Original Huronian district: [specimens] 45820-45880, 45926-45932. No. 372 Summer of 1902

Van Hise, Charles Richard, 1857-1918; Leith, C. K. (Charles Kenneth), 1875-1956
[s.l.]: [s.n.], Summer of 1902

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 No 372.

45820 - 45880
45926 - 45932.

ORIGINAL HURONIAN DISTRICT.

SUMMER OF 1902.

C. R. VAN HISE-C. K. LEITH.

V. S. HILLYER,
Compassman.

Garden River.

August 25th.

Van Hise-Leith. Notes by Van Hise.

Drove from Sault to about 4 1/2 to 5 miles east of Garden river on Bruce mines road. The only rocks we found east of Garden river are the great ledges of "slate conglomerate" of Logan, presumably from their location upper slate conglomerate. This rock did not show more than small pebbles and even those are rare. The chief rock is slate and graywacke, dense and well indurated, fractured by numerous joints not mashed or showing any signs of a schistose structure. The bedding is very flat, the dip being about 10° to the south. Inland the dip is so slight that the ledges break off with steep or vertical cliffs on the side toward which it dips, i. e., to the south,- a rather unusual occurrence.

We went for about 1/2 mile across the strike to the north thinking possibly we might find the limestone, but none was seen nor could we really hope to find same if Murray's mapping is correct.

August 26th.

Got camp equipment and moved to Garden river village by boat.

ORIGINAL HURONIAN DISTRICT.
SUMMER OF 1902.

Garden River.

Aug. 25th and 26th.

Van Hise-Leith. Notes by Leith.

Visited the limestone quarry north of Garden river. The dip of the limestone is from 45 to 60° S. It is beautifully banded and shows many minor rolls. To the south and east of the quarry is also conglomerate containing fragments of limestone, doubtful ones of graywacke, and several kinds of granite, principal among which is a quartzose granite which is sometimes greenish and sometimes reddish. This granite resembles the white-eyed porphyry of the Basement Complex of the Vermilion district or the Saganaga granite in places. In addition there are a few greenstone and green schist fragments and jasper and vein quartz.

45820 45820 represents several phases of this conglomerate.

Went around the end of the bluff across the strike of the limestone and found the limestone to continue almost without break for 225 paces. The strike is about N. 70 W. The limestone ends abruptly in a low northward facing escarpment and after about 25 paces comes into the lower slate conglomerate. This is followed for about 150 steps and then lost. There

are no ledges to be found from here north. With the slate conglomerate we found also a few fragments of undoubted quartzite, which undoubtedly belong with the drift.

Finding no exposures to the north we went out diagonally north, northwest and struck the high bluff which we supposedwould be found to be granite. To our surprise it was a white vitreous
45822 quartzite for the most part showing marked brecciation. On the weathered surface it was difficult to decide whether or not it was conglomerate, but all gradations appear from the brecciated phases through intermediate jointing and slaty schistose phases to gneissec phases; the fragments in the breccia are all angular quartzite; and finally the breccia occurs at places th throughout the quartzite mass. Then crossing the quartzite for about 75 paces, at one place we not ed what we believed to be bedding which had a trend north 60 to 70° E.

On the next hill to the south, about 300 steps, is another bold bluff facing to the north. This is found to be a conglomerate, striking N. 75° W., and dipping almost vertical. There is a marked schistosity with the same attitude. The most conspicuous pebbles of this conglomerate are quartzites,
45823 identical with those on the hill to the north. In addition there are a number

of other more vitreous red quartzite pebbles and vein quartz pebbles; abundant white granite porphyry pebbles (the white-eyed porphyry); finally abundant fragments of green schist, for the most part disintegrated, with their characters sufficiently obscured that it is just possible that they may be fragmental. None of the red granite pebbles were found.

Continuing north quartzite of a vitreous nature is found. This seems to have a thickness about the same as the quartzite to the south. It appears within 5 steps of the conglomerate, and seemed to show no gradation. On the north side of the quartzite it was traced up to within a few steps of the greenstone and green schist ledge which had the aspect of the Basement Complex of the Vermilion district of Minnesota. On the edge of the greenstone there are some tuffaceous or brecciated or conglomeratic material which may represent the basal conglomerate of the quartzite. A dike of similar looking greenstone in the quartzite seen in the afternoon suggested that after all the greenstones may be intrusive into the quartzite, and bearing in favor of this is the fact that the quartzite does not change its character in approaching the greenstone.

Offset west 250 paces where we left

the greenstone. At 750 paces west struck quartzite, that is, the northern quartzite belt. Continuing to 1000 west and turning south, the quartzite was found forming the escarpment of the highest hill facing the south. Its strike is about parallel to the hill, that is, 10°S. of E. Bedding, while faint, was distinct and dipped to the N. at an angle of 45 to 50°. Also some
45825 beautiful ripple marks were seen. The quartzite is continuously exposed down the slope.

Continuing south the lower portion of the slope is found to be overlain by conglomerate which we had found when we were running north to be well up on the crest of the hill. The conglomerate has the same characters as before noted.

Still continuing south quartzite is again found identical with the first quartzite crossed in the morning. On the north this is massive and vitreous while to the south it takes on a feldspathic phase and shows abundant quartz eyes. This phases is the same as Van Hise found to result from the gradation upward of the lower slate conglomerate.

Garden River.

August 27th.

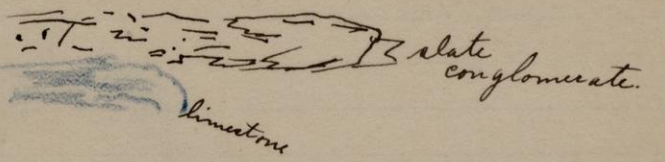
Van Hise-Leith. Notes by Van Hise.

Visiting again with Leith and Hillyer the conglomerate above the limestone described by me on my visit 12 years ago. I state this locality is two miles east of Garden river, whereas it is really about one mile north of Garden river. Found the facts to be just as described. The limestone where quarried dips 45 to 60° to the south and strikes ..... The conglomerate is separated from the limestone by probably 20 steps or possibly 25. The conglomerate contains very numerous quartzose granite pebbles and possibly graywacke pebbles. The fragments vary from those of small size to boulders a foot or more in diameter. The limestone fragments are often several inches in diameter and some of them 8 or 10. The slate is well indurated. (Pebbles of conglomerate specimened by Leith.)

I now parted from Leith and Hillyer and went east along the limestone front. In about 1/2 mile the ledge broke back to the north showing the limestone on the crest. I then went on a little farther and found the

45840 "lower slate conglomerate". 45840. This is a coarse conglomerate containing many large boulders of granite, pebbles of vein quartz, etc. Was unable to find any of limestone. Looked for contact of limestone with the conglomerate but a valley separated the two.

At the end the limestone struck north and south and dipped 30° to the west showing a sharp turn at this point and carrying the limestone out under the sandstone plain. The exposurers are about thus:



It appeared therefore improbable that I should again find the limestone this side of Garden river so I took trail running approximately north and crossing slate conglomerate about 1 1/2 mile east of the end of the limestone. Walked up a high ridge and found slate conglomerate continuously for 1/4 mile or more, perhaps 1/3 mile. Then upon the north side of the ridge found same to be much more like quartzite, finely conglomeratic, and containing white
45841 quartz pebbles.

Here passed upon low ground which continued without exposure for about a mile. Then came upon the broad ridge at least half a mile wede composed of quartzite.

45842 45842, from south side.

Then after another interval of about a half mile came to a dense somewhat schistose greenstone, the schistosity vertical, in places having slaty appearances, but nowhere showing sedimentary character. This

45843-5 is represented by 45843, 4, and 5. Have no doubt that same is the true Archean greenstone.

