-rock. Very much like the coarse rock from the palisades. West of 14521

A short distance east of Beaver Bay, on the coast opposite a small island, perhaps a mile or a mile and a half, is found a large variety of rocks very closely associated with each other. The rocks here become of a more basic character, and some of the flows are thinner.

14523 Fine-grained diabase, which contains
14524 within it a dark, almost pure feldspathic rock (labradorite). West of 14523-24
14525-26 is 14525-26, amygdaloide. 14526 is taken a few feet from 14525, farther in the flow, and contains fewer amygdules.

A short distance farther to the west is
14527 a brownish-red quartz-porphyry. This is
14528 cut by a dyke of red crystalline rock.

14529 Olivine gabbro. A short distance west of the previous numbers. This rock contains large crystals of feldspar, and the flow is a much larger one than those of the previously described rocks.

14530 Anorthite rock. Occurs in large irregular
14531 masses in 14531, olivine diabase

The distance from 14523 to 14530 inclusive is not more than ten rods.

In traveling west from here towards Beaver Bay, just west of 14530 the anorthite rock is very much coarser. This extends

some distance beyond the last, forming two or three points, between which are bays with shingle beaches and fine-grained acid rocks, which are occasionally cut by dykes of red rock, which are, however, here less frequent than farther east.

14532 Felsitic breccia. From a bay west 35° north of the island from which 14522 was taken.

Going still farther westward towards Beaver Bay is another succession of basic flows containing anorthite rock. The first of these basic rocks is 14533 fine-
14533 grained diabase, which appears to lie just above the acid flows. Above this
14534 follows coarse olivine diabase, which contains large pink crystals of feldspar, like those in 14531. Next of this in order
14535 is 14535, anorthite rock. It is here coarse grained and looks much like an interbedded flow. It seems to be dipping at the same angle as the basic rocks.

14536 A fine-grained dyke, apparently recent

bling 14534, which cuts 14535.

14537 Coarse-grained olivine gabbro. West of 14535. This coarse gabbro extends for fully a quarter of a mile, and has the appearance of being two basic flows, one of which is followed above the other.

14538 Is a large specimen showing the most coarsely crystalline phase of this gabbro. The diallage crystals, including feldspar, are at times three inches in diameter.

14539 White anorthite rock. Included in 14538.

14540 Finer grained black gabbro. A few rods west of 14539

West of this again follow coarse mottled rocks, forming several points, extending about one-fourth mile, and constituting the eastern side of Beaver Bay.

11

A full set of specimens was not collected from Beaver Bay, although the shore

was followed and the rocks observed. After the shingle beach is passed on the northwest part of the Bay, the first rock found is a fine-grained diabase, which is cut by, or at least includes red-rock — granitic porphyry. In addition to these, the anorthite rock occurs intermingled with the diabase in all sorts of confused shapes. A little west of these
14541 first rocks is found amygdaloid, which
14542 grades into non-amygdaloidal fine-grained diabase. This diabase is cut
14543-44 by dykes of red rock — granite porphyry, and the anorthite rock continues to be intermingled with the diabase to near the stream which enters the Bay. Before
14545 this stream is reached, however, quartz-porphyry is found. This rock is fractured in every direction by joints, and it was impossible to obtain trimmed hand-specimens from the ledge.
The rock making up the point at the southeast part of Beaver Bay is mainly red-rock — granite porphyry. Following the coast beyond Beaver Bay the coarse-grained lustre mottled gabbro

again appears, and it continues without any great interruption for five miles

14546 is a specimen of one of the freshest varieties of this gabbro, from a point about two miles west of Beaver Bay.

14547 Olivine gabbro. Five miles west of Beaver Bay. The gabbros here are cut by a dyke of red-rock.

The next point to the westward is composed of red-rock, and at the first bay beyond this appears numerous flows of amygdaloid, with calcite and other fillings.

14548 Non-amygdaloidal phase. From one of the flows

14549 Amygdaloid. From same flow

14550 Another phase of amygdaloid. From the same locality. The amygdules are here apparently laumontite, which vary from the size as seen in the specimen, to those which are three inches or more

in diameter.

Between this point and the mouth of Split Rock River, at which point we camped, are large masses of anorthite rock included in a dark rock. These irregular masses have sometimes the appearance of fragments of various sizes which have been caught up by or have separated from the magma of the black rock. There is a sharp junction between them, at times indicated by cracks. Just east of the mouth of Split Rock River is an amygdaloid like that from which 14548-49-50 are taken.

14551 Quartz-porphyry. From the next bay to the westward. This porphyry contains little pieces or inclusions of a dark rock.

In passing still farther to the westward, the next few points are amygdaloidal
14552 flows. 14552 Amygdaloid from first point.
14553 14553 Non-amygdaloidal part of flow from

14554 second point. 14554 Amygdaloid from
third point, containing green and calcite
14555 amygdules. 14555 Amygdaloid from
third point. Some of the amygdules here
are of very large size, most of these being
calcite.

14556 Continuing westward, the amygdaloid
continues to be the main rock found,
until Gooseberry River is reached, near
the center of 54 A. R 9 W. about three
miles east of the river, the amygdaloid
differs from the one ordinarily found,
in that the amygdules are more
largely chalcedonic.

14557 Fine-grained dark colored rock. From
large exposure just east of the mouth of
Gooseberry River.

In the next bay west of Gooseberry
River is a vertical cliff some 40 or 50
feet high showing a beautiful amygda-
loid dl. flow from base to summit.
The upper part of the flow has been
very vesicular, and contains numerous

large fillings of a pink mineral taken to be laumontite. Passing towards the base of the flow, the laumontite amygdules become mingled with those of a green color. The green amygdules increase in abundance in passing downward, and at the base of the flow only this variety is found. The flow shows beautifully, by the elongation of the amygdules and their arrangement in lines, the flowage structure of the rock.

14558 Laumontite and calcite from amygdaloid, as high in flow as could be reached.

14559 Amygdaloid, lower down, containing amygdules of laumontite, and fewer of calcite.

14560 Amygdaloid. Showing the transition from the laumontite to the green amygdule.

14561 Amygdaloid. Nearly all of the amygdules

bring of the compact green variety.

14562 Green amygdule. Collected from the lower part of the flow.

14563. Amygdaloid, containing light olive green amygdules. From point about 2¼ miles west of Gooseberry River.

14564 Fine-grained porphyrite. From an amygdaloidal flow about 2½ miles west of Gooseberry River.

14565 Gabbro. About 3 miles west of Gooseberry River. This gabbro contains large fresh crystals of feldspar, and includes masses of almost
14566 pure feldspar rock. This feldspar rock is
14567 bordered by a fine-grained trap. Immediately west of this point amygdaloid again appears, and continues to the next large point, which is again composed of gabbro like 14565.

14568 Amygdaloid. From first point west of the mouth of Encampment River.

In passing west from Encampment River, the rocks continue to be a succession of amygdaloidal flows, like those from which specimens have already been taken. There then appears a fine-grained brown,

14569 amygdaloidal rock, which continues for quite a long way.

14570 Olivine gabbro. West of 14569. From a heavy flow ~~of~~ which caps a high bluff, at whose base are large loose bowlders, from which the specimens was taken.

14571 Amygdaloid. From the head of a bay about 1½ miles east of large point 2 miles east of Two Harbors.

14572 Fine-grained diabase, approaching an amygdaloid in character. From point between Two Harbors. There are here also amygdules like those already observed.

13 x (Notes by C R Van Hise)

August 17, 1888

Arrived at L'Anse from Duluth. The afternoon was used in a walk along the shore of Kewenaw Bay, northeast from L'Anse.

14573 Pebbles from conglomerate in Potsdam Sandstone, about 2 miles down the bay from L'Anse. This is the place where the unconformity between the Potsdam Sandstone and the Huronian, described by Foster and Whitney, is found.

August 18, 1888.

