Original Hur. [Huronian] II: [specimens] 45882-45892, 45933-45961. No. 373 1902

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

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U. S. GEOLOGICAL SURVEY

FIELD SECTION BOOK

9-891

LAKE SUPERIOR DIVISION.

INSTRUCTIONS.

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

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

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

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Notebook No. 373.

45882 - 45892
45933 - 45961

See Notebook 374

Bruce Mines Road.

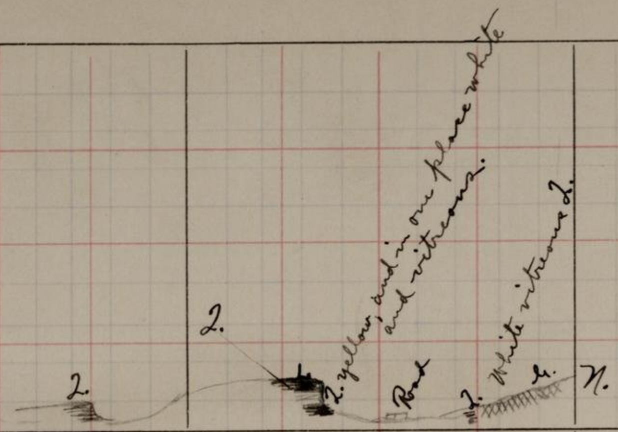
Sept. 6th.

Leith.

Worked west from camp along Bruce mines road. A little way west of camp the road crosses a ridge of white quartzite. The course of the road and the outcrops are marked upon the map.

At about 1 1/2 miles east numerous exposures of diorite appear on both sides of the road. We turned south toward a knob at about this point expecting to find limestone well to the south of us and were surprised to find it close to the road. It is the quartzitic phase of the limestone The limestone appears in layers, sh sheets, and lenses in fine quartzitic material, just as near camp. As we go down the north face of the hill the rock becomes more and more quartzitic and near the bottom is a reddish quartzite, more or less banded, and almost entirely lacking limestone. Both limestone and quartzite have an excellent banding of colors.

Just to the north across the road about 100 paces in the farmer's yard is a low outcrop of diorite, intrusive into the quartzite. However it is difficult to get strike and dip of the quartzite. However, the best place shows what was taken to be a gentle dip to the south. In another place the rock was evidently on



Blue square = 100 ft.

edge, due to the intrusion of greenstone. The quartzite and limestone were traced as far as the township line, where we found a large mass of greenstone. Then we went south from the road, i. e., a little west of the greenstone, across the open field. Here we found a white cherty graywacke and slate. This is yellowish-white on the weathered surface but on breaking open is found to be black slate and chert. The bedding is beautifully shown by difference in texture and color. There can be no question as to this being different from the quartzite to the north of the limestone, while the quartzite to the south probably underlies it. The relations of the three rocks in this place are shown by the cross section on the opposite map.

The limestone may be seen continuous for nearly a quarter of a mile on the northern escarpment of the ridge. It is mainly quartzitic but shows distinct limestone bands. The lower portion of the excarpment is a reddish and yellowish quartzite of very fine grain. At one place this quartzite was found to go down into a broken layer of white vitreous quartzite, while just across the road to the north the white vitreous quartzite appeared in a small ridge. This seemed to me conclusive proof ofthe conformable

succession of the three formations.
The strike of the upper quartzite was about N. 65° W. and the dip 10 to 12° to the S.
45933 Specimen showing banding.
Some ofthe material is much more black and cherty and some a trifle coarser, but this is a good average. A few bands take on a distinct reddish color giving them a conspicuous
45934 appearance on the weathered surface,
& showing characteristic light yellow a
45935 and less characteristic red quartzite phases.
Coming back north crossing the limestone, quartzite similar to that found to the south was found forming the capping of the hill and showing a complete gradation down into the quartzite, bearing stringers of limestone. The total thickness of the limestone, therefore, cannot be greater than 100 feet and probably is not greater than 50 or 75 feet.
Then crossed over to the upper quartzite and worked along the ridge to the northwest following this ridge When within about 3/4 of a mile of camp struck off north toward the road. In going northwest of the main road we strike the limestone in the low ground as we ought to.
Then went to the road and worked