From the section is appears that north of the slate conglomerate on the north side of the Huronian trough is a quartzite the same as on the south side. Could the slate conglomerate back of the limestone also be the same as that of the conglomerate, this being repeated by faulting?

Garden River.

August 28th.

Van Hise-Leith. Notes by Van Hise.

Van Hise and Leith started on the great hill north of the center of Little George Lake where we left off the day before. The southernmost quartzite is broken and brecciated and porbably older than the one to the north. The conglomerate rests unconformably upon this quartzite and grades up into the one to the north. At this place a re-examination showed very few quartzite fragments and in some places none at all. Working to the west the conglomerate was followed continuously along the southern escarpment of the great ridge for over half a mile. Then granite comes in to make a great bluff and the conglomerate shoots by to the north. The two rocks were found within 5 steps. The conglomerate contains fragments identical with the granite, which is a white weathering quartzose one showing a number of phases, white, red, greenish, etc. The strike of the contact was about N. 50° W.

In view of these facts the southern most quartzite is believed to form an anticline on which rest the conglomerate and quartzite dipping off to the north. Following to the west the granite wedges in on the same general anticline, showing that the conglomerate and the quartzite to the north are really parts of the other basin which may be continuous with that

of Goulais Bay. If this be the case, the quartzite on the north is probably not unconformably upon the green schist, although it still may be by folding. Near the contact of the quartzite and green schist there is a zone of brecciated and tuffaceous material which is exceedingly schistose and of doubtful character. We at first called it conglomerate, but in view of the following facts have concluded that the green schist is probably in part at least intrusive into the quartzite. (1) The quartzite runs up to within a few paces of the green schist without change of character. (2) The character of the supposed green schist conglomerate is doubtful and it may be nothing but a breccia. (3) The conglomerate dips to the north, that is, into the green schist. (4) A fine-grained greenstone and green schist dike of almost the same character is found intrusive into the quartzite at another place.

We did not follow the contact of the conglomerate and granite, but it evidently could have been easily followed to the northwest.

We then followed the granite ridge, forming the great escarpment, around to the west, southwest, and south onto the Bold Knob, rising just north of the west end of Little Lake George. The granite continued well up to the base of the last ridge but one.

Crossing a deep ravine and going up

on the last knob to the south, we crossed first conglomerate, which is mainly recomposed granite, although containing fragments of green schist and greenstone and perhaps also graywacke, although of this we could not be sure. Continuing up the hill, cherty limestone is found dipping to the south and striking about east and west. On the south side of this is massive quartzite, rather feldspathic, and varying in character. This quartzite continued to the south edge of the bluff. About two-thirds of the way out it contained a considerable zone of conglomerate, that is, quartzite containing fragments of granite, greenstone, chert, and doubtful quartzite.

Following the quartzite north it is found to rest unconformably upon the limestone which has evidently been very much broken up and brecciated and the quartzite dropped in upon it. Large angular pieces of limestone are sliced off and this has resulted in one place in giving apparently two bands of limestone. This is really but the effect of erosion. The quartzite cannot be traced continuously across the limestone, although quartzite of the same character occurs on both sides. Following down the slope to the north the quartzite is found to grade into a coarse conglomerate with angular fragments of banded limestone and quartzite apparently resting in depressions

and crevices in the limestone. Also about 75 paces east of the east end of the limestone exposure the quartzite is found to lap nearly over the quartzite, although it does not cut it out entirely. It laps well down on the hill to the north and as it approaches the valley it becomes more feldspathic and resembles greenstone or granite to
45828 a great extent. At first we could not make up our minds that this was quartzite, but the exposures were followed nearly continuously. To the south and west of the limestone is recomposed granite, conglomerate and feldspathic quartzite, which have not been connected directly either with the limestone or with the overlying quartzite. The conglomerate seemded to dip under the limestone, but it is not improbable that it may really be a part of the quartzite series which has simply lapped around the west end. On the east end of the hill also quartzite is found apparently to cut off the limestone, although there is an interval of 25 paces without exposure.

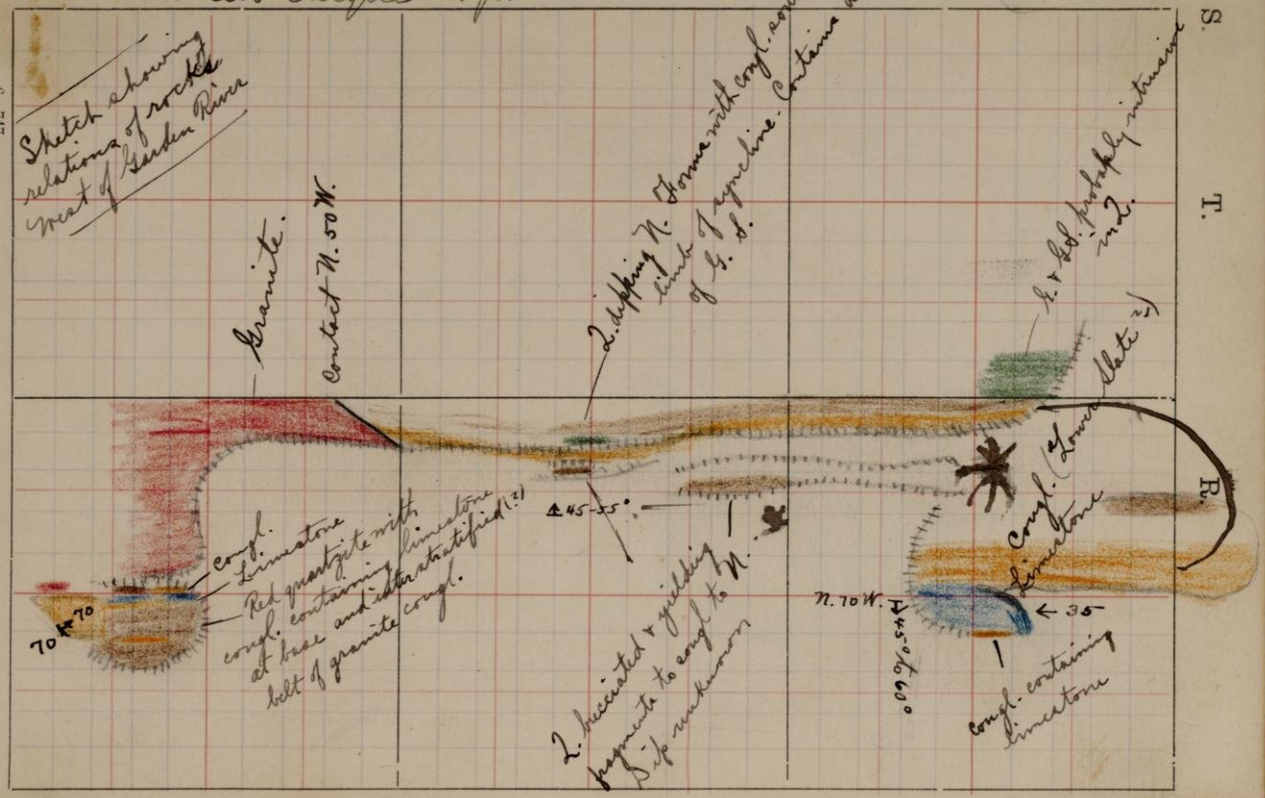
The quartzite is therefore probably unconformably above the limestone.

Van Hise followed the limestone to the west for a quarter of a mile and then lost it in the woods. He also found the quartzite to lap over the limestone. There can be no question as to the fact that there is a con-

siderable erosion interval between the two series, as well as between the lower series and the granite.