The time was used in company with Bayley in a trip to Taylor's Mine, following the railroad. Also the place where a large dyke cuts through the slate, along the west line of the SE 1/4 of Sec. 22, T. 56 N., R. 33 W. Mich., was visited. See notes by Irving Book 53, page 38. The trap which here cuts through the slate contains many fragments, varying from angular to tolerably well rounded, of chert and

14574-75 granite. 14574-75 represent this trap

with its inclusions. The slate has been altered by the trap, apparently showing contact metamorphism

14576 14577 14578 14579 are taken in order in passing away from the trap. The first is taken as close to the trap as any specimen could be gotten, and is profoundly altered. 14577-78 are also much altered, while 14579 appears to be the normal slate.

14580 White quartz. From large white quartz vein in the slate. This seems to be the series whence the most abundant fragments of this sort in the trap appear to be derived. The granite included in the trap does not outcrop in this neighborhood.

Calumet, Mich., August 20, 1888.

14581 Lustre mottled melaphyr on road from Lake Linden to Calumet. As near as could be located, in the southeast corner of Sec. 33, T. 56 N. R. 33 W., Mich.

14582 Fine-grained massive diabase, containing amygdaloidal cavities. A short distance

north of 14581.

14582A. Amygdaloidal phase of same

14583 Copper-bearing conglomerates. From the
14584 Osceola Mine.

August 21, 1888.

14585 Lustre mottled melaphyr. From high bluff with an eastern face, just after crossing Eagle River on the way to Central Mine. Probably is east part of Sec. 29, T. 58 N., R 31 W., Mich.

14586 Massive diabase. Central Mine. South part of Sec 20, T. 58 N., R 31 W., Mich.

14587 Amygdaloid which comes out with vein material of Central Mine, and is rejected as not bearing sufficient copper to pass through the stamps.

14588 Conglomerate, showing many phases of pebbles. From the dump pile of Central Mine. This conglomerate composes a small percentage of the dump pile only, and in

some of it copper is contained.

14589 Vein material containing a good deal of copper. From the Central Mine. This is much richer than the average ore, but is the material from which most of the copper of the mine is taken.

14590 Same material, showing crystallized copper.

The diabase, amygdaloid, and vein material come out of the mine in cars together, and the material is hand picked before the ore goes to the crusher, the larger lumps of rock being rejected.

14591 Copper-bearing amygdaloid. From a test pit, or small open pit near Eagle Harbor. Probably the NE 1/4 of Sec 6, T. 58 N, R 30 W., Mich.

14592 Diabase. Somewhat amygdaloidal. From the point forming the lake side of the west end of Eagle Harbor, Sec 6, T 58 N, R. 30 W. Mich. (Lake shore trap)

14593 Diabase amygdaloid. From the lake shore, about the center in an east and west direction of Sec. 6, T. 58 N., R 30 W. (Lake shore trap) Drawing 8.

14594 A very open amygdaloid. From same location as 14592.

14595 Sandstones. From the south side of
14596 Eagle Harbor. All in Sec. 5. T 58 N., R. 30
14597 W. Mich. These sandstones are inter-
14598 stratified with, in some cases, and in other cases overlain by a coarse conglomerate (the great conglomerate) Drawing 7.

14599 Fine conglomerate. Interstratified with the above sandstones.

August 22, 1888.

14600 Conglomerates. From the west end of
14601 south side of Eagle Harbor. The N E 1/4 of Sec. 6 T. 58 N., R. 30 W. Mich. (The great conglomerate)

14602 Sandstone. From exposure at stamp mill of Copper Falls Mine. Probably

the NE 1/4 of Sec 12, T. 58 N., R. 31 W. Mich. (The great conglomerate belt.)

14603 Ore from Copper Falls Mine. NE 1/4 Sec.
14604 12, T. 58 N., R 31 W., Mich. The ore is an amygdaloid, and most of the copper is in the form of amygdules.

14605 Amygdaloid, the amygdules of which are all filled with copper. From the same mine.

14606 Pebbles from the Great conglomerate. Near the mouth of Eagle River. Collected from the exposures above and below the bridge at Eagle River village, NW 1/4 of Sec. 19, T. 58 N., R. 31 W., Mich.

14607 Sandstones. Interstratified with the
14608 conglomerate from which 14606 is taken.
14609
14610

14611 Sandstone. About 2 feet above the base of the great conglomerate. A short distance south of bridge at Eagle River village. NW 1/4 Sec. 19, T. 58 N. R. 31 W. Mich.

14612 Sandstone at base of great conglomerate

and in contact with the upper surface of
14613 an underlying amygdaloid

14614 Same amygdaloid 2 feet below the contact with this great conglomerate.

14615 Same amygdaloid. Lowest layer of bed obtainable below the lower falls of Eagle River — that is, the falls a short distance above the Eagle River village bridge

14616 The base (diabase)
14617 The middle
14618 The top (amygdaloid)
} From a basic flow of medium thickness on Eagle River, at its upper fall. Probably not far from the South quarter post of Sec. 9, T. 58 N., R. 31 W. Mich. See Marvin's map for exact location of this fall.

14619
14620
14621
14622
14623 Taken from base to top — that is South to North, along Eagle River. From a flow of very considerable thickness which unmistakably overlies the bed from which 14616-18 were taken. The series of specimens show well the gradual transition from the massive phases to

the amygdaloidal portion of the bed.

14624. Specimens taken from base to top —
14625. that is, South to North, from a very thin
14626. bed, a short distance north of 14619-23,
14627. upon Eagle River. The contrast between this set of specimens and the previous one is noticeable, they being much finer grained. The bed is not more than six or eight feet thick, while the previous bed is more than a hundred, and perhaps a good deal more than a hundred feet thick.

14628 Compact sandstones. From a very thin
14629 layer of sandstone between two eruptive flows a short distance north of 14624-27. This sandstone in its widest part was not observed to be more than 6 or 8 inches in thickness. In place the sandstone layer divides into several layers interstratified with eruptive material. It is evident that this thin bed of mechanical sediments did not form undisturbed by lava flows.

14630 Shows the junction of the above sandstone and the overlying amygdaloid.

14631 Amygdaloid. From the same bed as 14630. About 2 feet higher up in the flow.

14632 Lustre mottled melaphyr. From near top of south face of a bluff at the Cliff Mine. Probably near the south line of Sec. 36 in its SE 1/4, T 58 N., R 32 W, Mich.

14633 Sandstone. From exposure in wagon road from Cliff Mine to Calumet, about 2 miles southwest of Cliff Mine; probably near the center of the W 1/2 of Sec 11, T 57 N., R 32 W. Mich.

14634 Coarse specimen (large specimen)
14635 Fine conglomerate
14636 Medium conglomerate, showing copper
14637 Coarse sandstone
14638 Fine sandstone
14639-40 Amygdaloids

All taken from the dump pile of the Allouez, near the south line of Sec. 31, T 57 N. R. 32 W. Mich. The sandstone and conglomerate, as shown by the large fragments, are interstratified, the

transition between the two being usually abrupt. The amygdaloid specimens were both taken from large fragments, a portion of which fragments were the conglomerates. These large specimens then show the junction of the amygdaloid with the conglomerate

August 23, 1888.

