Marquette Range: [specimens] 25197-25284. No. 147 1893

Van Hise, Charles Richard, 1857-1918
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U. S. GEOLOGICAL SURVEY

FIELD SECTION BOOK

Marquette Range

C. R. Van Hise

LAKE SUPERIOR DIVISION.

INSTRUCTIONS.

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

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

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

Could not locate
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#147

Camp near Palmer, July 5, 1893.

Visited the lower conglomerate and upper conglomerate described by Wadsworth near the Platt Mine, Sec 32, T. 47 N., R. 26 W. The contact between the jasper and the lower Marquette series and the upper conglomerate was found. This conglomerate in one place contains a good deal of material derived from the Basement Complex, including gneiss, vein quartz, and even granite in places; yet jasper fragments are the chief component. These, as Wadsworth says, lie with their axes in all directions, and in them the laminae had been developed before being deposited in the conglomerate.

From the upper conglomerate we went south, noting on the way several exposures of jasper, until we came to the lower conglomerate. This conglomerate alternates with layers which approach jasper, and in passing upward the jasper layers become more and more prevalent until they are predominant. These alternations are such as are usual when a mechanical sediment passes into a chemical or organic sediment. This upward gradation of the conglomerate into the genuine jasper combined with the unconformable contact of the jasper with

the upper conglomerate, seems to preclude the idea of a single conglomerate. There is also a great difference between the conglomerates. In the lower are no undoubted pebbles of jasper. Certain pebbles are impregnated with iron ore. Irregular areas of jasper or chert appear, but such appear to be secondary concretions or impregnations, rather than original pebbles; or possibly they may be jasper bands broken by dynamic action. Some of the jasper layers in the black ferruginous rock have the same character as shown by the pebble-like areas. It therefore appears that the lower conglomerate carries abundant material from the Basement Complex, but not derived from a clastic series.

Going south from the conglomerate perhaps 50 steps, we come to a green gneiss, which is cut through and through by granite veins. In passing a little farther south, the granite veins become larger, and take on the character of dikes. These soon reach a thickness of several feet. This granite and green rock are identical in appearance with the larger number of the pebbles of the conglomerate, and are doubtless their source.

25/97 Conglomerate.

25198 Green rock from northernmost phase of Basement Complex. The latter is fractured in every direction by dynamic action.

25199 Just south of the Platt Mine, blasting has
25200 exposed some of the fresher green schist.

This in passing toward the north becomes
25201 in a few steps a more foliated rock, and
25202 this passes into sericite schist.

The question arises whether the transition is due to weathering, or whether the contact has been passed between the Basement Complex and the Lower Huronian, in which case the last 2 specimens would represent sheared decomposed rocks.

25203 Platt Mine, jasper, about 25 steps south of shaft. This lies flat, the dip not being probably more than 15° or 20°.

We again visited the old shaft of the Volunteer Mine, and particularly examined the place shown me by Dr. Wadsworth last year, where he thought the lower conglomerate and upper conglomerate are very close together. The facts noted are as follows:-

Farthest to the S.W. is a schist, which may possibly be the schist of the Basement Complex, but which is more probably a decomposed rock.

25204 This passes up within three or four feet
25205 into a schist conglomerate, and this passes
25206 up within four or five feet into impure jasper,
which appears near the base of the lower Marquette,
but it may be impure jasper at the base of the
Upper Marquette. Above this jasper, which is 6 or
8 feet thick, is a lower schist much sheared, being
evidently the base of a slipping plane. This
schist is 3 or 4 feet thick, and over this comes the
unconformable Upper Marquette Conglomerate.

Upon the whole Wadsworth's explanation
is regarded as the more probable one, but it is
possible that the Upper Marquette erosion has
entirely cut away the jasper here for a short
distance. If so it appears again a little
farther to the N.W. At the N.W. end of the pit
the Lower Marquette jasper has a considerable
thickness, a surface width of 50 or 60 feet ap-
pearing, with a dip of 45°. The Upper Mar-
quette quartzite is seen to rest upon the irregular
red surface of the jasper. The dip of the con-
tact plane varies from 35° to as little as 10°,
showing well the irregular red surface of
the Lower Marquette jasper.

We now went to the east side of the brook
a short distance east of the Volunteer. Here is a
set of schistose rocks, which it is very difficult

to determine whether fragmental or non-fragmental. These have a lamination parallel to the general structure of the district, and are but a short distance south of the jasper.

25207 Quartzose phase.

25208 Graywacke-like phase, at the north side of the exposure nearest the jasper.

A short distance to the south the rock becomes a sericite schist very similar to that on the north side of the Basement Complex at the Platt Mine. In the sericite schist are two veins of white quartz.