Attention is called to the fact that the quartzite, i. e., the older quartzite, occurs in two hills. Where we first saw it, it was on a hill by itself and to the west it was on the south face of the next hill. This suggests the existence of an anticline at this point. The quartzite and the granite together would make the anticline, and the coming in ofthe granite is in favor of this view.

See description on preceding pages.
See also Cheyne map.



Garden River.

Supplementary notes by Van Hise.

From the place where Leith found quartzite apparently overlapping the limestone I went south to the south crest of the hill. At the outset the quartzite was so red and feldspathic as to have almost a granitic appearance Indeed I examined it with a lens to be sure that it was not granite, but in passing away from the limestone it becomes less feldspathic and becomes the
45830 typical red quartzite of Logan. About half way to the south crest of the hill the quartzite apparently grades into fine conglomerate and then into coarse conglomerate. This conglomerate was examined for limestone and quartzite pebbles and none were found with the
45828 possible exception of chert, which may have come from the limestone.

I then returned to the limestone bel belt and followed the contact between t the limestone and quartzite to the west. The limestone was seen at intervals estimated to be at least 1/4 of a mile. At several places the quartzite was found near limestone on the south side. Along the strike of the limestone the country became low and wooded and as there did not seem to be likelihood of finding limestone again for some distance I turned south and here found the rock to be conglomerate almost immediately, which continued

quite to the south slope of the hill. In places it was very coarse. The dominant pebbles were granite. Indeed in many places it was not more than a granite stucco. This conglomerate was examined very carefully for quartzite and limestone pebbles. No limestone pebbles were found which could be gotten out, although I thought I found one of two and a number of pebbles
45829 which certainly have a quartzitic
45831 character. 45831 represents a finer phase of the coarse conglomerate. The conglomerate everywhere crossed is interlaminated with quartzitic and fine conglomeratic bands which at one place strike n. 45° W. and dip 70° to the N. E.

Continued northwest across a strike of the outcrop to the very edge of the bluff, thinking as the conglomerate became coarser in this direction I might find the granite. This, however, was not found and immediately at the foot of the bluff found the road which identified the locality as being the one, where in 1891, I had found the slate conglomerate had worked along the face of the cliff to the northwest until the granite was found within a few feet, at one place separated by a steep ravine and at another in actual contact with the granite. The granite at this place is a granite stucco

or recomposed rocks which so clearly resembles the granite that the two can only be discriminated on the weathered surface. (This last is taken from notes of previous years.)

It thus appears that the limestone is not overlain by the conglomerate but that the limestone is completely overlapped by conglomerate where the latter comes in contact with the granite. This of course could be explained by change of sedimentation or by overlapping or by unconformity. Since an unconformity is known to exist at the base of the conglomerate, the latter is the natural explanation to apply. The bluff of red quartzite is in exactly the right position to be the 3G of Logan, which he maps as disappearing under the Cambrian sandstone northeast of Great Lake St. George. This suggests that the conglomerate north of the Garden river limestone is equivalent to the conglomerate associated with the red quartzite and that the break in the Huronian may be between an upper slate conglomerate and the quartzite 3G rather than between the limestone and the upper slat conglomerate as had before been supposed.

The structure suggested by the cross-section of Leith of the previous day and by our travels today is that

S. T. R.

2. with slate next to the limestone.
↧10-20°

10-45° Limestone Lake

2.

Lake

×2

Starting point on Echo Lake at west end of the bay N. of Limestone Point. Scale: one blue square equals 100 steps. For continuation see p. pp. 24.

E & W. 2 with congl. resting on it.
This congl. Van Hise thinks is interstratified. No decisive evidence.
↓15°

the two quartzite bands, separated by a valley without exposure just north of the slate conglomerate, are the same quartzite formation, repeated by folding, and consititute the crest of an anticline; that the quartzite would thus be below the slate conglomerate, which in turn is below the limestone. The great conglomerate seen during the forenoon would be the base of the series, resting unconformably upon this quartzite, as shown by the observations of Leith the day previous. The regularly bedded quartzite above this conglomerate would be the next higher member of this succession, dipping off to the north. The northward dip of these two beds suggests that we are now on the south side of a synclinal of Huronian rocks which fills the country between Goulais and Batchawana Bays, and that suggestion becomes very plausible in view of the fact that a great band of conglomerate is traced north of the granite mass making up the country south of Goulais Bay.

Echo Lake, Aug. 30th.

Van Hise-Leith. Notes by Leith.

Started on Echo Lake at the west end of the bay north of Limestone Point. Ran about a mile and a half west, then south and east to the lake. The results are shown on the accompanying sheet.

Van Hise's notes, same trip.

We went to the west end of Little Bay north of Limestone Point, then up the slope toward the end of a steep eastward-facing bluff. We found quartzite on the slope gray to pink, and vitreous. This quartzite Van Hise traced around the northeast corner of the hill, while Leith did the same for the southwest corner, while Hillyer went up over the end of the limestone bluff. The limestone here where it breaks off in eastward-facing cliffs is in series of minor rolls so that as far as this exposure is concerned it might be an anticlinorium, a synclinorium, or a monocline. Van Hise followed west along the north base of the hill where he found repeated in going up and down a succession from the base up, quartzite, fine-grained conglomerate, and limestone. The dip of the quartzite and conglomerate was nowhere clear, but in every case the limestone was found to dip to the south at angles varying from 10 to 20° or even more. This north slope of the hill was followed for about 300 or 400 steps. No where were the three members found in absolute contact, but at various places they were found very close to one another. In one place especially the quartzite was found and then going up

a steep incline with no exposure for 10 or 15 feet conglomerate appeared and over this with scarcely any break the limestone appeared. Apparently there can be no doubt that the quartzite and conglomerate at this place pass under the limestone. The limestone at its base is gray siliceous rock which might as well be called a siliceous phase of graywacke or conglomerate, and this within a few feet passes up into
45833 the distinctive banded gray and blue
45834 limestone.

Van Hise then climbed up the cliff of limestone, joining Hillyer about 500 paces from the lake. Hillyer reported as being on limestone all the way. Leith followed around the east and south escarpment of the hill and was on quartzite all of the way. On the south side worked north and soon came upon limestone. Working up the slope a doubtful limestone breccia or conglomerate was found above which again is apparently more limestone and perhaps more slate. The relations here can be fully worked out, but as the others had gone on Leith hurried to follow and it will be necessary to cover this area again.

After Leith joined us we continued on our course west. At 600 paces from the lake we came to the northwest facing escarpment of the limestone

down which we climbed and continued our westward course. We found no rock rocks in this course until we had reached 650 paces west of the lake where gray and pink massive quartzite ledges were found both to the right and left of the course at such frequent intervals as to leave no coubt that the entire country is underlain by quartzite ledges to where we found a small lake. (See plat). The north side of this lake is bounded by quartzite ledges but on the southeast corner of the lake we found quartzites similar to those over which we had been travelling which was immediately overlain with sharpt contact by conglomerate containing fragments of granite, greenstone, vein quartz, and very likely other kinds of pebbles. Apparently there was no gradation between the two. Quartzite pebbles were looked for but none were certainly determined to be such. The strike and dip at this contact is E. and W. and 15° S.