I walked up the ravine just south of the old road from Calumet to Lake Linden, in Secs 19 T 20, T. 56 N., R 28 W. Mich. As paced upon the road, the distance traveled was about 500 steps. This is the ravine described by Irving and Chamberlin in Bulletin No. 23 as the St Louis ravine. I began in sandstone and walked up to the trap. About 500 steps below this trap
14641 I found 14641 sandstone, and a conglomerate
14642 from which 14642 represents pebbles. This sandstone and conglomerate are well exposed upon the south side of the creek. The fine and coarse layers were interstratified so as there was no doubt as to the direction of bedding. I had no dial compass with me, but the dip did

not vary far enough from the horizontal for the eye to discover it. In passing up the ravine I came to other beds of sandstone plainly stratified, over which were low falls in the creek, about 4 to 6 feet, and these beds plainly dipped up creek at low angle as showed by the level of the water above the falls. The fall higher up the creek dipped at a larger angle toward the west than the lower fall, this dip being estimated at 10°. In passing up the stream from this point no further exposures were noted for some distance, perhaps 300 to 350 steps from the beginning. Here was seen an exposure of heavily bedded quartzite or indurated sand-
14643 stone (14643), which contained purple strata dipping up stream — this is towards the west — as much as 35 degrees. The sandstone was, however, so heavily bedded that this estimative may vary quite widely from the truth. No farther exposures were found until within 30 steps of the trap, where the water
14644 falls over 14644, massive sandstone — white friable massive sandstone, the dip of which could not be determined. A short distance

14645-46 above this place are 14645-46 trap. This same trap is exposed in the wagon road directly north, or a little east of north of this place. I next followed the ravine containing a small creek, north of the old road to Lake Linden. This ravine is between the road and Irving and Chamberlin's wall ravine. At several places recent slides well expose the rocks on the side of the ravine. I began to follow the ravine at quite a distance below the junction, going up the creek. The sandstone and interstratified conglomerate are here approximately horizontal, dipping slightly away from the Keweenaw Series. This horizontal material is at times a red shale. I returned down the same ravine. Beginning at the copper series we have, near the top of a
14647 flow, 14647, amygdaloid, and at the base of
14648 this same flow 14648, compact trap. Plainly underlying 14647-48 is a coarse conglomerate
14644 sandstone and shale, which dip up stream towards the copper series at 40°, estimated. Whether this conglomerate is really interstratified with the trap it is impossible to say, as it could not be followed far enough

under the trap to determine this point.

14650 Pebbles from this conglomerate.

14651 Sandstone. 25 steps down stream from 14650. The sandstone here dips 45° down stream in coarse beds.

The question arises whether, between the location of 14649 and 14650 and 51 is not found the break between the Eastern Sandstone and the Keweenaw Series. 14649 appears to dip under the trap, and if the sandstone and conglomerate, 14650-51, were horizontal, I should be inclined to regard 14649 as inferior to the trap; but the sandstone nearer the trap dipping toward it, and the sandstone a short distance away from the trap dipping as strongly away from it, would rather seem to indicate that here had been some violent local disturbance.

14652 Sandstone. 10 steps lower down the creek than 14650-51

In passing down stream, to about 200 steps below the trap, the exposure have a slight dip up stream. At 200 steps down stream we come to an exposure of coarse conglomerate, which dips about 30° up stream. This conglomerate is interstratified with
14653 Sandstone.

14654 Sandstone conglomerate. Down stream from trap about 220 steps.

The sandstone below the trap, for the distance of 200 paces or more, is evidently much disturbed, dipping sometimes in one direction and sometimes in an opposite one. Both upper and lower conglomerates in this ravine should have been carefully examined to determine if there is not a difference to be made out in the nature of the contained pebbles. Random pebbles were obtained only from the upper conglomerate.

14655 Sandstones. From Torch Lake quarry.
14656 See Bulletin No. 23, Irving and Chamberlin.
14657 The quarry was closely examined and, so far as could be judged, the bedding

is perfectly horizontal. Nowhere was there found any bede whatever that could be interpreted as indicating that this sandstone is in an inclined position.

August 24, 1888

14658 Diabase amygdaloid. From cliff over which falls occur at the Douglas-Houghton ravine, about half way up the cliff. The same diabase is found about 50 steps down the ravine in the bed of the creek.

14659 Sandstone, From a layer interstratified with a conglomerate. About 200 steps down the stream from the falls. There is a large exposure of this sandstone & conglomerate on the south side of the ravine. That in the bed of the creek and that upon the bank above dip up stream at an angle estimated to be 15°.

14660 Pebbles from this sandstone.

In passing down stream from the location of 14659 & 60, there were observed several large exposures made by recent slides. The dips

of the rocks change gradually from the inclination shown by 14659 and 60, until at 400 or 500 steps down the ravine the rocks were so nearly horizontal as to make it impossible for the eye to detect any dip.

14661 Calumet and Hekla conglomerates, carrying
14662 copper.

14663 Large pebble from Calumet and Hekla conglomerate. Very largely replaced by copper

14664 Amygdaloid. From Calumet and Hekla Mine

14665 Amygdaloid. From Calumet and Hekla Mine, some of the amygdules of which are metallic copper.

Negaunee, Mich., August 27, 1868

A railroad cut near Negaunee upon the Northwestern Road was examined, which shows a beautiful anticlinal, as perfect a one as I ever saw. The layers are alternately of
14666 a green massive material, and of a ferrug-
14667 inous slate, which is generally thinly bedded, but which in the specimen does not show this.

A rough sketch of this anticlinal is seen on the opposite page, a photograph of it having been taken. Both the sketch and the photograph show the rocks to be cut by dykes. The latter are in nearly a vertical position, as though they had intersected the ferruginous rocks after its present folding had occurred. The ferruginous layers are greatly disturbed and show fine contortions in the neighborhood of the
14670 dyke. There is absolutely no doubt of the dyke-like character of this cutting rock. The con-
14668-69 tacts are perfectly sharp. The dykes themselves have a schistose structure parallel to their sides, and the more altered parts of them are like the so-called soapstone in some of the mines. The width of the dyke varies greatly on each side of the cut.

14671 "Soapstone" From the dyke along the wall of open pit No. 7 in the Jackson Mine, Negaunee.

14672 Contorted jasper. From Jackson Mine.

14673 Finely-banded specular lean ore from the Jackson Mine.

14674 From a large open pit southeast of the village of Humboldt. This specimen is taken because peculiar. It is found upon the north hanging wall of the mine, near an overlying fragmental quartzite.

The succession of rocks at Michigamme and at Humboldt, in the mines at those two places, were closely examined. In both cases the quartzite is over the ore, but at Michigamme it is upon the south side of the ore, while at Humboldt it is upon the north side. At Michigamme the dip is south, while at Humboldt the dip is north. So far as one can judge from these mines, there is here a synclinal trough.

Republic, Mich., August 28, 1888.

14675 Garnetiferous actinolite slate. From the
14676 southwest angle of the outer (lower) layer of Brooks set of formations, just above lower quartzite. A short distance southeast of the north quarter post, Sec 15, T. 46 N., R 29 W., Mich.

14677	Quartzose schist	From Brooks upper quartzite.
14678	" " and conglomerate	
14679	Ferruginous quartzite	Taken from ledge on low ground not far from
14680	Conglomerate	
14681	Quartzite	

Smith's Bay at southwest angle of Horse Shoe. The contact between the schist and conglomerate is very sharp, as shown in 14678. The conglomerate contains jasper and ore (proof of early silicification). The conglomerate grades into the schistose quartzite.

14682 Schist
14683 Garnetiferous actinolite schist
14684 " " " , Weathered surface:

14682-83-84 are taken from a ledge a short distance north of location of 14677-81. The exposure was at first taken to be a greenstone, but if so it is now a large schistose altered one; but it does not appear to be certain that it is not a coarsely actinolitic member of the iron series.

14685 Soapstone. Containing crystals of biotite.

14686 Soapstone. From dump pile of Republic Mine.

Facts given by J. Parke Channing, Bessemer, Mich., August 29, 1888.

List of mines on the Penokee-Gogebic Range which have so-called north veins: (1) Tyler's Fork. Good deposit. No south deposit found. (2) Iron Belt. No south deposit found. (3). Montreal. Good south deposit found, from which main quantity of ore is now taken. The north deposit is, however, still producing ore. (4) Iron King. The main deposit is the north one. A south deposit has been found (5) Colby. There is here a peculiar state of affairs, as the north and south deposits are practically connected. The peculiar position and relation of deposits shown by plate. (6) Brotherton and Sunday Lake mines. Both are north of the quartzite. They contain no dykes. The ore is here in more isolated and irregular patches than in the larger mines. The lenses of ore are usually not more than 10 or 12 feet wide, and are separated by a barren rock, between which is sometimes as much as a hundred feet in thickness.

The footwall quartzite in some of the large

mines has been found to be very irregular, as irregular as the present surface of an eroded country. Within the present extent of some of the mines, the foot-wall quartzite varies many degrees from the average plane of the formation.