Going a short distance east, and again
25209 south, there appears the typical green schist of the Basement Complex, cut by granite veins.

Following the valley east which separates the jasper and the Basement Complex, a low
25210 ledge of cherty rock is found.

A short distance north of this, not more
25211 than 10 steps, appears the Lower Marquette
25212 conglomerate. This contains pebbles of many kinds from the Basement Complex.

25213 Piece of one of the green schist pebbles

25214 " " " " " sericite schist pebbles, apparently exactly like much of the sericite schist at

the brook section. The conglomerate quickly varies up into jasper, there being however at many places several alternations of conglomerate or quartzite and jasper before the typical banded state is reached. The severe dynamic action has folded and faulted the rock, so that the jasper occurs in minor rolls and minor faults, some of the latter having an east and west, and others a north and south direction. As a consequence of this faulting there is in places in the jasper along the fault planes Reibungs breccia. As a consequence of this dynamic action the bands of jasper break up into pebble like areas. However none of them are true pebbles, as all stages of the change can be traced from the evenly laminated jasper to the Reibungs breccia where the jasper appears as partly rounded pebbles. The belts of jaspered jasper layers stand out in marked contrast to the quartzose layers, and seem to be of a wholly different character

25-215
25-216 } Quartzose layers from the ferruginous conglomerate
25-217 Same containing fissured jasper pebbles.

In the afternoon we went north on the

railroad track about on the east ¼ line of 28-47-26. We found fine in the lean ore formation to extend very near to the quartzite. The quartzite in the S.E. ¼ of the Sec. is much broken by dynamic action, becoming in places true Reibling's Breccia, but in places it is a true conglomerate holding white pebbles of quartz. On the north side of the great bluff of quartzite is a schist conglomerate, with nearly vertical cleavage, much like the schist conglomerate below the jasper of the Cascade Range in the same section.

Specimens of the lower conglomerate of the Platt Mine, collected by Clements and Smith.

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} Specimens of the conglomerate showing various phases of the pebbles.

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} Pebbles or parts of same from the conglomerate. These represent the predominant phases, excluding the quartzite. Many of the green pebbles contain olivine, are closely similar, and seem to have been derived from the massive green rock of the Basement Complex just to the South. Some of them show a zonal arrangement, due to

contact action.

With Pley I ran south from the N.W. corner of Sec. 33. After passing a ridge of granite, typical lower quartzite and conglomerate was found, like that near Palmer and south of the Platt Mine. Only here it appears to be thicker than at either of those places. Just across the was the schist granite complex.

Ran on a course approximately east for some distance, being sometimes upon the Basement Complex, and at other times upon the jasper.

In the afternoon Smith and I returned to place where Bayley's specimens 22784 to 22790 (1892) were taken. The exposures on the south side of this hill are undoubtedly the same bedded and foliated shistose rock which appears at so many places in the Palmer area facing the north side of the Basement Complex. It contains the same shaly veins, and from one of these
25232 25232 was taken.

Going a short distance west there is finely exposed an almost vertical cliff of the Basement Complex. This is faced in many
25233 places by 25233, impure limestone. The lime-

stone and schist are here intricately intermingled, and the limestone appears to be in veins in the schist. Going to the top of the ledge the limestone is seen to be clearly a secondary vein formation. Continuing south it dies out within a short distance, the schist at the same time taking on a more greenish color. Is it not possible that the green brittle schistose rock of the Southern Complex by shearing passes into white sericite schist. The same thought was suggested by the occurrence at the Platt Mine.

Continuing south about 50 steps there appears another ridge, in which the schist has been injected through and through by granite veins, the granite being usually parallel to the lamination. Some of the bands are 6 or 8 inches wide, each of which continues for a greater or lesser distance, the width varying irregularly. Often the finer layers taper down and run out. The wider ones were not followed out.

We next ran east to point where Bayley's 20554 to 20559 were taken. Here was found the same dolomite veining of the north surface of the Basement Complex. Back of this veined schistose rock is the ordinary white sericite

25234

schist, and this is intelaminated with
25235 green schist. The whole is regarded as be-
longing to the Southern Complex

We next went to the S. W. ¼ of Sec. 28, where
we took Bayley's numbers 21970 to 21973.
Here south of the quartzite was found a ridge
25236 of well rounded chert and lean ore, having a
somewhat novaculitic look. The strike and
dip are regular and uniform. Determination
of last year not verified. The quartzite to the
north is very massive, is in some places a
coarse conglomerate containing white quartz
and chert pebbles, but no jasper pebbles were
found.