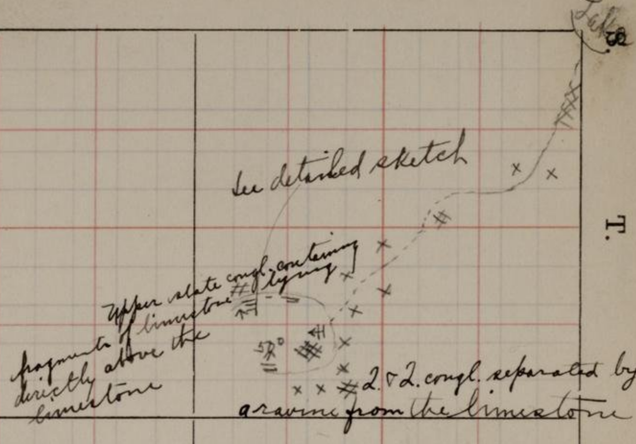
We now continued our course to a high quartzite ridge and then changed our course. We found the steep crest of the hill which we descended, went across a little swamp, and at ..... steps on that course found quartzite. Going up the slope near the crest of the hill we found first graywacke and conglomerate and then

crossed a minor depression. After a few steps came upon the dark siliceous rock weathering with a yellow color, which we recognized as similar to the base of the limestone where we first struck the ledge. Indeed at that moment we regarded it as the base, but immediately above this up the slope we found ledges of typical limestone, the exposures, however, being small. We now went on a course comewhat south, then southwest, following the low ground between the conglomerate and limestone, going from one to the other. We however found nothing to definitely determine the stratigraphic relations of the two rocks. We concluded that we were south of the eastward bending nose of limestone directly west of the south part of Echo Lake. We therefore turned back on our course to the east, then north and northwest, then west, until we got around the nose of the limestone. Near the nose we first found the ledges of limestone and conglomerate very close to one another. The limestone was, however, very irregular in its dip and we did not feel certain of the relations. At last on the west slope of the hill we found ver very small ledges of limestone dipping into the hill, and 5 or 10 steps above this limestone up the slope of the hill found conglomerate. Also we found this conglomerate to contain very numerous fragments of limestone which show distinctly on the interior and xx

were marked on the weathered surface
45835 by patches. This looked very much as
if the conglomerate overlaid the
limestone. Continuing a little farthe
to the north Leith found the actual
contact between the limestone and over
lying rocks. Here the limestone
45836 grades up into the reddish limestone
45837 which is actually under a quartzite.

6—747

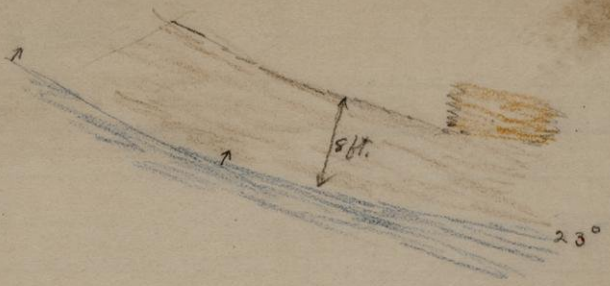
S.



Left
See detailed sketch
Upper slate congl. containing fragments of limestone lying directly above the limestone
57°
2. & 2. congl. separated by a ravine from the limestone

T.

R.



Sketch of escarpment facing east. Looking west. Dip of contact from this view is 23°. Real dip of contact and bedding of limestone and of conglomerate and quartzite is 10 to 15°, strike is S. 10° E.

We have here about 10 or 12 feet of escarpment. On the bottom is limestone. In direct contact with this is vitreous quartzite. Within 6 inches of the contact the quartzite contains apparently a thin band, of limestone, indicating a slight gradation or possibly indicating simply slicing off of the limestone. The quartzite is about 8 feet thick and grades into conglomerate containing limestone fragments. We were at first in doubt as to whether

the quartzite graded into the conglomerate or not, but finally decided that it did.

This quartzite is only a few feet in thickness and grades upward as far as could be ascertained into graywacke and conglomerate.

45838 45838 represents an intermediate phase.

45839 45839 represents the conglomerate

Here the ledges are in conformity and the only evidences of physical break are the abrupt changes in sedimentation in passing from the limestone into the quartzite and the presence of a number of limestone pe pebbles in the conglomerate.

We now turned back to the south and then east, and almost immediately ran upon quartzite which continued for some distance, certainly 500 steps and possibly 1,000 steps, where we came to the edge of the great cliff. This cliff is plainly visible running a long way west of the south end of Echo lake. Here along the lake shore a short distance south of camp we first came upon quartzite exposures. Then continuing northeast along the shore perhaps 200 steps from camp we came upon this ledge of slate conglomerate which contained well-

rounded pebbles of granite, greenstone, vein quartz, and apparently a few of limestone, although none were gotten out to show this to a certainty. Upon the south side of Limestone Point just before reaching camp a skim of slate conglomerate varying from one inch to two or three inches was found directly across and capping the layer of limestone. This conglomerate, although insignificant in amount, was perfectly distinctive in character since it contained, besides the limestone pebbles, well-rounded pebbles of granite, greenstone, quartz, and other kinds of rocks, one pebble of granite especially beautifully rounded and several inches across. It therefore cannot be a phase of the limestone but is a part of the conglomerate formation which is found immediately to the south and conclusively demonstrates in connection with facts noted that the band of conglomerate has been deposited after the limestone had become compact and after erosion had been sufficient to cut across a considerable though undetermined thickness of the limestone.

A very fundamental point undetermined by this rock is the relations of the quartzite on the two sides of the limestone. Does the conglomerate

grade upward into quartzite to the south, or is the conglomerate a mere subordinate syncline in an older series of rocks, the quartzite belonging with the limestone? The latter point of view is suggested by the appearance of the conglomerate upon th quartzite at the small lake. It is further suggested by the fact that the quartzite was followed almost continuously at the bluff near the lake from the north side of the limestone to the south side. Therefore there remains to make decision between the following possibilities.

(1) The quartzite north and south of the limestone may be the same, bein an older formation than it, and the limestone a synclinal upon it. Over these two in this case the conglomerate would be deposited.

(2) The quartzite north of the limestone may be a different one from that south of the limestone, they being in monoclinal succession, with the limestone between and the slate conglomerate deposited unconformably upon the series.

(3) The quartzite north of the limestone and that south of the limestone may be different and the slate conglomerate lying in stratigraphical position between the limestone and conglomerate to the south in which case the quartzite belongs to the upper series.

One thing is certain, and that is that the great area of rock marked upper slate conglomerate west of the south half of Echo lake is not slate co conglomerate but is quartzite. The slate conglomerate is a mere subordinate band adjacent to the limestone.

45840-5[illegible] Specimens 45840-45845 are in Van Hise's manuscript notes. See pp. 6-8

45846 45846 is an average sample of conglomerate nearest to the limestone on the nose at the west end of the lake.

Echo Lake.

August 31st.

Van Hise-Leith. Notes by Leith.

With Van Hise worked along the limestone belt on the main land just west of the camp. We first struck the east nose and worked around the southward facing escarpment for perhaps 500 or 600 paces. In going up the hill from the lake the first rock crossed is a gray and yellow vitreous quartzite somewhat feldspathic. Above this and a little to the south is "slate conglomerate". In working around, the slate conglomerate was everywhere found on the middle slope. Near the bottom it is coarse, containing granite and greenstone, vein quartz, and other pebbles. Going upward toward the limestone it is uniformly finer-grained. There is a very sudden break in character, more vitreous quartzite below, and conglomerate apparently above it, but no direct contact was found. The upper portion of the hill throughout was found to be occupied by limestone with gentle folds but in general dipping into the hill. Van Hise found the limestone the day before to dip into the hill on the other side and it was evident from today's work that the limestone lies in gently folded synclines pitching off to the west. The slate conglomerate was followed for 500 or 600

paces around the hill and in some places appeared as close as 60 steps on the steep slope. As we left the conglomerate and approached the limestone, the limestone was always seen pitching into the hill. The thickness shown in the great escarpment is quite too great to warrant the supposition that it might be bent down to go under the limestone. Nothing but a fault would bring it under. We are justified in concluding that the slate conglomerate rests beneath the limestone. This conclusion rests on the attitude of the south face, on the fact that the slate conglomerate was followed almost continuously around the nose, and on the fact that Van Hise saw the same feature on the north side where he had the two clearly together. In following the conglomerate, there were several gaps with no exposures and there was room for the limestone to get through. However, the attitude of the limestone was sufficient to show the slight probability of its going through such a gap. Therefore the upper slate conglomerate and lower slate conglomerate in this area are the same thing. The syncline here pitches to the west, evidently making a turn to the east, and pitches to the east, for it may be observed to

pitch off and to form the syncline in which the camp and point are situated

Well up in the limestone there are observed a considerable amount of limestone breccia or limestone conglomerate. The fragments vary from minute size up to several inches and from angular to beautifully rounded. However, there is nothing but limestone in it and it is followed both above and below by typical banded limestone with normal strike and dip. It was not absolutely certain that the conglomerate was interbanded, but it apparently was. If it were simply a patch against the limestone it would represent the base of an upper series, but it would be strange if no other fragments were present as is the case in the other areas where we have a true conglomerate.