The hard blue ore lies next to the dykes of the mines in quite a number of cases. This is true at the Ashland, Norrie, Aurora, Montreal and Colby

The Ironton-Curitan lenses pitch to the east. No dyke has anywhere been found in the mine, although one comes to the surface 300 or 400 feet west, but even this is a very thin two feet dyke.

Bessemer, Mich., August 30, 1888.

In company with J. Parke Channing and Capt. Roberts of the mine, I went into the Colby and made a close examination of many of its drifts, rooms, etc., at various levels.

The Foot-wall Quartzite.

The quartzite is not a regular plane, but is as irregular as the ordinary undulatory surface of the country. The

shaft resting upon this footwall, which was followed to the bottom of the mine, was at various angles. In some places it dips as high as 75° or 80°, while in other places the dip is not more than 45°. This undulatory character of the quartzite was shown as well in the drifts which followed the quartzite as in the shaft. One of these drifts, in following the ore, bowed sharply south and went for some distance almost due south before it struck the quartzite, having been just before alongside of it.

While the main mass of ore in general lies comparatively close to the quartzite, it by no means rests directly, or even usually directly upon it. Frequently above the quartzite, in the hollows of its surface, is found a layer of sand rock so friable as to readily crumble between the fingers — is, in fact, no more than the coarse sand. More abundant than this is, however, what the miners call "paint rock." This material is soft and red, rich in iron, at times carrying more than 50%. It appears like a heavily ferruginous clay. This paint rock varies from a

mere film between the ore and quartzite, to a layer 15 or 20 feet in thickness. The undulatory nature of the quartzite, the coarse sand, the paint rock, all would seem to suggest that after the sandstone, which now forms the quartzite, was deposited, and before the beginning of the deposition of the iron-bearing belt, the country surface had been somewhat eroded, and the debris filled to some extent the hollows. If this is the case, how does it happen that the loose material escaped induration? The general pitch of the ore of the south vein to the east is very marked. At a certain point in the second level, just east of the shaft entered, the "cap rock" was struck. In the next level below this, the drift extended about 75 feet farther east before the cap-rock was struck. And the next level below the latter it has not yet been found, although the drift has extended some distance farther than in the third level. Each of the drifts referred to rest upon the foot-wall quartzite, and were therefore in the corresponding plane in the ore-

body. While the above is true in a general way, the cap-rock comes down much farther in some places than in others. A huge wedge of cap rock comes down into the deposits in the upper levels with ore upon both sides of it. In passing to the lower levels, this becomes narrower and narrower, until it can be seen to disappear like the point of a sharp wedge.

The position of the ore with reference to the dykes, as developed here, corresponds to the general facts of the region. Below the mass of the ore, and found at quite a number of levels, is a dyke of great thickness, which is believed by the Captain to be the same dyke which comes to the surface in the north vein. If this is the case, the destinction between north and south veins amount to nothing. In the more eastern workings of the mine this dyke has not yet been reached, but it has been penetrated at the middle of the mine, near the foot-wall quartzite, by a vertical drill hole, which went through about 50 feet of ore before it struck the dyke. Besides this dyke, there is

another of smaller dimensions in the higher levels of the mine. Ore is found upon both sides of this one, but it is believed by Captain Roberts to be connected with the larger lower dyke. Besides these main-mass dykes, there are three smaller almost vertical dykes in the mine. These the Captain also believes to be connected with the larger masses. The places where the dykes penetrate the foot-wall quartzite are not known. At times the main-mass dyke gets so fresh
1468) that it is easily recognized as a diorite. The ore is mostly of the soft red kind so characteristic of the Penokee-Gogebic Range. This mine is one in which the ore carries quite a percentage of manganese. This manganese is mostly concentrated in narrow belts and seams, which are readily noticed in the drifts and rooms as black streaks. At times these streaks become almost pure, coarsely crystalline pyrolusite.

The following specimens were collected by Dr. W. S. Bayley from Mt. Menard, near Marquette. The NE ¼ of the

NW ¼ of Sec. 1, T. 47 N. R. 25 W. Mich:

14688 Quartzite. The ordinary rock of the mount.

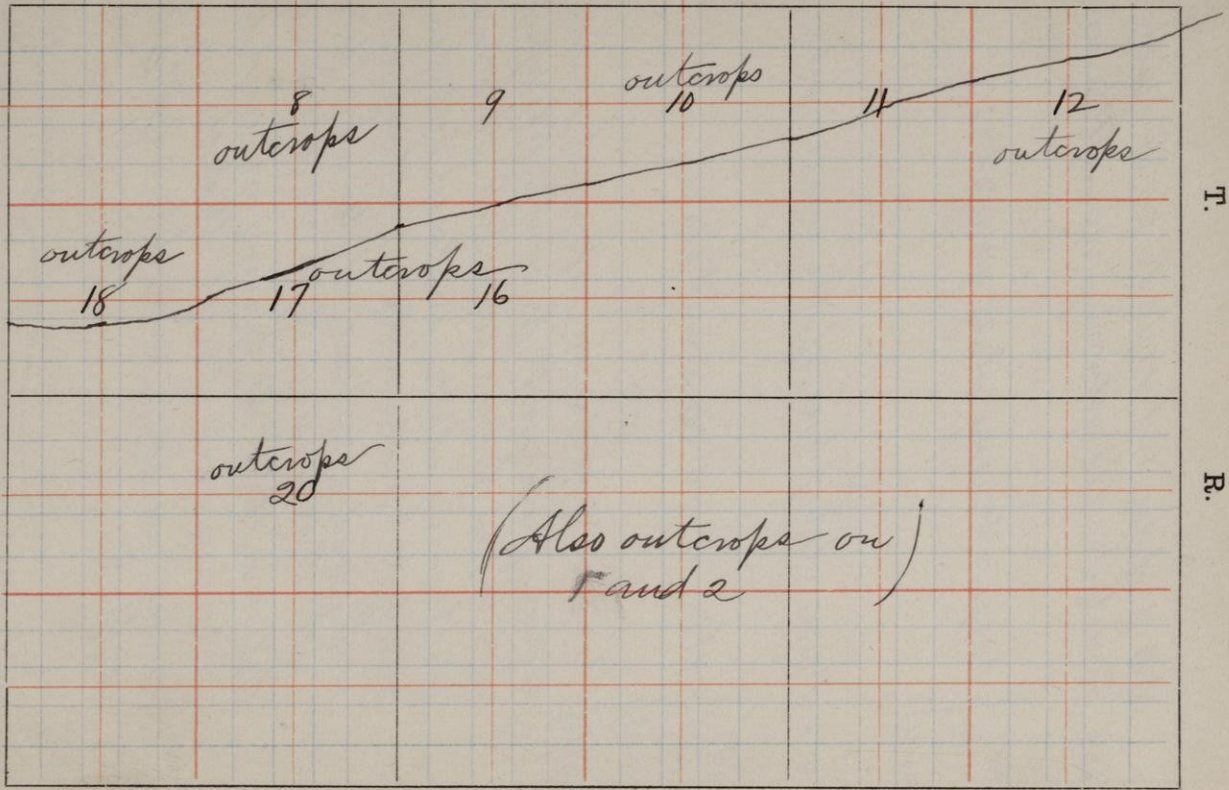
14689, 14690, 14691 } Copper-bearing slaty quartzite.

14692 More slaty phase of the same rock.

14693, 14694, 14695 } Slates. From the same place.

14695A The above specimens represent a cross-section from north to south. The specimens are taken from a pit, which shows the ore-bearing slates inclosed between a quartzite to the north as a hanging wall, and a talcose slate as a foot-wall. There seems to be no difference between the slate bearing ore and the ordinary slate, except that the ore-bearing ones look more like crystalline schists.

42 2E W15.


8
outcrops
9
outcrops
10
11
12
outcrops
outcrops
18
17
outcrops
16
outcrops
20
(Also outcrops on
1 and 2

T.