Next going west to the hill from which 22811
and 22812 were taken, this was found to
be a tuff conglomerate

25237 Fine grained phase. This varies into a
25238 } schist conglomerate, which holds numerous
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25240 } large pebbles and boulders, which weather
25241 } pale pink and red, while the schist wea-
25242 } thers green. In all respects this conglo-
merate appears to be the same as the
tuffaceous material found elsewhere in the
district.

Saturday, July 8,

In the N.W. part of Sec. 35-47-26, directly after leaving the swamp, is found a knot of granite which undoubtedly belongs to the Basement Complex. A white sericitic quartzite looking rock is injected through and through with granite veins. The foliation is N.W. SE and its dip is at a high angle to the S.E. This sericitic schistose rock is like that of the great ledge to the east, the one difference being that the larger ledge is not injected with granite veins. In the large ledge to the east the sericitic quartzite or quartz schist or schistose acid granite is foliated in an indirect way in places. At times the folding of the brittle rock has resulted in producing a Reibungs-breccia. Also the rock contains numerous veins of chert or quartz

2 5243 Massive phase of the white rock cut by quartz ~~veins~~ veins. The strike of the foliation of the schist ledge is N. 30° ± 40° magnetic at the north end of the ledge. The schist is impregnated with veins of hematite. In short in all respects it is very closely similar to the Goose Lake county quartzite, which Bayley placed with the marble series. It is af-

frequently also similar in containing granite injections. This schistose rock is also similar to the quartzose rock of the Brooks section, which also appears to be injected by granite.

On the SW face of the ledge at one place is a huge vitreous quartzite, and a little way to the NE. facing in the same direction is
23244 a coarse conglomerate, which contains very
245 numerous fragments derived from the
246 more massive phase of the schist, of the coarse vein quartz cutting it, of the chert from the veins in the schist, and also numerous fragments of red jasper.
23247 Pebbles from this conglomerate. That the pebbles of the conglomerate have largely been derived from the adjacent quartzose schist can hardly be doubted.

We now went west along the contact between the Basement Complex and the conglomerate in the NE 1/4 Sec. 34. Huge ledges of the Basement Complex were found, and a short distance north of same in a few places was seen a conglomerate. One of these is a great bluff of conglomerate, containing huge boulders of quartz-schist, chert, etc., and also irregular masses of jasper, whether segregations

or fragments I was uncertain. Running north from the Basement Complex about 200 steps east of the 1/4 line, ledges of the sericite-schist, supposed to belong to the Basement Complex, were passed, until within 200 steps of the north line of the section. The last ledge of the schist was succeeded by pits, in which were found ferruginous chert. The conglomerate evidently runs back into a bay of the Basement Complex in the N.6 1/4 Sec. 34, and NW 1/4 Sec. 35.

At a pit near the S line of Sec. 27 in the SE 1/4, the iron ore + chert and conglomerate are both found, the conglomerate being but a short distance north of the ore and chert. A short distance to the SE of this point is an outcrop of quartzite. Evidently the ore of this area is north of the conglomerate seen during the day. Either there is here a fold which represents the upper conglomerate, or else the ore and jasper of this locality belong in the upper series. The only other alternative is that the southern conglomerate-bearing jasper derived this material from the Basement Complex.

We looked for granite at place marked thus on map of last year N6 of the S 1/4

25248 ✓ front of Sec. 27. None was found, but at about 300 steps was seen an exposure of conglomerate, containing fragments of quartz and jasper.

July 9.

We ran north to the quartzite ridge in N E ¼ sec. 29. We found the center of the same to be a schist, in all respects like the schist below the Cascade Range. It is cut by granite dikes and bears granite veins. The strike of the schist is N. W. & S E. Facing this schist on both the north and south sides, and mantling the ridge, and occupying the top in most places, is an undoubted quartzite, which is in places conglomeratic. The whole appearance is that of an anticline of quartz mantling over the schist.

25249 ✓ Granite from vein schist near top at south face of ridge in S E ¼ N E ¼ 29-47-26.

25250 ✓ Green schist cut by granite. This schist is also cut through and through by quartz veins, and contains chert bands. It is extremely contorted, foliated and brecciated.

25251 Sericite schist higher up on range.

Upon the extreme north of the ridge is a

25252 knot of quartzite.

We now went to the south base of the

ridge, and a short distance west of a ravine which separates the ridge here in part from the great cliff of quartzite to the east. We here found white cherty quartzite, interlaminated with black chert. Shows the contact of the two.