Sept. 1st.

On the southeast shore of Echo Lake.

Van Hise-Leith. Notes by Leith.

First examined island and found it occupied by slate conglomerate containing fragments of granite, greenstone, vein quartz, and a few un-
45847 doubted graywacke pebbles. The dip could be well seen. The strike was approximately east and west and the dip 55° toward the south.

Then struck the main shore just back of the limestone point and worked along the ridge to the southwest. Near the top of the ridge we
45848 struck diabase or gabbro showing a considerable variation in texture from place to place, but in general appearing fresh and massive. This was found with almost continuous exposure to within 700 paces of the farm house at the foot of the lake and probably also constituted the hill seen just back of the farm as a continuation of the same range. Copper is found in this rock.

About half mile south of the limestone point there is a gully which crosses all the greenstone and cuts down to a slate conglomerate. It is separated by about 50 paces from the greenstone.

The uppermost rock seen is slate c
45849 conglomerate. In going down this

45850 becomes black siliceous slate, which has interleaved with it layers of quartzite. The dip is well marked and is slightly into the hill.

Echo Lake.

Van Hise, s notes for the same day.

Went from the limestone on the east side of the lake across the lake toward the prominent point next north of Limestone Point. Before getting too close to the shore I took observation as to the general attitude of the rocks in relation to the topography. It seemed to me that while the limestone ridge before visited is very likely synclinal, as we supposed, it is a gently tilted synclinal toward the south, thus:

The quartzite ridge toward which I was going has a very decided synclinal appearance but also with a very slight dip to the south. Starting up the nose of this hill in a course almost due west I came almost immediately upon gray quartzite which varies somewhat in grain, but shows distinctly a quartzitic texture, although it has been more or less granulated. The quartzite ledges were ascended one after another up the retreating slope of the nose, in each case the cliffs being almost vertical, although

breaks were found where one could make the ascent. Near the top the beds of quartzite show distinctly and have on the north side of the hill a dip of as high as 15° to the south, gradually flattening out to a horizontal dip and then when followed still farther to the south has a gentle dip to the north 5 to 10°, thus showing that this is again a southward tilting syncline.

After the last of the prominent quartzite ledges was crossed, it was seen that there was still higher ground farther west. Ascending this I found at the base of a little cliff in the wood clean-cut quartzite. This continued to a certain line and above this was conglomerate. The quartzite appeared to ge somewhat graywacke like in appearance near the top, and the conglomerate, where it first appeared as such, was very fine-grained, but I could not be sure that the change from one to the other is not abrupt rather than a transition, for the ledges were almost covered and somewhat obscured. However, the conglomerate is certainly fine-grained at its base and in a few feet large pebbles of granite are seen and in the middle or higher ledges, pebbles 6 to 8 inches in diameter are plentiful. The bedding of the conglomerate is not distinct.

However, it has the same spoon-shaped outcrop as the quartzite and I have no doubt that it has substantially the same attitude. After reaching the top of the conglomerate there is an interval of a few paces with no exposures, and then well laminated limestone appears. The limestone makes a relatively small exposure upon the very crest of the ridge, which breaks off with almost vertical escarpment on three sides and shows horizontal bedding. It therefore appears perfectly clear that this is the center of the syncline, the quartzite being the great formation at the base of the series, and the conglomerate here being a subordinate matter, not having a thickness greater than 30 feet, and above this the limestone, the exposures of which have a thickness of 15 or 20 feet.

45851 45841 shows the limestone at this place.

45852 45852, fine-grained phase of conglomerate.

45853 45853, quartzite where it first has its typical appearance below the conglomerate near the top of the hill.

The succession on this cliff, according, as it does, completely with that observed on the prominent cliff west of camp where there is such a thickness of limestone, fully confirms the conclusions of the previous day as to the relations at that point, show-

ing that the succession at the two cliffs is the same except that on the south cliff more limestone is exposed and comparatively little quartzite, whereas on the north cliff the main mass of material is quartzite and limestone in a mere patch.

I next went to the very prominent eastward facing cliff with the great talus slope which descends quite to the water. Here the major portion of the cliff is a beautiful vitreous quartzite. The lower parts expecially are coarse and show false bedding. The dip is here much steeper to the south than any of the previous cases. The angle is estimated to be 30 to 40° This monoclinal succession was followed up layer after layer by keeping to the edge of the talus slope until finally a quartzite was found in actua contact with very coarse conglomerate. The quartzite is here very fine-grained, yellow, reddish, and brownish, having almost a cherty look and when broken and examined with a lens is found to have distinct quartzitic appearance. It evidently contains ferruginous material, probably as carbonate, which gives the reddish and brownish colors to the weathered surface. Immediately above the quartzite the conglomerate is very coarse, having pebbles and boulders of granite, greenstone, and a few pebbles

and boulders of what I took to be quartzite. (This to be confirmed by further observation.) The marked structure of the conglomerate is nearly vertical fracturing, which approaches a cleavage or a truly schistose structure. The bedding was obscured but seemed to be somewhat flatter than the quartzite. (This to be further examined.) The conglomerate was followed perhaps 100 to 150 paces to the west until an opportunity was found to descend from the fliff and after going through perhaps 100 feet of conglomerate the quartzite was again found, showing that the conglomerate is after all a mere plaster on the southward dipping quartzite. The quartzite south of the conglomerate was followed all the way to the lake. The dip of the quartzite is here flat or slightly to the north, showing that the structure of the quartzite is that of a very marked southward tilting syncline. (Leith to make sketch.) The very highest point back of the conglomerate was not examined. This may perhaps furnish limestone.

Echo Lake.

Sept. 2nd.

Van Hise-Leith. Notes by Leith.

With Hillyer (Van Hise in the canoe) ascended the great knob northwest of the limestone point, the one plainly visible from the ca camp. The height is 570 feet. The talus slope is almost entirely
45856 greenish slate conglomerate containing fragments of greenstone of various kinds, vein quartz, greenstone, but no quartzite (?). The top ofthe hill at the edge of the escarpment was found to be this conglomerate. This came down perhaps 50 feet and below that was
45854 massive vitreous quartzite which near the top shows more feldspathic phases. Reaching the top of the hill we worked westward along the dip. The conglomerate could be seen to have a beautiful bedding, shown by the dark slaty layers. This invariably intersected the schistosity and joint planes. In going back from the crest about 50 paces white
45855 vitreous quartzite was found showing some red variation from place to place. This was followed over the highest portion of the rock for perhaps 100 paces. We thought from analogy with the hill to the south that we might find the limestone in the western portion of the hill on the assumption that the hill was mainly a synclinal, but instead of

this we found quartzite. Coming back a little to the south of our course the quartzite was crossed as before and followed back to within 10 steps of the conglomerate. The quartzite was found from one escarpment perhaps 10 feet high and the next bench to the east was slate conglomerate, dipping gently to the west. In other words the bottom of the quartzite was about on a horizon with the top of the conglomerate and the latter unquestionably dipped under the quartzite. There may have been room for a few feet of conglomerate between the two, but the exposure was such that one could not be sure that there was not less than this.