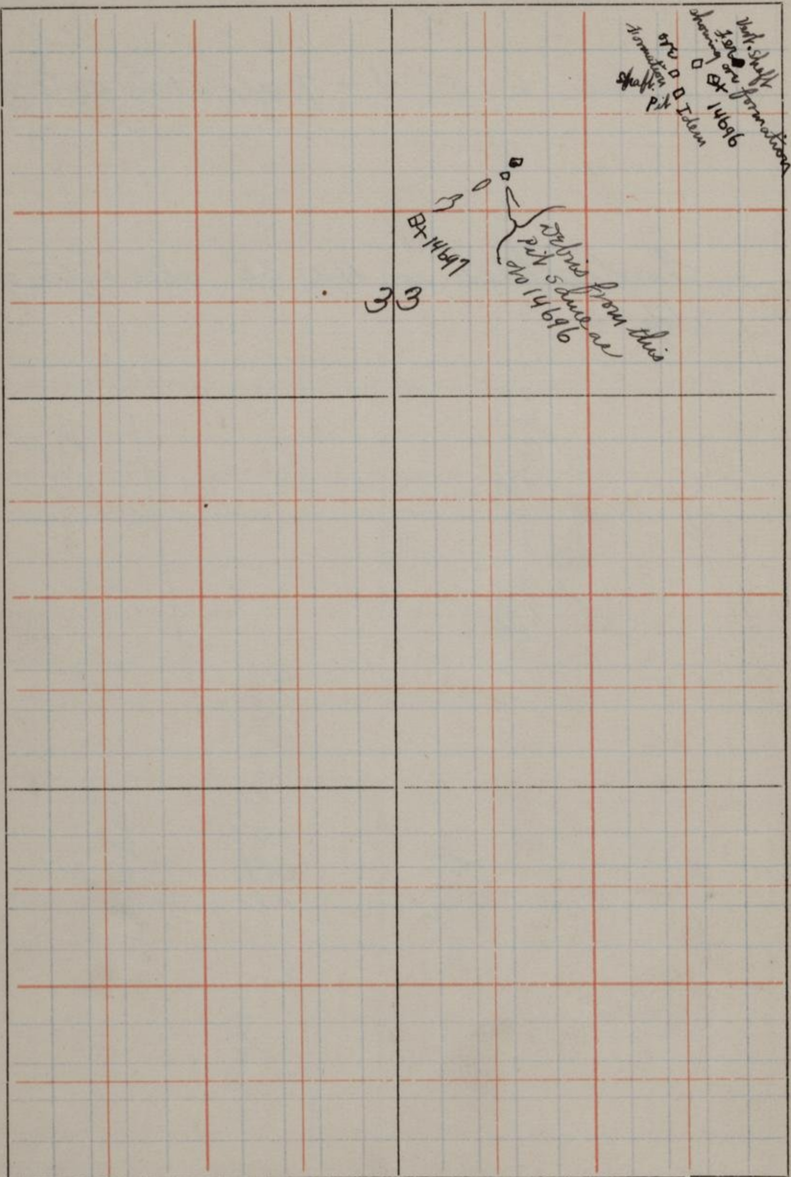
R.

Notes by C.M. Boss.

Sec. 6-5-4-7 all show outcrops.

Turtle Tails in 42 3E also outcrops dip S.

T. 46 N. R. 2 E. WIS

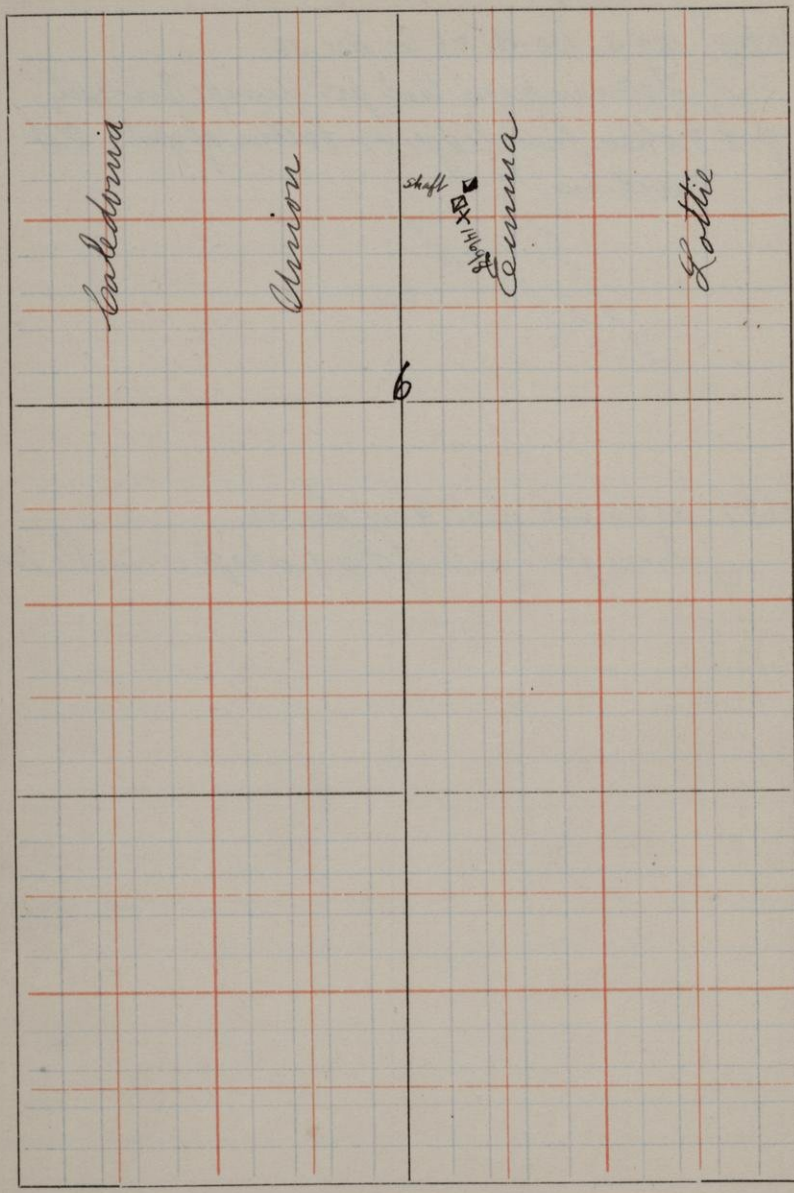


Vert. shaft
Fer. formation
showing ore
14696
ore
formation
shaft
Pit Idem
14697
33
Debris from this
pit same as
no 14696

14696 160 S. 150 W. N.E Cor. Sec. 33
From rock on test pit dump. Evidently broken from ledge at bottom of pit. Pit caved in.