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On the ground these were supposed to be a part of the Basement Complex, and different from the viteous quartzite. Resting directly upon the cherty quartzite, and bearing abundant fragments apparently derived directly from it, is a beautiful conglomerate. The fragments in the specimens are small, but in the exposure they run to those 2 or 3 inches, or even several inches across.

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25257A. Pebble from conglomerate.

Either this contact must mark an unconformity, or else be a mechanical conglomerate. A little way to the north and near the crown of the hill, the quartzite appears, showing that this rock marches over the ridge as it is seen to do at the more prominent ridge to the east.

Going west a short distance the schist was again found on the hill. In following this down the south slope the contact of the

quartzite was not found. The foliation of the schist corresponds to that before given and the dip of the schistosity is to the N.6. Near the center of the south slope was found
25258 – which appears to be quartzite, and near
25259 the base of the slope was exposed ferruginous quartzite. So far as could be determined the structure of the quartzite corresponds roughly with that of the schist, and apparently dips under the hill or into it, as though the supposed anticline had been pushed over from the north.

We now went into the S6 ¼ of Sec. 28, at the place where were taken Phillips Nos. 23506 to 23509, and here was found the
25260 recomposed jasper resting upon the original red jasper, and a short distance to the north is the typical upper quartzite bearing fragments of jasper. The ledge S6 of this, observed by Mathews as having southern dips, was seen, and the observation verified. The exposure is however not large enough to show that this is not a local fold in the general northern dipping formation, just as occurs at the Mine, and at other places where minor folds have been seen.

About 200 steps south of the Platt Mine shaft, 130 steps west and 10 south from little red house, is an upper quartzite with a strike about due north & south, and dip 15° west.

2 T 261 Ferruginous quartzite which resembles upper quartzite, and above it are typical jasper outcrops, with a similar strike and dip.

Following along the east slope of the ridge to the north, other outcrops of jasper are found with similar strikes and dips and when the N.E. corner of the hill is passed the jasper is again found in a body with an east & west strike and southern dip.

Returning now to the S.E. corner of the hill, the contact between the jasper and the upper conglomerate is found. Here the strike is somewhat S of an E. & W. course.

Going a little farther west to the point where the great jasper conglomerate is found the strike is east and west, and the dip, flat, not more than 20° to the north. At an intermediate point, the jasper has a N.E. & S.W. strike.

Continuing west along the conglomerate

ledge, it spreads out into a magnificent exposure of conglomerate, showing beautiful rounded pebbles of jasper, and the various rocks of the Southern Complex. Upon the top of the conglomerate is a mere skin of quartzite. Along the edge of the exposure it is seen that the beds are almost flat.

Following along the contact, the jasper is seen to turn toward the N, and finally takes on a due N & S. strike at the west end of the hill, with a low dip to the east.

Thus this hill is plainly an oblong east & west basin of jasper, filled with unconformably overlying quartzite and conglomerate of the Upper Marquette series.

Looking over the country to the N. is seen the northward dipping jasper in its ordinary position, and upon this the great Palmer Upper conglomerate. This fold explains the minor faulting and corrugations of the jasper south of Palmer, and its sudden widening just to the east, the width being due to the passage of the monoclinal dip into the fold, and the still greater N & S extent of the jasper seen farther east is doubtless due to other folds.

The soft ore jasper of the Wheat Mine is near the crown of the anticline, just N of the above

basin, and it is seen to have several minor anticlines and synclines, which are the usual accompaniment of larger folds. However at the S end of the Mine the dip is rather flat for some distance, as though the crown of the anticline was a little way to the S.

The open pit at this mine gives the most perfect evidence of the folded character of the jasper formation in this area. The same is indicated by the minor eastern plunging corrugations seen at the west end of the basin.

Monday, Aug. 10

We visited the west end of the ridge examined yesterday in N. part of Sec. 29-47-26. Here at the place where was taken 23511 of last years work, the quartzite is plainly but heavily bedded. This bedding is indicated by a narrow belt of conglomerate at the east slope of the ledge, which was traced for a distance of about 40 feet. The strike is N 20° E. and the dip is 40 to 45° to the west

25262 Conglomerate. Contains prominently pebbles of white quartz, and appears also to contain pebbles of jasper, running up to ½ inch in diameter.

25263 Quartzite from bed just above conglomerate, which also appears to contain small particles of jasper.

Near the south end of the ledge, but mantled over on both sides by the quartzite, is an exposure
25264 of green schist, the strike of the foliation of which is N 45 W. and the dip about 70° to the N. It was concluded that the quartzite was the upper quartzite, and rests unconformably upon the Archean schists. The actual contact between the two rocks was not seen.