back toward camp until we struck a ridge which crosses the road one-half mile east of the northeast corner of section 25. Here white quartzite comes almost down to the road. Then worked south up the hill and actually saw white quartzite grading into red quartzite and this in turn into finer grained red quartzite and this in tur: turn after about 25 feet whole bands and shots of limestone, the quartzite becoming finer and containing occasionally clear limestone bands, continuing for an indefinite distance, perhaps 75 feet. Then we strike normal upper slate and graywacke. It is not possible to say how thick the limestone is, for it is so indefinite in ch aracter. It grades into quartzite above and below and is itself mainly quartzite. In this place its thickness did not seem to be more than 50 feet and in one place not more than 25 feet. It is really but a calcareous gradation phase between the coarse white quartzite and the fine cherty slate and graywacke above.

In the afternoon worked south along the road south of the northeast corner of section 25. At the creek near the south section line "limestone", that is, limestone consisting mainly of quartzite, is found in the bottom of the creek under the bridge. The dip is low, about 8°, and a little east of north, about north 20° east. Then turned southeast along the road toward the mill. Several exposures of typical upper slate and graywacke with yellow weathering were seen with gentle dips in northerly direction, and a little distance to the east, about 1/4 mile, large ledges of the same material were seen with similar dip. The latter were not visited. Taking a boat at the mill we went down the shore of the second lake. The north shore is occupied mainly by intrusive diabase, but the south shore is occupied by normal upper slate and graywacke with yellowish weathering and dipping in northerly directions. Dips as high as 45° were seen and as low as 15°.

Returning toward camp we visited a synclinal of quartzite and limestone 500 steps southwest of the northeast corner of 25 to ascertain the pitch of the syncline. While the evidence is not conclusive, it looks as though the syncline pitched to the east. Working around the end of the ledge I was particularly struck with the beautiful false bedding shown by the quartzite beneath the limestone. Angles of 20°

were shown by the different massive layers. It was the most beautiful case of false bedding I have seen outside of the Dalles of the Wisconsin and even this was scarcely on a larger scale. The layers of quartzite are of various shades of red, yellow and white and the different colors make the beds very conspicuous The false bedding in one place looks like unconformity for the rocks on two sides of the plane are at different angles and of different colors, but examination shows no trace of conglomerate and no evidence of movement.

General.

In general during the past two days we have determined conclusively:

(1) That the white quartzite underlies conformably the so-called limestone.

(2) That the white quartzite contains jasper pebbles in places, making it probable that it is closely associated with jasper conglomerate.

(3) The gradation upward into the limestone is by change of color of the quartzite almost entirely with increased content of iron and calcareous material.

(4) The limestone itself is a rock consisting mainly of quartzite but containing layers, lenses, and shots of carbonate, which weathers to a rusty brown and contains also chert.

(5) The limestone becomes finer-grained above and the coarse quartzite gives way to a finer one.

(6) Above it grades into beautifully banded slate and graywacke and chert, the characteristic color of which is yellow, but which contains also reddish bands. In this rock, as well as in several layers of quartzite associated with the limestone, the most beautiful ripple marks and false bedding are to be observed, as well as ordinary bedding. These features are exceedingly conspicuous, in this