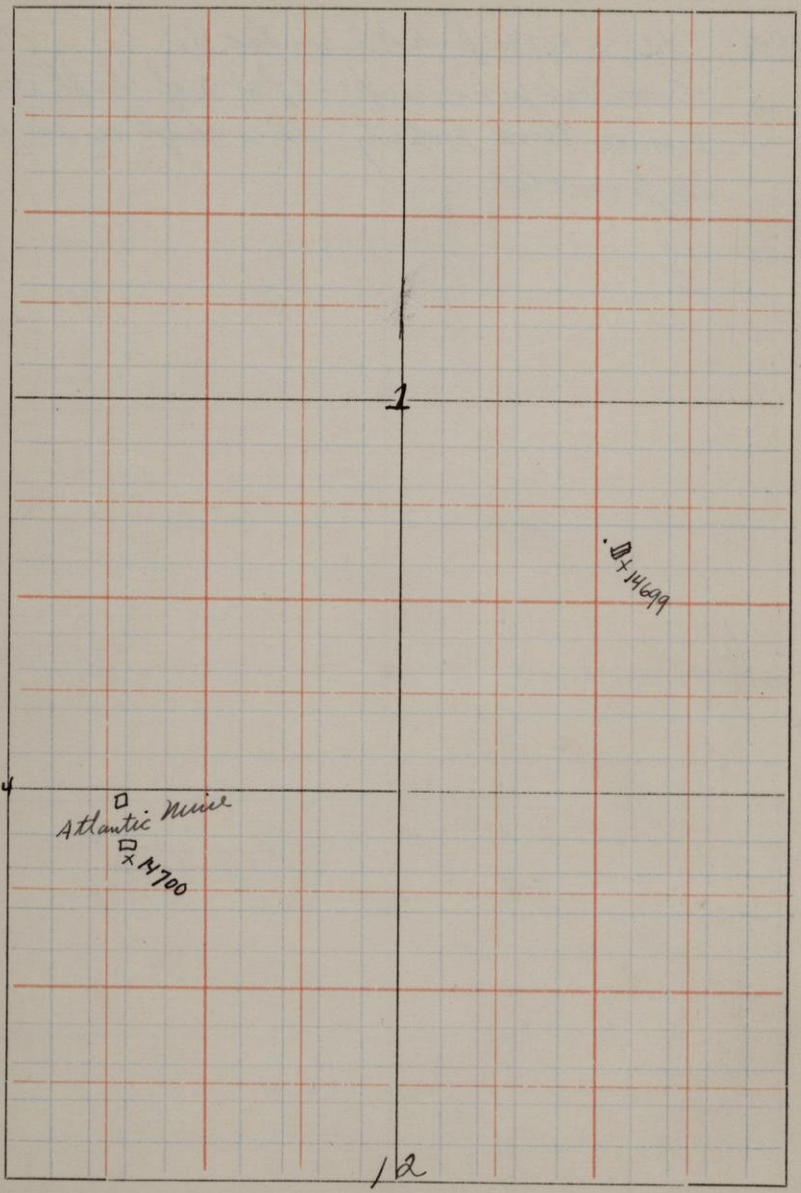
14697 550 S. 60 E of N ¼ cor. Sec. 33.
From foot-wall of No 1 shaft Trimble Mine.

T. 45 R. 2 E.



14698 450 S. 850 W. from NE. cor. Sec. 6.
From test pit dump. 25 feet S. of shaft on Emma Mine property. This shaft is in the ore formation.

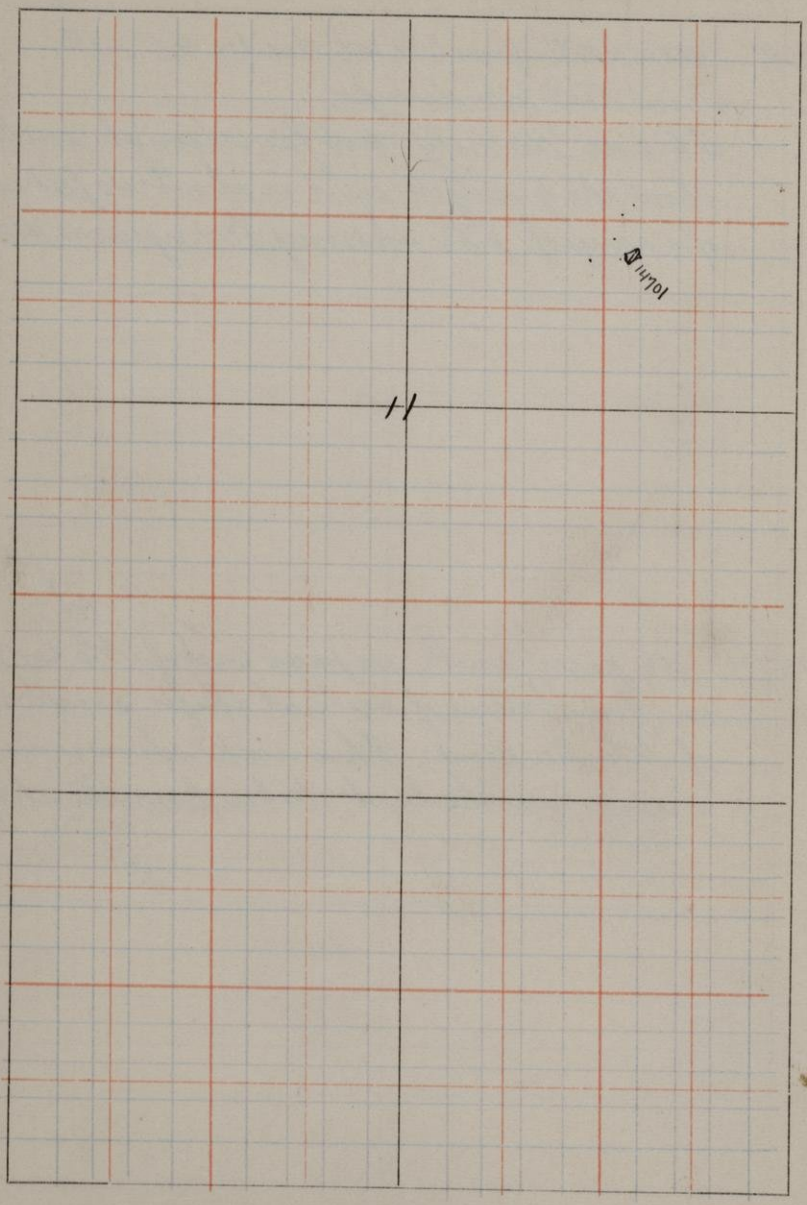
T. 45 R. 1 E.



14699 400 S. 400 W. from E 1/4 cor. Sec 1 - 45 - 1E.
From test pit dump.
This is the only pit far enough south to show the quartzite, and is about 40 feet south of a range of pits showing ferruginous material

14700 150 paces south, 300 paces east of NW Cor. Sec. 12, from bottom of vertical shaft. south shaft of Atlantic Mine. This rock shows on the dump as the last taken from the shaft.

T. 45 R. 1 E.



14701 600 S. 400 W. from NE Cor. Sec. 11-45-1E.
Iron Belt Shaft. from slate taken from foot-
wall in sinking shaft.

From the Iron Belt on Sec. 11 to the explora
tions on SE cor. Sec 16, no work has been
done far enough south to expose the
quartzite.

T. 45 R. 1 E

16

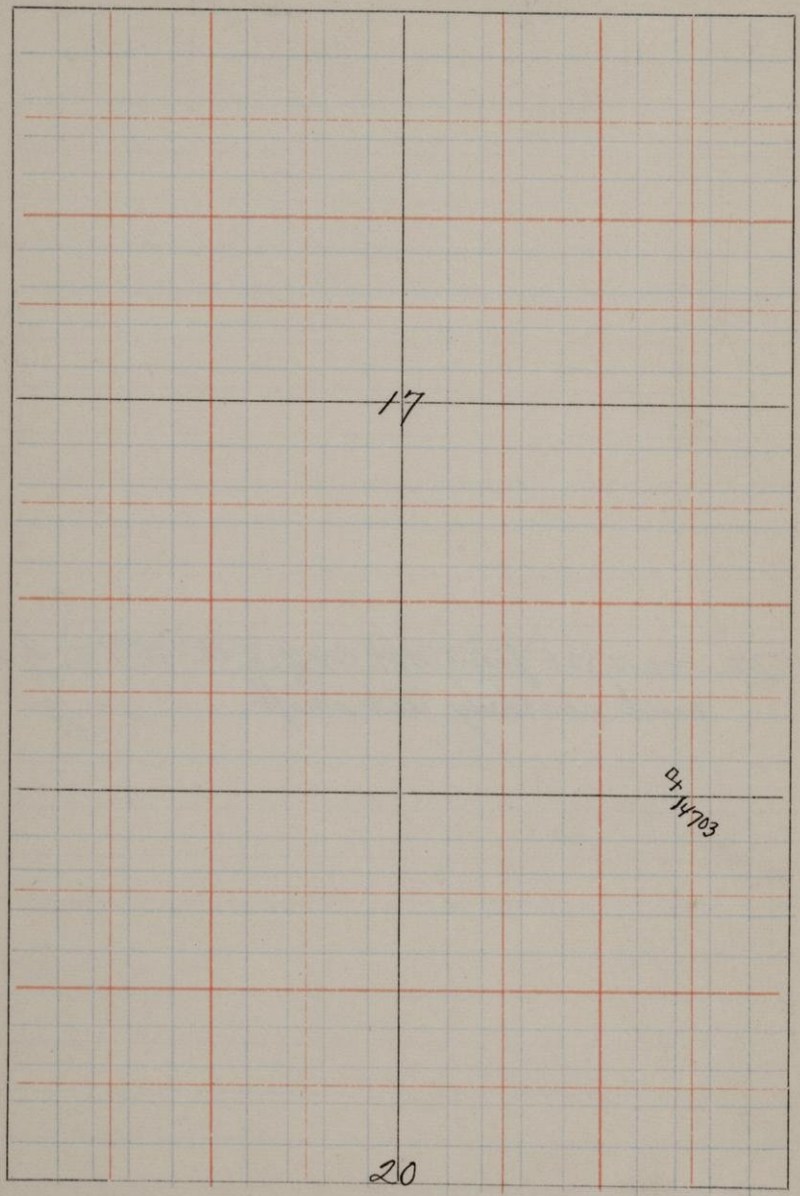
shafts in ferruginous material

14702

Sec Cor.