About 500 steps N of the above exposure at the bottom of the valley is a ledge of bowlders
25265 of a large sized actinolitic looking jasper, with strike N 45° W. and dip 30° to 40° SW.

About 150 steps farther on the S. slope of the ridge are typical exposures of actinolitic
25266 slate, with strike E. & W. and dip 50° N.

We now went N to the prominent hill near the center of the W½ of Sec. 20. On the S.E. slope of the hill, graywacke was found with a strike N. 30° E and a high dip 50° or 60° to the N.W. (?).

Continuing up the hill, quartzite is found, until at the S. crest, where is seen a very curious contact between the jasper and quartzite.

25267 The jasper is first seen dipping under
25268 the quartzite at an angle of 50°. In going over the crest is seen a little acute fold of jasper on both sides of which is quartzite.
In going over the level surface at the top the jasper at first sight appears to be interstratified with the quartzite, but upon the S brink of the hill, the jasper is seen to be in a little sinclinal fold, the point of which plunges sharply to the N. This sinclinal is not simple, but has several anticlines and sinclines. Going to the N. several alternations of jasper and quartzite are found, each one being due to a fold in the jasper, and finally upon the N. face of the cliff, dipping off into the valley at an angle of 35° to the N. and a strike N 10° E., is a great ledge of
25269 typical jasper.
25270 Jasper from the crest of the hill, being intermediate in character between 67 and 69. 67 under the quartzite appears to carry iron carbonate, and 70, which has an open fit adjacent to it, is typical jasper. Thus we appear to have here a fair transition from one to the other, the first perhaps being more protected by the overhanging quartzite. In the quartzite are pebbles and even large blocks of

jasper. Also the lamination of the jasper goes directly against the lamination of the quartzite in such a way as to show an undoubted unconformity between the two.

It is concluded that the peculiar contacts on this hill are due to overturned folds, which have been pushed over to the E, and therefore dip to the W. This explains the unconformable contacts between the jasper and the quartzite, the presence of pebbles and blocks of jasper in the quartzite, and the alternations of the two. There is little doubt that the minor folds are but parts of great folds, which are overturned in the same fashion.

A hasty examination of this hill might lead to the conclusion that the jasper and quartzite are interbedded.

We now turned E., going into Sec. 29. The first ledge we found was well bedded graywacke. This probably was not far from 500 steps west of the center of the Sec. The strike was N 30° W. and the dip 60° to 70° to the E. (?).

We walked for some time over the quartzite ledges in Sec. 21. We found these rocks for the most part too massive to give strikes and dips, but at several places we saw.

ledges which were well enough bedded so that the strike was ascertained to be N 20° to 30° E. The quartzite was iron stained vitreous, not sheared, and contains jasper pebbles. It appeared without doubt to be the upper quartzite.

We now took a southern course in Sec. 28 along and near the N & S ¼ line. We soon came to heavy beds of quartzite, which seemed to dip to the N.

25-271 Conglomerate containing very numerous iron stained pebbles of white quartzite, and quartz schist. Some of the fragments in the conglomerate are a foot and more in diameter. (In the field it was not doubted that this was a genuine conglomerate, but looked at in hand specimen, while the quartz fragments, on account of iron staining, and the matrix appears to be different from the pebble like areas, a lens shows the pebbles and matrix to have a very similar character, and the question arises whether this rock is not autoclastic produced by dynamic action.)

We continued S for some distance over the quartzite, until we reached the S. brow of the highest ridge, where was seen

another belt of coarse conglomerate, which also includes boulders a foot or more in diameter, and runs for a considerable distance E. & W. These two conglomerates have similar positions on the opposite sides of the bluff. They seem to lie very flat, as though the conglomerate mantled over the anticline.

Going on S. quartzite and conglomerate continue for quite a distance.

25272 Iron stained phase of conglomerate, heavily bedded, dipping S.

Getting well down the S. slope to the point where the last strip pitch occurs, a conglomerate is passed, after which a
25273 little ravine is crossed, and in this is
25274 found the typical sericitic schist. The foliation of this rock strikes nearly E. & W. and dips to the N. This appears to be identical with the schist first appearing in the Basement Complex south of the Cascade Range, being foliated, bituminated, and veined like that rock.