Then worked down the hill on the north side and found the contact of the conglomerate with the underlying quartzite. We were there first quite unable to place the contact, but we finally struck a place where within four feet we were sure that one rock was quartzite and the other conglom-
45857 erate. The quartzite in going up takes on schistose and quartzitic phases similar to the conglomerate.
45859 45859, conglomerate near the contact.
45860 45860, phases of the intermediate material.
45858 The conglomerate in going down shows finer and finer fragments and

is finally a rock which we could not discriminate from the quartzite. Separating rocks which we supposed were respectively conglomerate and quartzite was only a bedding or joint plane and above this plane the rocks differed from those below only very slightly in schistosity and quartzose content. Also the bedding in the two rocks had almost identically the same attitude, i. e., a gentle dip to the west into the hill. The facts point clearly to the conclusion that there is ~~e~~conformable gradation of the quartzite into conglomerate. This conclusion is further confirmed by the absolute lack of quartzite pebbles in the conglomerate although we hunted for same for some time.

Looking at the cliff from the gray quartzite below it may be seen to have a structure dipping 35° to the south and to be capped by the conglomerate which apparently lies flat. On the top of the hill we could not get down to the dipping quartzite, but where we examined it the conspicuous parting or schistose structure was everywhere inclined to the true bedding and the only true bedding we saw was parallel to the bedding in the conglomerate, hence we concluded that probably the dipping structure noted by Van Hise is probably a secondary one.

Then went across to the next hill to the north and found the same capping of conglomerate underlain by quartzite. As before, the facts pointed to gradation shown by unconformity in bedding and gradation in the series.

45861 Schistose conglomerate near contact.

45862 Quartzite near contact.

45863 Typical quartzite lower down.

In the afternoon climbed the big hill on the northwest corner of the lake. Just to the west of the great escarpment showing white weathering

45864 we find a peculiar slate which is similar to the slate conglomerate, especially in that it lacks pebbles.

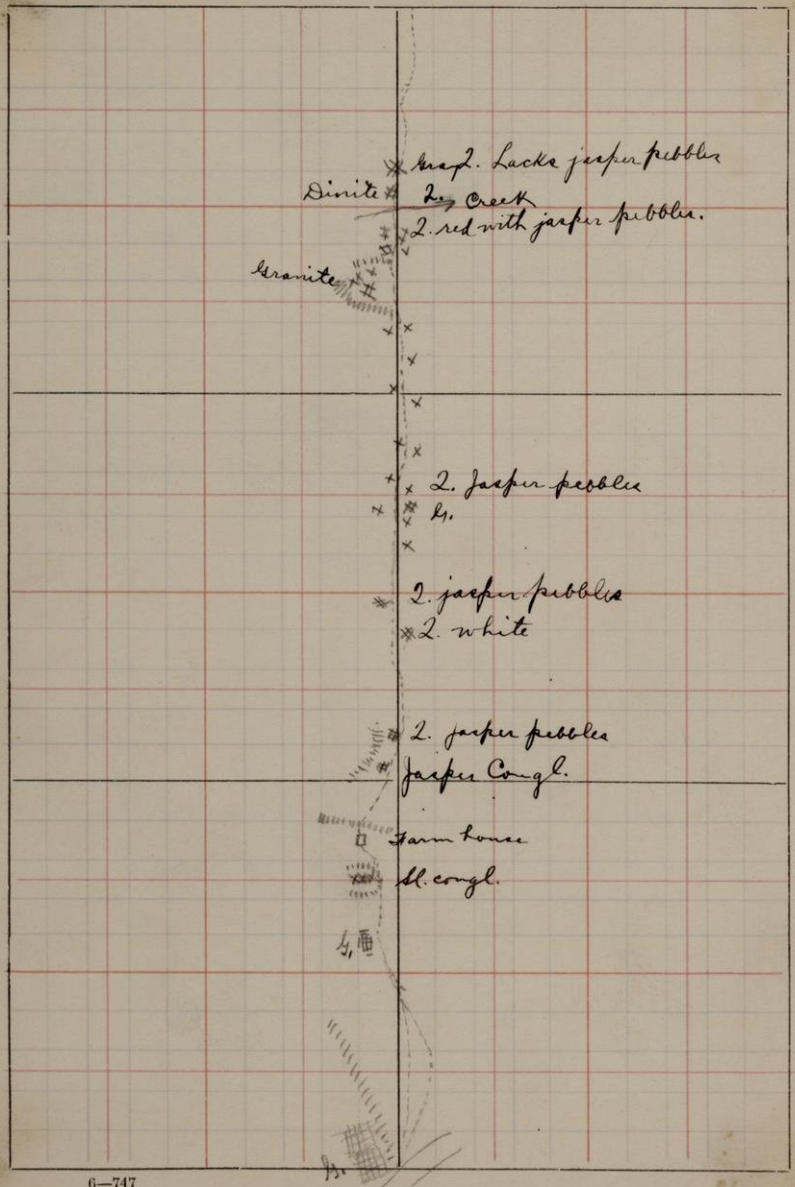
Then working up the hill it was fo fuund to consist in its lower portion of a sheared quartzite and slate, showing much folding.

45865 Feldspathic quartzite. This is associated with certain slates and schists which are in part original slates and in part sheared phases of the feldspathic quartzite.

45866 Near the top is a carbonate slate, which on the weathered surface looks yellow and white. Van Hise thinks this is the representative of the limestone, but it looks to me like th the simple carbonate slate, possibly iron carbonate rather than calcium carbonate. The dip of the layers is

very variable,- we see it only where a dike crosses it. Rising through the layers of the quartzite and carbonate slate is a dike of diabase or diorite which on the top spreads out and covers the entire top of the hill. The height of the hill is 640 feet.

S. T. R.


Mesa? Lacks jasper pebbles
Dinite
2 Creek
2. red with jasper pebbles.
Granite
2. Jasper pebbles
2. jasper pebbles
2. white
2. jasper pebbles
Jasper Congl.
Sandstone
Sl. congl.

Echo Lake.

Sept. 4th.

Leith.

With Hillyer worked north of Echo lake. The river took us up the east nose of the great escarpment of greenstone seen from the lake. At the landing the greenstone itself may be seen. From the landing a good trail goes almost due north with many windings. Greenstone appears in the drift along the trail at several places. At 1200 north is greenstone.

At 1500 north is a greenstone conglomerate showing granite fragments with quartz eyes. These weather like greenstone or green schist and were it not for the occasional pebbles and quartz eyes the rock could be called green schist.

About 1800 north strike a farm house and from here worked along the old trail and road on the east side of the great cliffs seen north of the house.

We first struck at about 2100 paces a large ledge of white vitre-
45867 ous quartzite, which in its lower portion becomes slaty and finely conglomeratic and in one layer contains an occasional jasper fragment as well as fragments of chert and vein quartz. The dip of the coarse conglomerate band is 30° to the north. This probably represents the bedding. The rock is cut by diabase which

forms the highest part of the little hill near the trail. The strike is about east and west, but this is only a guess.