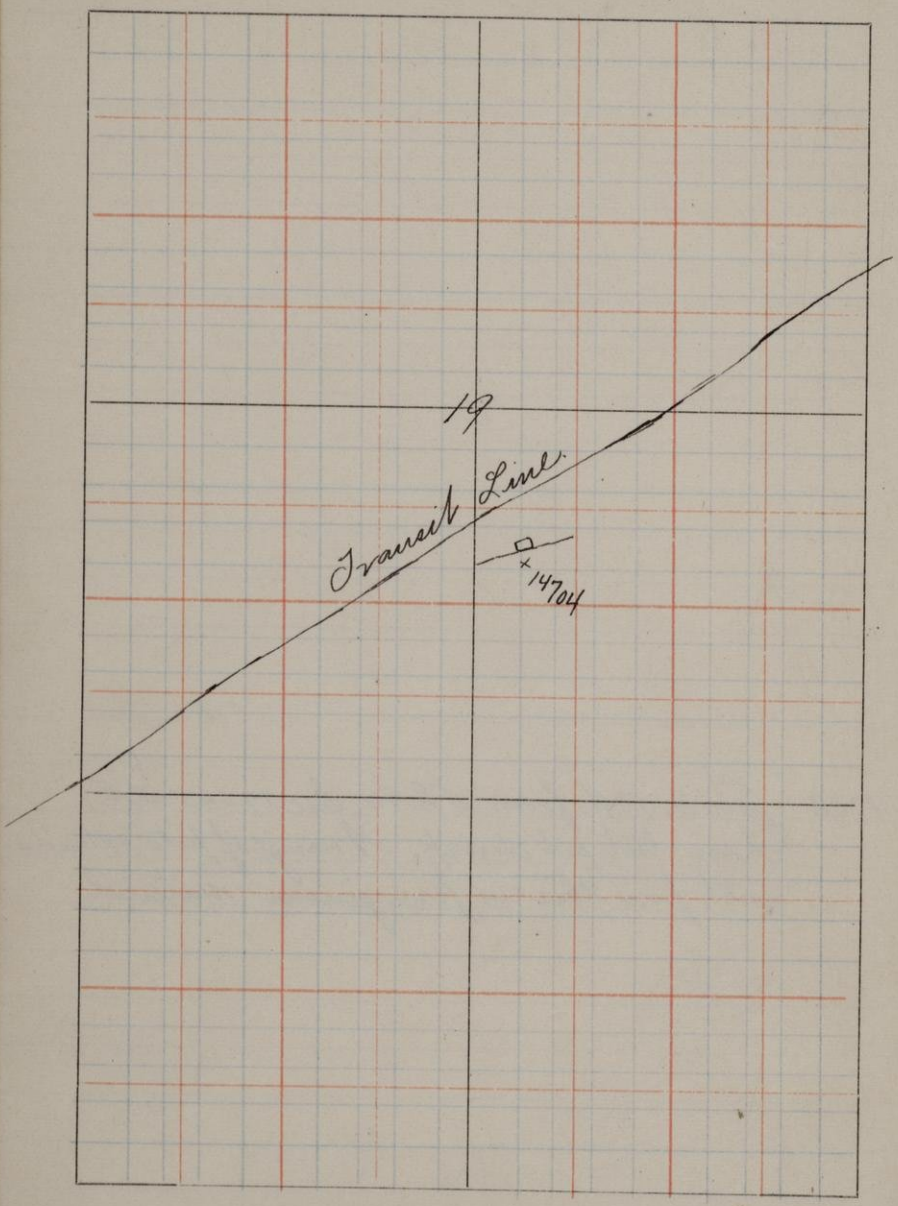
14702 200 N. 80 E from Sl. Cor. Sec. 16-45-1 E. From most southerly test shaft.

T. 45 R. 1 E.



14703 300 W. 50 N. from S'E Cor. Sec 17-45-2 E.
From test pit dump. A range of pits extends
north from this in ferruginous material.

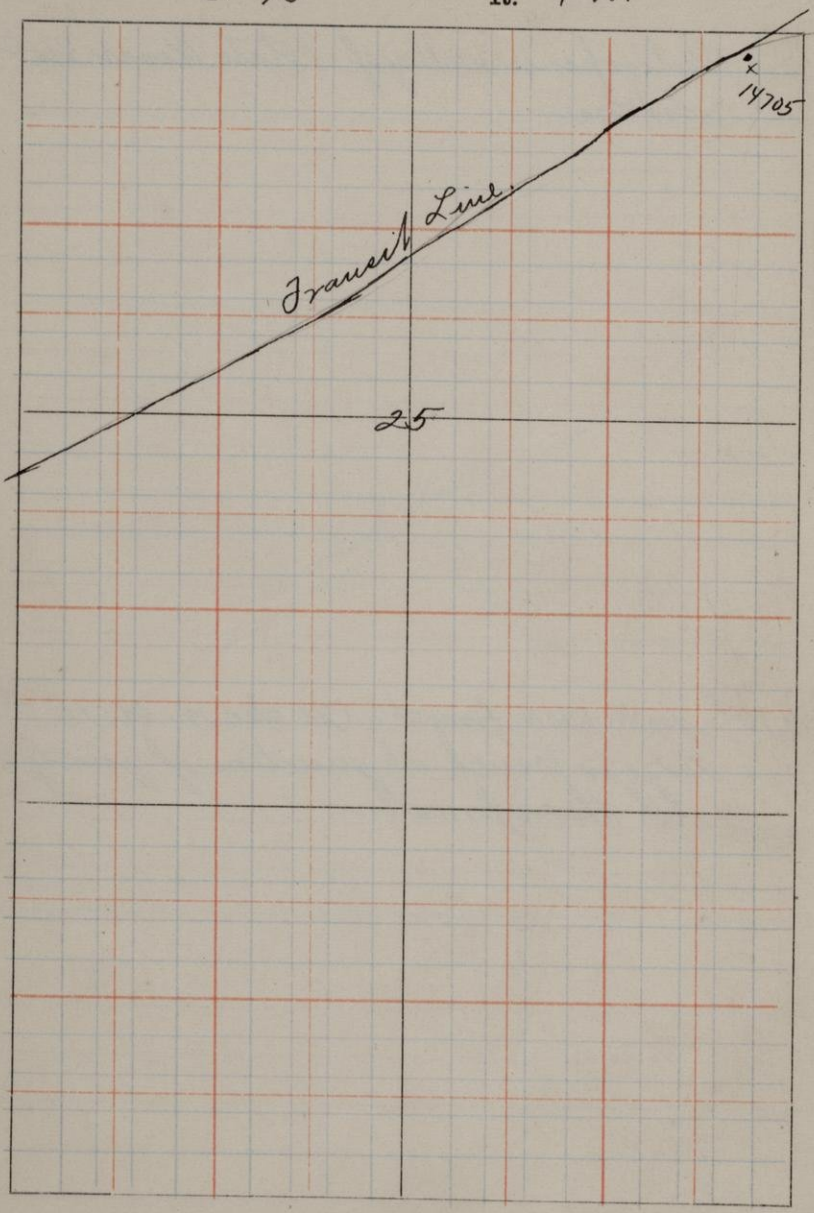
T. 45 R. 1 E.