Wednesday, July

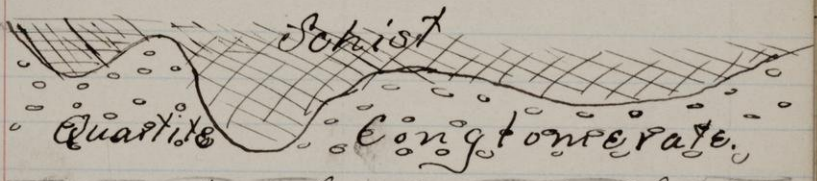
25275 The ridge of quartzite next to the

sion one S of the great ridge in Sec. 28-47-26, is very glassy and much fractured, the fragments having been recemented by vein quartz. This cuts the massive ledge in every direction. In many cases the infiltrated quartz has not thoroughly healed the cracks, and the rock breaks along them, yielding very angular specimens. (This quartzite is very closely indeed to the Goose Lake cherty quartzite.)

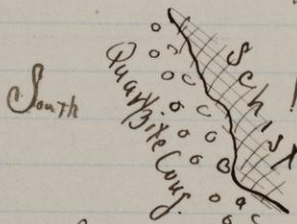
We next went to the S. crest of the main ridge, where the ordinary vitreous
25276 plainly fragmental quartzite appears. This quartzite has layers of conglomerate or breccia, and has a jointing which dips steeply at a varying angle to the N., i, e, under the schist. The ledges are however so massive, that I could not be sure that this jointing corresponds to true bedding. Where the schist and quartzite come into contact, the quartzite extends under the schist at an angle of 60°. This south contact was found at place where we left off work Monday. The quartzite is like conglomeratic, and there is do doubt that it rests uncon-

formably upon the schist. In plan looking down on the ledge, the exposure is like this:

Plan



In section the exposure is like this:



Section of contact at south side of schist exposure.

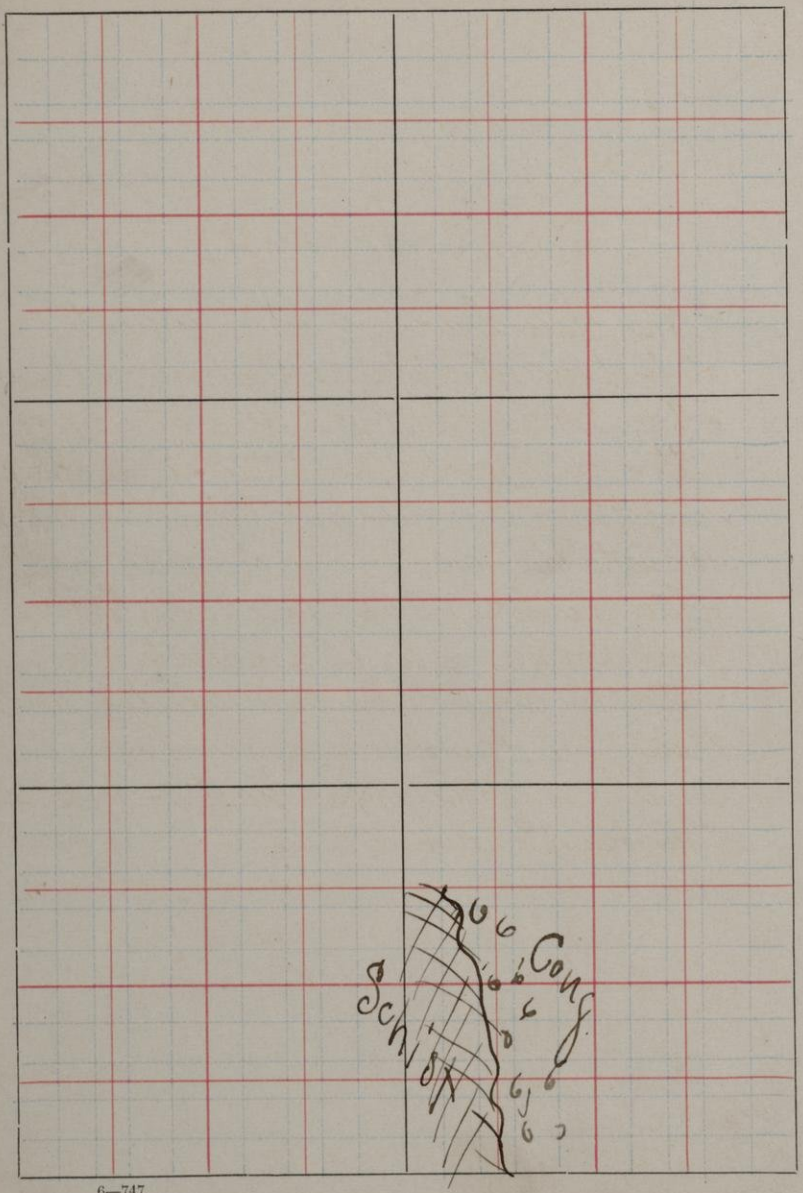
25277 Conglomerate.
25278 Schist at contact.
25279 Another phase of schist about 25 steps farther N.