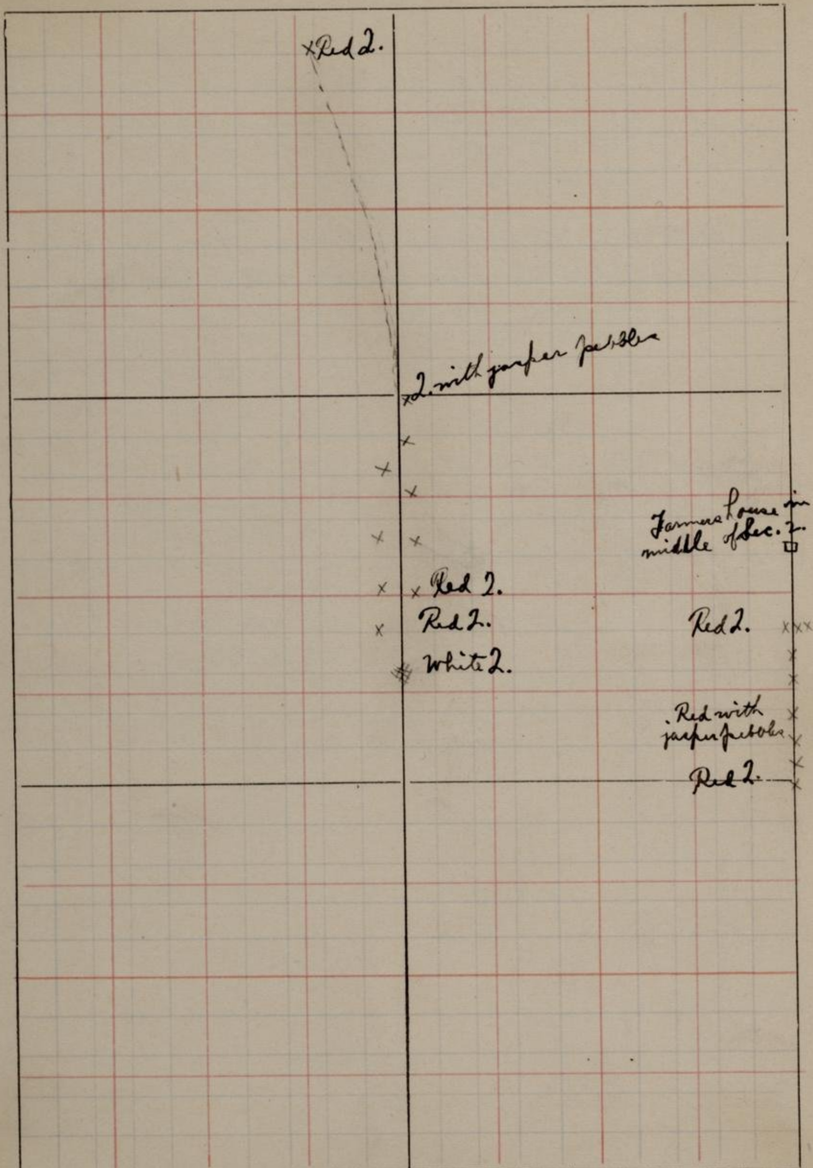
differing from the white quartzite, although this also shows bedding by the way it lies in the layers and by occasional coarser bands of conglomerate. The thickness is greater than 400 feet and probably considerable greater, although the entire section was not crossed.

(7) The thickness of the limestone including the gradation phases both above and below does not exceed 100 . feet and is certainly in some cases not as much as 50 feet.

(8) No traces of limestone were found in the upper formation. In two places, south and southwest of the northeast corner of 25, limestone associated with quartzite was found in the area mapped as upper quartzite by Murray and Logan, but in both of these cases it seemed to me that the limestone was identical with that underlying the series and their appearance in these places explained merely by this being the end of a basin, the pitch being apparently in an eastern direction, thus allowing exposure of the lower members at this place. In the area southwest of the corner of 25 the limestone is not only the same, but the gradation phase into coarse quartzite below and fine graywacke above are the same as the typical limestone mapped as such by Murray and Logan.

(9) The structure of the basin is essentially synclinal as mapped by Murray and Logan and all the dips observed on the north side of the basin were flat to the south, while all observed on the trip to the south side of the basin were flat to the north. On the south side of the basin the upper material was crossed for a distance of perhaps 300 steps, while on the south it was crossed for a greater distance. The only change required in the map would be the mapping of the upper series as a well-defined yellow slate and graywacke unit with beautiful marks of sedimentation under vigorous currents and quite independent of the peculiar limestone phases associated with the fine and coarse quartzite which really belong to the lower and appear as they do by synclinal folds.