45868 To the north of this we strike beautiful jasper conglomerate, at locations given on the opposite page. The rest of the run is noted on the opposite page. The red jasper conglomerate was followed to a distance of about 2 1/2 miles north of the lake, i. e., for a distance of 1 1/2 miles. If the observed dip is a true one, we must have crossed the series and therefore would have a considerable thickness of the formation. However, it is probable that the thickness is exaggerated.

45869 After passing the red jasper conglomerate we came upon gray quartzite lacking in pebbles. On returning we looked at the topography and found we had crossed to the north between two high ridges, the one to the west being greenstone and the one to the east and north being quartzite. The road winds around on the jasper conglomerate hill.

At a distance of about 2 1/2 miles from the starting point the road reached a high point on the hill, and walking a little distance west, a look-out was obtained. The hill was found to be just north of the

great greenstone bluff at the starting point and to consist of coarse diabase and of red fine-grained granite.(70) The relations of the granite to the diabase could not be obtained, but from its coarse nature it was judged to be a late intrusive like the diabase.

45870

The quartzite conglomerate was found on the lower slope of the hill both north, south, and east of the main crest of the igneous rock. In general there was igneous rock to be seen at numerous places on the trip.

At a distance of 3 miles north of the starting point or 3 1/2 miles by the road as we came, the road swings to the west on the north crest of a great hill. As it was past noon and we could see no chance of getting across the great valley in time to get back to camp at night-fall we turned back.

Returning to the boat the talus slope near the east nose of the big ridge at the east end of the lake was examined just above the creek where the boat was left. It was found to consist mainly of coarse diabase but associated with it was a very small amount of carbonate or marble, some of it of a much more distinct character than I had seen two days before on the same ridge to the west.

45871

45871 is a sample of marble taken from this place.

We did not go up the hill but it was apparent from the weathering that the limestone material was near the upper part of the escarpment. The lower portion of the hill, the middle portion, and evidently the upper portion were greenstone as shown by the talus slope and by exposures on the lower and middle parts and by the aspect of the topography and rocks above as seen from below, and it is evident that the limestone formed but a small portion of the hill, which is mainly intrusive diabase.

45872-4 See page 51.

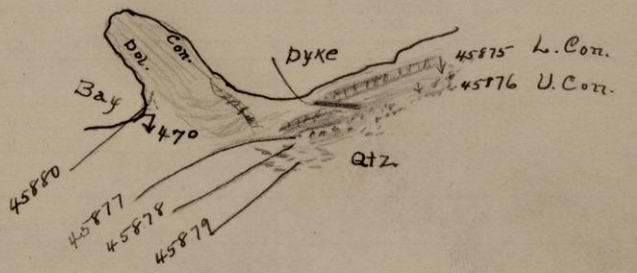
Echo Lake.

Van Hise-Seaman.
Prof. Seaman's notes.

On the southeast side of Echo Lake on a point of rocks east of the small island of conglomerate, the following succession was seen. At the base is a quartzite .... feet thick dipping at from 33° to 39° southeasterly; this is followed by a conglomerate-graywacke 20 or 30 feet above this a rather pure banded dolomite. The interveing 20 or 30 feet marks a gradation phase between the quartzite and dolomite, the gradation being through a conglomerate-graywacke and dolomitic graywacke to dolomite. The graywacke dips 33° to 37° S. E. and the dolomite 33° to 35°. The strike was taken on the end of a pitching tilted synclinal and was n. 75° W. The observations were taken on the northeast side of the second hill from this point.

On the east end of the hill where
45875-6 specimens 45875 and 6 were taken the quartzite grades into the dolomite through about 25 feet of banded conglomerate and graywacke similar to that seen farther west. The dolomite is exposed for a width of 70 paces across beds which dip southward at about 45°. At the east end of the hill the conglomerate overlaps the dolomite
45877 for at least 35 paces. Specimen 45877 is from a boulder in the conglomerate

taken from the west end of the hill.
45878 No. 45878 is the upper quartzite
45879 showing gradation phase; No. 45879
is the upper quartzite from the highest
exposed beds of the section about 100
paces across the strike from the con-
45880 glomerate. 45880 shows dolomite frag-
ments in the conglomerate.



In going south from where specimens 45875 and 45876 were taken there was a gradual ascent until the crest of the ridge was reached, one mile to the south. On the south side the descent was rather abrupt over some exposures of dolorite; then began another gradual ascent until the crest of the second ridge was reached. This point was about 1 3/4 miles south of the starting point. To the south about one mile distant another crest with gradual northern slope was seen and also one smaller intervening one with the same topographical features. The second ridge dropped off very pre-

cipitously to the south, forming mineral-like escarpments of dolorite 200 to 400 feet high.

Sept. 3rd.

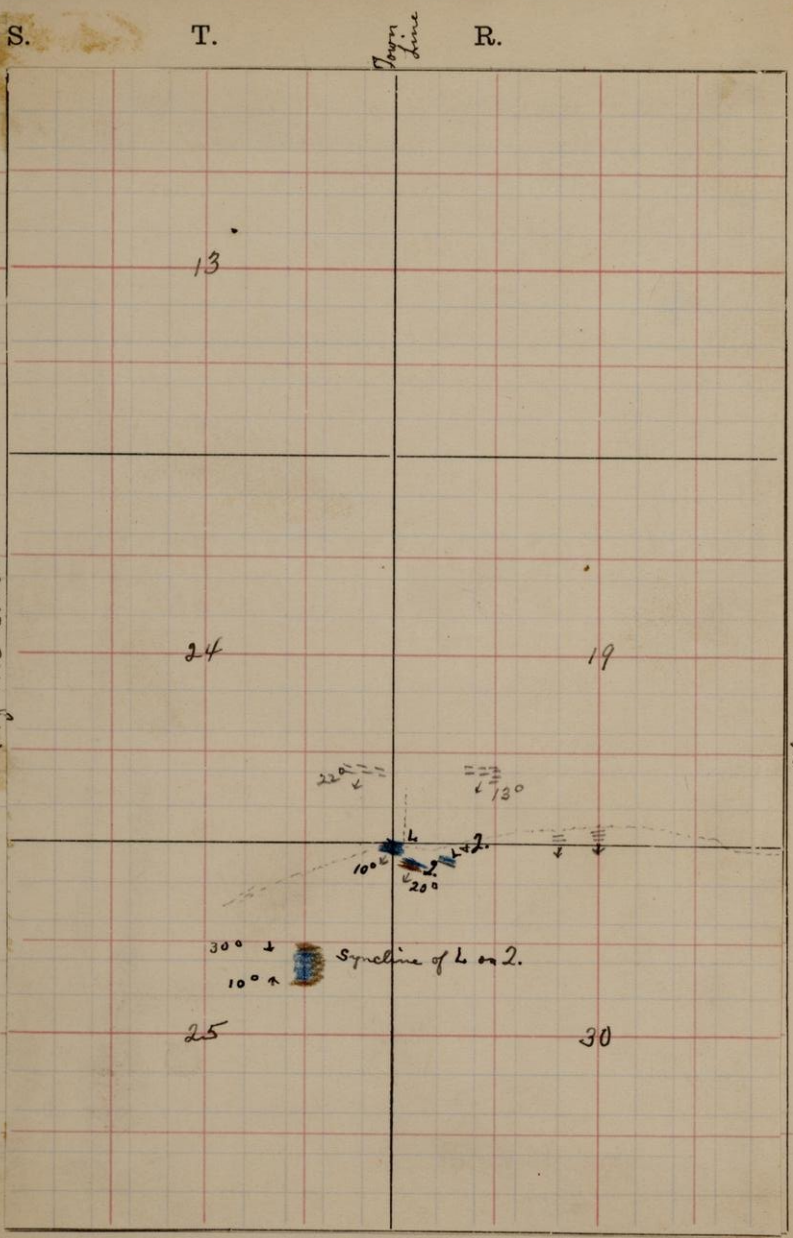
45872 Specimen of autoclastic limestone or of transformational conglomerate. From point on the east side of Echo lake.