About 50 steps N of the S. contact is the northern contact, it being the exact verse of the S contact.

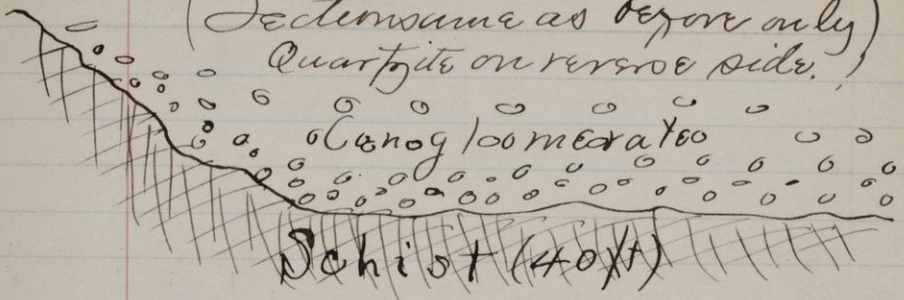
The relations are as follows;

(See next page)

S. T. R.



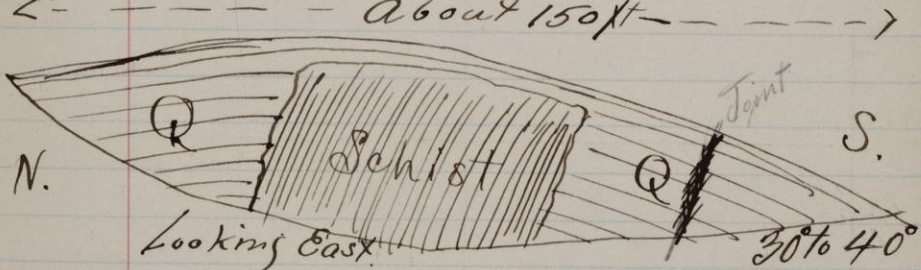
(Section same as before only Quartzite on reverse side.)



We thus have an arrangement, which at first sight appears like an overturned fold, but in the light of what was found later, is regarded as a ledge of schist projecting up sharply parallel to the schistosity, forming a crag against which on both sides the quartzite was laid down. The conglomerate would naturally form along these cliffs, and thus give the appearance shown in the sketch, only the upper part of this section being shown

Crag.

Going on toward the E, or perhaps a little S of E, a solid ledge of schist is passed. Then a little N. S ravine is crossed, beyond which is a ledge reaching a higher level than the schist. Here the relations as seen are as shown:-

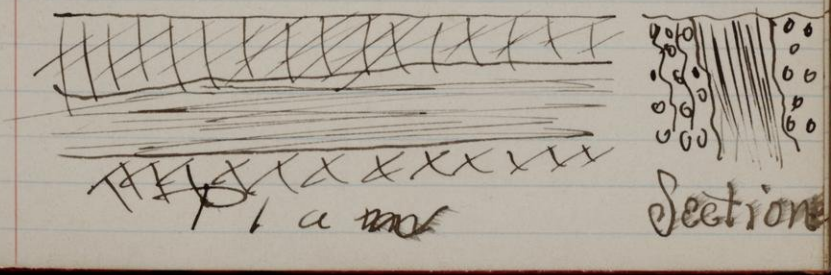


25280 In the quartzite adjacent to the schist are blocks of that rock. Specimen from one of these included blocks.

The bedding of the quartzite is quite clear and it rebuts almost perpendicularly against the schistose structure at the sides of the projecting ledge of schist. At one place, if we do not go quite to the top of the ledge the schist protrudes through the quartzite. It looks as though here we were near the crown of an anticline. At the N end of the ledge the dip is about 10° N, while at the S it is high as 30° or 40° to the S, although before so large a dip is obtained a joint is passed, upon the opposite

side of which the dip is but 30°

Continuing on our course toward the E. the contact between the quartzite and schist is seen at many points. The quartzite is a very thin mantle, and through this the schist protrudes in the most irregular way. If one regarded only the nearly flat outcrops on top of the slopes, he could discover no order in the relations between the schist and the quartzite, for the former rock protrudes through the latter in almost every fashion, but because of its schistosity before the quartzite was deposited, the ridges of schist were generally roughly parallel to the schistosity and thus the horizontal surface gives the appearance of rough interlaminations of the schist and quartzite. This peculiar fact, combined with the likeness of color of the two rocks, makes one particularly liable to overlook their true relations.