S. T. R.



Red 2.
2. with jasper pebbles
Farmers house in middle of Sec. 2.
Red 2.
Red 2.
Red 2.
White 2.
Red with jasper pebbles
Red 2.

Bruce Mines Road.

Sept. 8th.

Leith.

worked north along the road from th the northeast corner of 25.

The old road follows a fairly s straight course for a mile north and then is nothing but a trail along an old log road. It swings about gradually and so our locations are only approximate.

In going north, white quartzite and red jasper conglomerate are found at the places marked. These have no unusual features until we reach a point we supposed to be near the east quarter post of 12, when the red jasper conglomerate takes on a reddish appearance throughout, i. e., while it contains red jasper fragments, the matrix itself is not white but is also reddish. The rocks show considerable brecciation in places and cementation of vein quartz. The dip as shown by the heavy layers is apparently gentle in southerly directions. The pebbles consist of vein quartz and chert showing various colors from red to black and occasional pebbles of what look like granite.

In working north and west frequent exposure of this material was seen for a considerable distance, as shown on the map. When it gave way to a coarse red and purple quartzite which continued to the great escarpment overlying the valley near the center of section 2. On the north side of the valley as well as on the big knob to the northeast the diorite forms the great ridge on the south shore of Echo lake.

Striking the main road on the north line of section 2 we worked west. At the place indicated on the map, about 300 paces east of the northwest corner of 2, we struck a fine
45936 band of yellowish and grayish graywacke and slate with bedding well marked, and dipping 70° to the south and striking east and west. It is well within the area marked as slate conglomerate by Murray and Logan.

Sudbury District.

Sept. 8th.

Van Hise-Seaman. Notes by Van Hise.

With Seaman most of the day. See his notes. But made section along Railway from about 1/2 mile above Onaping to sand plain about 1 mile below Onaping. Was in granite (really diorite) for some distance south of Onaping. Then came a break of 200 steps and then the breccia or conglomerate. This very coarse in places contining fragments up to 2 feet or more in diameter. The coarse phases found first, and upon the whole became finer-grained as went south. In places has a slightly sedimentary appearance as if arranged by water. Most remarkable characteristic is the great variety of fragments contained, various kinds of granite, quartzite of various kinds, chert of various kinds, greenstones and slaty and schistose rocks of various kinds, etc. This combined with the fact that nowhere in the basin of Bell's Cambrian ? sediments are any instances found except the latest columnar dolerite dikes, making certain the slate graywacke-breccia series the latest in the district.

45883 45883. Characteristic specimen of the fine breccia.

45884 45884. Same containing quartz fragments.

45885 45885. Same showing various granites.

45886 45886. From pebble and boulder of conglomerate and breccia.

The well-rounded character of the granites, quartzites, and cherts as pebbles and boulders in the breccia is certain evidence of the water rolled character of these materials, although mixed with much volcanic material. The breccia 45883 also apparently contains sedimentary material in the matrix.

Seaman.

Sudbury, Sept. 9th.

45887 45887. Much granitized and dioritized quartzite from Wahnapitae.

45888 45888. Quartzite strongly pegmatized but no so much as is 45887.

45889 45889. Quartzite less strongly dioritized and pegmatized. Here one side is plainly quartzite; the other like gneiss. Above south of the river.

45890 45890. Most granitized quartzite north of the river.

45891 45891. Normal phase of quartzite at this point making up the main mass of the ledges.

45892 45892. Garnetiferous diorite in broad band injecting the quartzite and both injected by red granite. from 45887-92 from Wahnapitae.