45873 Specimen of fine-grained novaculitic rock associated with true limestone and evidently being a phase of the same formation.

45874 Specimen of limestone showing false slip. Collected by Van Hise from Limestone Point on the east side of Echo lake. This number is given also to several other specimens showing structural features collected by Van Hise.

45875-82 Specimens 45875 to 45882 from east shore of Echo lake.

45883-45925 Specimens 45883 to 45925 collected by Van Hise and Seaman.


S.
T.
Town line
R.
13
24
19
25
30
Town of McDonald.
Town of Meredith
22°
13°
10°
20°
30°
10°
Syncline of L on 2.

Bruce Mines Road.

Sept. 6th.

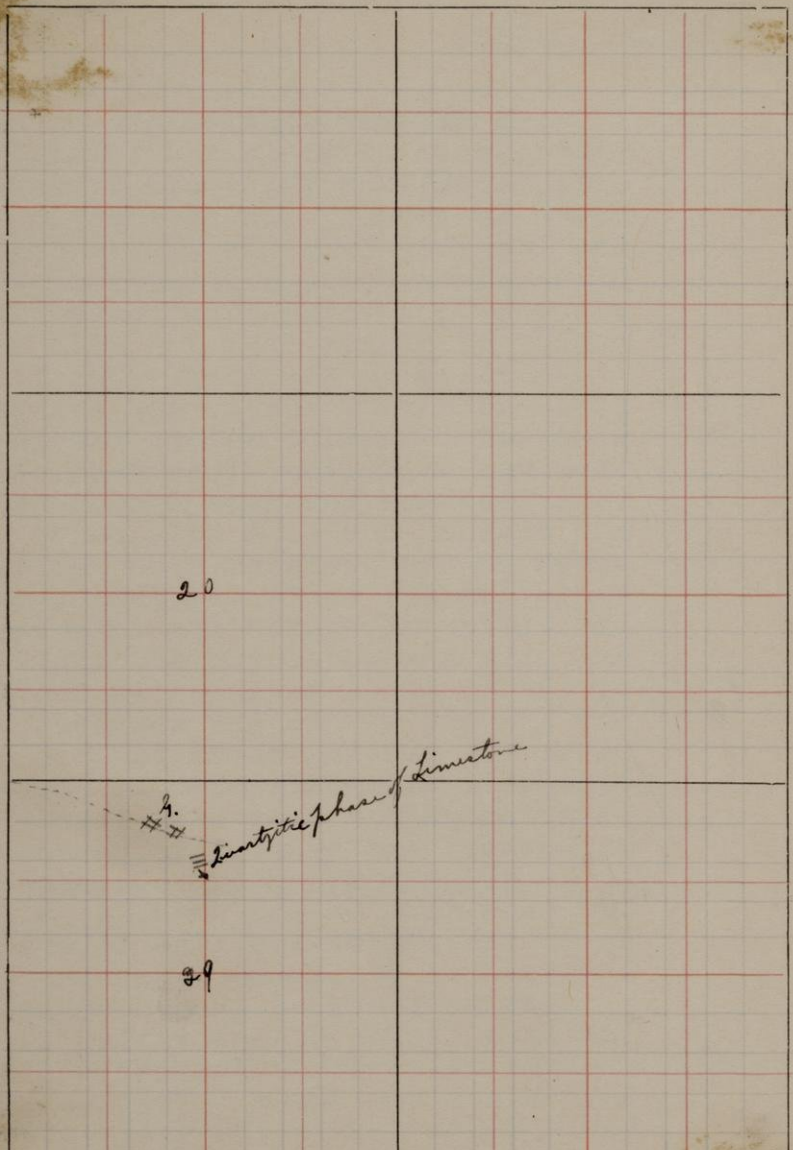
Leith.

With Hillyer started at the northeast corner of 15 in the township of McDonnalds on the upper limestone belts of Murray. In approaching the locality from the west along the Bruce mines road, exposures of white vitreous quartzite were passed at a number of places from 1/2 mile to 1 1/2 miles to the west. The lime-
45926- stone is a very cherty and quartzitic
45930 limestone, showing colors varying from red to yellow. The reddish varieties are the pure limestone and weather out to a dull rusty brown on the surface. The yellowish varieties are uniformly cherty and th the different phases are interbanded and give a good strike and dip. The strike is about northwest-southeast and the dip 10° to the southwest. Besides the banding there is also considerable variation along a given layer which may show both cherty, carbonate, and quartzitic phases.

In going south about 50 paces on the east side of the road, i. e., up in the succession, the layers are observed to become more quartzitic.

Just as the road goes down into the open fields of the valley the
45932 rock is feldspathic quartzite dipping 20° to the southwest. The quartzite has a white and yellow weathering

S. T. R.



due to the alteration of the feldspar. This grades so imperceptibly into the limestone that it is hard to tell what part of it does not actually belong with the limestone. Going southwest of the road about 100 steps another outcrop is found just on the south edge of the open field. This is a quartzitic phase of limestone and dips in the same direction.

Then went north along the road and across the open field to an outcrop seen across the valley on the east side of the road. The hill has an escarpment on the north and east sides as well as on the south side. Starting on the north side the lower part of the escarpment was found to be a loosely
45929 cemented quartzite, mainly red, but in places white. This quartzite is so coarse and loose that it resembles Cambrian sediments. Above this in the same ledge and apparently grading into it conformably is
45930 limestone showing red and banded phases similar to those seen on the hill to the south and for the most part showing quartzitic and cherty phases. Indeed most of it is apparently very cherty and quartzitic. The peculiarity of this limestone

is its banding and the absence of rough weathered surfaces just as on the ridge to the south, although in both ridges there are occasional layers which do weather out. Certain of the layers weather out in irregular areas as though pebbles or boulders of limestone had been weathered out. However, this is simply a matter of irregular gradation of the two.

The dip of the quartzite and of the limestone on the north side of the hill is south at about 30°. In going south across the hill the lime stone is found to become flat and on the south side of the hill to dip gently at 10° toward the north. Going down the north side of the hill quartzite was followed under the limestone, just as on the north side of the hill, hence it is clear that the limestone occurs in a syncline underlian by quartzite. The pitch of the syncline was not determined on account of rain.

In the afternoon visited the quartzite regions on the north side of the road near camp, i. e., both east and west of the road between the two towns and north of the corne of section 25. Both ridges are occupied by white vitreous quartzite lying in heavy beds dipping gently to the south and southwest at angles

varying from 10 to 25°. In addition the beds are cross-folded so that they show many minor rolls. About the axis of the hill the quartzite is very much brecciated and broken. All gradations may be seen from massive quartzite through quartzitic, joint and schistose structure and veins into a fine breccia which could scarcely be distinguished from a conglomerate. It is a note-worthy feature that where brecciated iron solutions have uniformly stained the cracks, thus in the breccias the fragments stand as white fragments in a red matrix and it looks almost as though another conglomerate were filling the cracks. A few layers of fine conglomerate were observed in the quartzite, especially on the hill west of the road. The pebbles were o: of vein quartz and jasper. In fact there can be no question from the aspect of these layers that the white quartzite is closely similar especially in its general lack of fragments t to the jasper conglomerate to the north.

On the east side of the road on the upper surface of the ledge there is a curious close and loosely-cem-
45931 ented quartzite with bands of white and red which very closely resemble the quartzite underlying the limestone seen on the ridge from which

45929 was taken.

On both hills the highest layers w were sighted upon and it was clear that the dip would carry them well under the limestone to the south.