Outcrops in valley of Potato River not noted here.

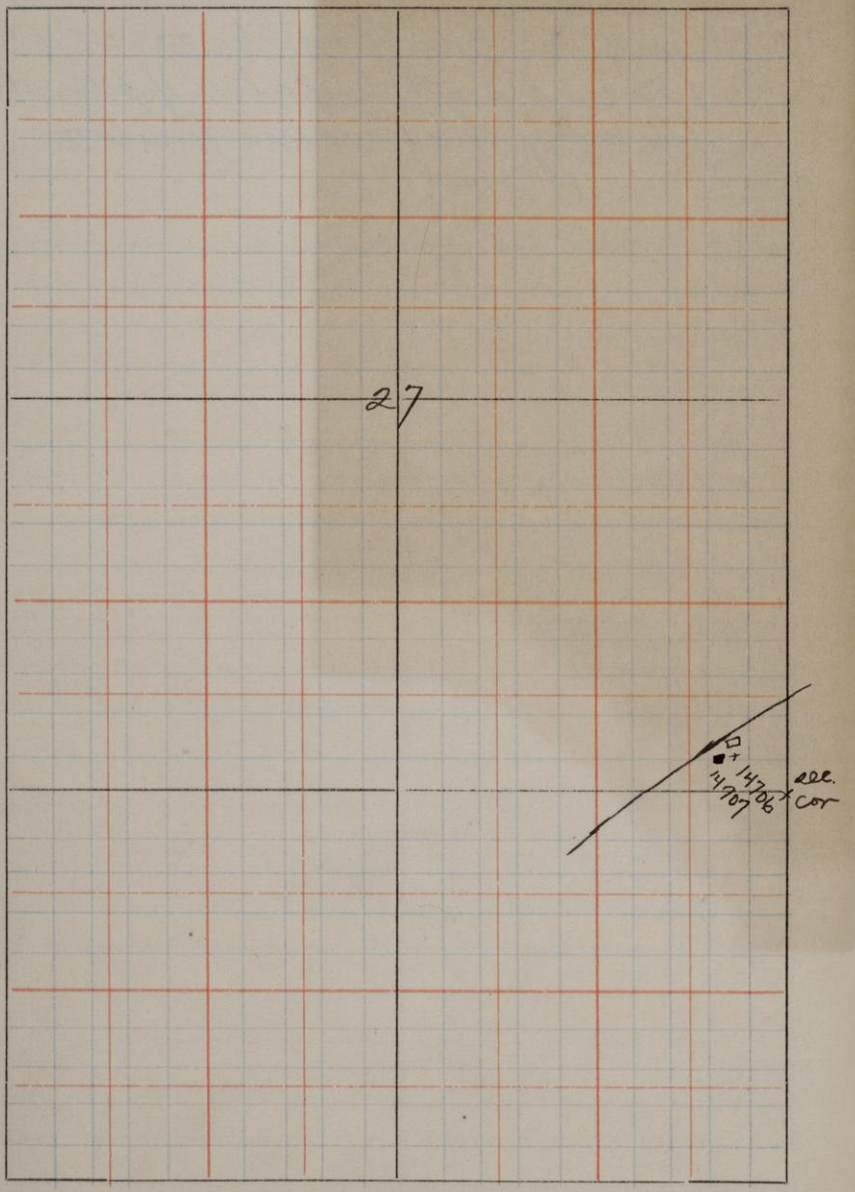
14704 900 W. 640 N. from SE. Cor. Sec. 19-45-1E. Edge in trench at junction of quartzite with the ore formation.

T. 45 R. 1 W.



14705 150 W. 60 S. from NE cor. Sec. 25 - 45 1 W.
from most southerly of a line of pits. All
pits north of this show iron formation.

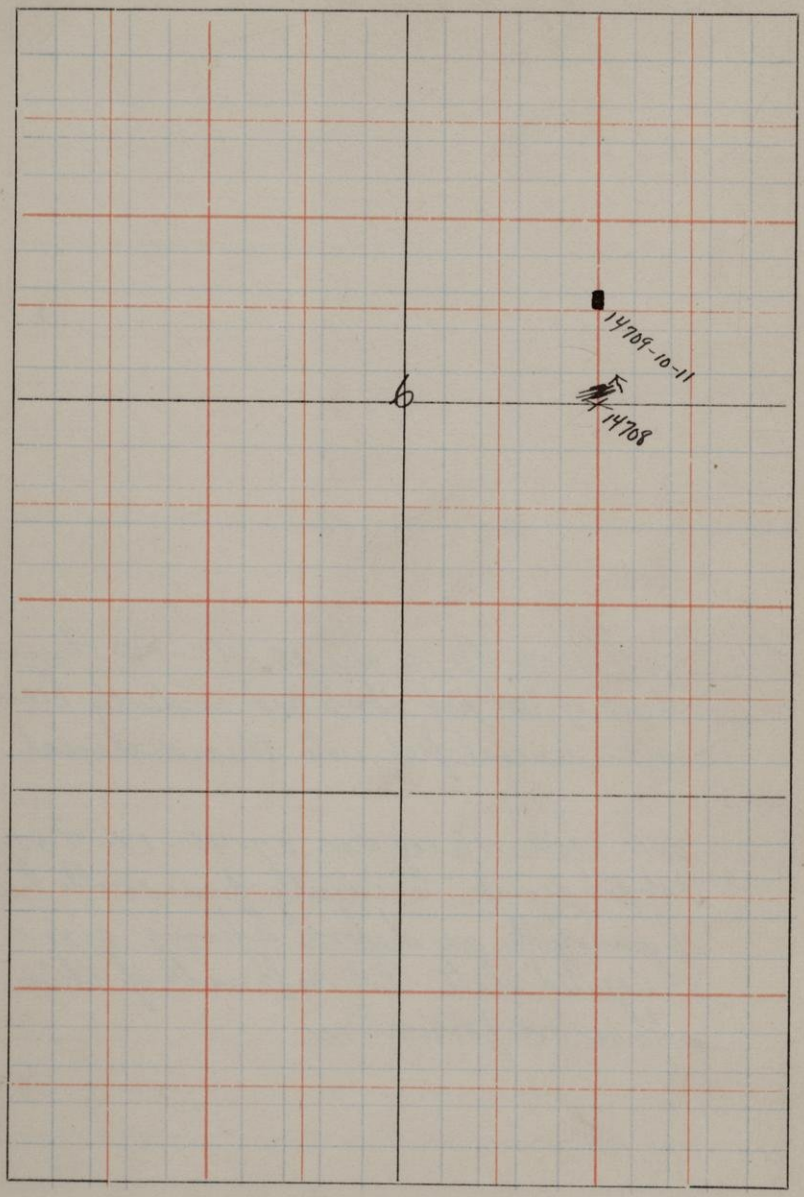
T. 45 R. 1W



14706 120 N. 120 W. SE cor. Sec 27 - 45 - 1 W. From dump of test pit that had evidently been sunk several feet into this material

14707 100 N. 130 W. SE cor Sec. 27 - 45 - 1 W. From test pit dump. Evidently from south limit of quartzite as debris shows some variegated slate. Pit 100 ft north of this shows ore formation.

T. 44 R. 1W.



14708 500 paces ~~300~~ West of E 1/4 Cor. Sec. 6-44-1W. From outcrop of variegated slate. Dip 70° N. Course N60°E. S60°W.

14709 500 W. 270 N. from E 1/4 Cor Sec. 6-44-1W.
14710 Ferruginous slate exposed in trench.
14711 Probable position of quartzite about midway between 14708 and 14709. No sample taken of quartzite at Tyler's Fork.

There are no known exposures of quartzite between Tyler's Fork and the west line of Range 1W.