In one place a knob of schist was found roughly circular in form, and almost entirely surrounded by quartzite.

The schist was traced for something more than ¼ mile E., it sometimes being wholly missing on top, and usually its exposures not being more than 50 ft wide; but the schist is always to be found on the cliff exposures of the narrow N & S cross ravines.

After loosing the schist on the easterly course, I went in a N. E. direction to the N. steep front of the bluff, but found only quartzite, although at one or two places the quartzite resembles the original schist. This may be due to its being a recomposed rock.

2528 (?)

One of the rather striking facts about the conglomerate is the abundance of quartzite and chert pebbles. This may, however, be only apparent. This the microscope only can determine.

Near the N brow of the hill we found unmistakable belts of conglomerate, interlaminated with quartzite. Here the strike is N 75° E and the dip 25° S

S. T. R.

A later examination of the localities 252 11 - 25 281 led to the conclusion that the stuffed encrusting was probably due to the development of a schistose structure in the argillaceous wall and it is absent in the massive nozzle. The stuffed encrusting is a thin coating between a secondary structure and the original wall rock of granite. This case is the most illustrative from this district, and it is rendered more difficult to detect by the actual brecciation of the granite, combined with movement

Thus it appears that the crown of the anticline turns N, and the great mass in the central part of the ledge is on the S. side of the fold. A little farther S other bands of conglomerate gave a somewhat steeper dip.

Negaunee, Thursday, July

Visited ledge east of Negaunee examined by Phillips in the year before, his No. 2190 We found the rock to be partly altered iron carbonate. There is here an anticline, the axis of which strikes N. 55 W. and which plunges to the N W about 20°. Ledge did not permit of accurate observations.

We next visited the East Buffalo and Pioneer Mines. The first two are not open pits, and show the character of the rocks only by the ore and dump piles. Latter show slate and graywacke. At the Pioneer the ore is clearly within the slates, there appearing to be gradations from the slates to the ore. On the S. side of the Pioneer Valley, the graywacke slates show a slaty cleavage, as well as bedding

between the beds of differ-
ent character, and an
actual appearance of fragments
of the schist in the quartzite
Moreover the coarser quartzite
does at times become
truly conglomeratic.

It is however not im-
possible at some of the places
that the schist of the basement
complex does not appear.
25280 by thin section - block
of schist in the conglomerate
thus appears. In the field
this genuine schist difficult
to discriminate from the schist
or graywackes.

The strike of the latter is about N. W and S. E, and the dip is 45° to the S. W., while the slaty cleavage is nearly vertical. The slates appear just E of the Pioneer, but passing over the ridge is another valley within which the soft ore formation has been found.

We went S. from Negaunee up the high hill, passing the Lucy and Davis Mines. The ore of the latter is soft, contains a considerable amount of hematite, and is very regularly stratiform. The ferruginous slate has the same structure as the ore, the ore being apparently produced by the removal of the silica of the slate (?), and the infiltration of iron oxide.

Continuing N W a greenstone ridge was passed, and we came to a valley, not very strongly marked, in which are numerous exposures of typical actinolite schist, the strike of which is N 63° to 65° W. and the dip about 60° to the S. W.

Continuing in a course somewhat W. of S. about across the strike of the rocks, we ascended the highest ground yet reached, where is a broad strip of greenstone, perhaps ¼ mile wide.

We then went down into a minor valley, in which was found striking
25283 parallel with it an exposure of actino-
25284 litic slate, with strike N. 60° W. and dip 35° to the S. W. The exposure is about 70 steps long. We did not attempt to find other exposures in this valley along the strike of this rock.

Immediately to the S. W. is a very narrow ridge of greenstone, passing over which we descended into the deep valley. At first the slope is gradual and only greenstone ledges were found but in the 100 steps in the bottom of the valley occupied by the stream, three ledges of actinolitic slate were found. Continuing our course about S. 30° W. we steadily ascended, passing numerous greenstone knobs. The S. summit was reached at a distance of ½ mile, and we looked down into a broad and deep valley, but did not go into it. On the S. side were seen at several places angular blocks, and in one place a ledge, of undoubted actinolitic slate.

This trip renders it probable that the actinolitic slate occupies a large part

of the valleys which extend in a direction about N 60° W, but even in the valleys greenstone also occurs, and this rock occupies the ridges to the entire exclusion of the actinolitic slates