At Wahnapitae saw one of the best cases of complex intrusion yet seen by me between the Huronian and the diorite and granite. The quartzite is cut in most intricate way by diorite. This in many places given parallel injection. Also great lentils of quartzite included in the diorite. Practically every gradation between quartzite and diorite. Then both intruded and pegmatized by red granite. Then followed injection, often parallel. The schistose diorite is plentiful. The granite going parallel to this gives most wonderful injection gneiss plicated and contorted. The quartzite shows cyanite as where injected at the Pike's Peak district. The diorite is full of garnet. Here specimens can be found which show any gradation between diorite and quartzite and again any gradation between any phase of the above and the granite. Not surprising that such complex injection areas should be described as Laurnetian; and believed that all Laurentian younger than the quartzite. But the same mistake might easily be made made in reference to the Pike's Peak area or any others. But Wahnapitae case perhaps as fine an illustration of injection gneiss as any I have seen because of the three elements.

On returning to Sudbury about 1/2 mile before getting to town find breccia exactly like the breccia of Onaping plentiful over the quartzite, the latter with perfectly definite banding, the breccia perfectly massive, and containing fragments of granite, of quartzite, etc. In short absolutely like the Onaping breccia and like it, almost certainly much later than the quartzite. The breccia is in joints and in the quartzite and same might be interpreted as dipping under. But the difference in structure of the two, the fact that the breccia contains fragments of quartzite, is almost certain evidence of the really more recent age of the latter.

It is probable enough that the peculiar tuffaceous quartzite of Sudbury belongs to the older series but this altogether different from the breccia.

The late breccia and the Chelmsford-Lachmond Basin are of the same age, and both probably younger than both the quartzite series of the original district.

Onaping.

Van Hise-Seaman. Notes by Van Hise.

Southwest of Onaping a broad belt of reddish dioritic rock resembling granite was crossed for 1/2 mile, then followed a porphyritic rock of varying width, being 100 paces wide and 200 paces broad where crossed. Resting unconformably upon this is a conglomerate, containing fragments of several kinds of granite, and many boulders of quartzite, chert, etc. To the southeast this conglomerate seems to pass into a pyroclastic which also contains boulders of various granites as well as fragments of quartzite and other clastics. In places below the conglomerate (or apparently so) a white quartzite was found adhering as a thin band, to the granite, and this same rock is found as pebbles in the conglomerate.

45882 45882 is the conglomerate.

Sudbury, Sept. 10th.

Van Hise-Seaman. Notes by Van Hise.

Southeast of Sudbury a tuff conglomerate can be seen in a belt overlying the quartzite of the main Sudbury area. These are best exposed along the north side of Lake Ramsey and along the railroad track about 1 1/2 miles east of town. Here at various places the thin conglomerate can be seen to lie across the eroded ends and edges of quartzite band-schist series. Pebbles of underlying clastics are found in great profusion as are also boulders of various kinds of volcanic and basic eruptives. The conglomerate is cut by olivine diabase in numerous narrow dikes and larger masses. Nine dikes were counted in 60 feet varying from a few inches to 50 feet. The norite is probably also later than the conglomerate, but the relations were not definitely determined.

Went back in the afternoon and found where the diorites cut the lower quartzite series. The overlying conglomerate here contains many fragments of diorite as well as of quartzite. In other words, in close proximity to these dikes there is a great profusion of boulders. This is probably what has led the Canadian geologists to suppose that it was a breccia altogether.

The great width of quartzite is only apparent, and is due to repetition by folding. The reason for the Canadians putting the norite as lower is that they could find no pebbles of norite in the conglomerate.

Copper ~~Cliff~~:

Copper Cliff.

Van Hise-Seaman. Notes by Van Hise.

The coarse graywacke phase has two principal sets of joints, one about parallel and the other perpendicular to the strike; in other words about parallel and perpendicular to the great intrusive mass to the south. When the slate beds are encountered the joints stop.

45883 45883, andalusite mica-schist, about 1 1/2 miles south of Copper Cliff, showing bedding.

45884 45884 is quartzite showing quartz veins and this is taken near Lake Ramsey southeast of Sudbury.

45885 45885, diabase from a large irregular mass near the road about 1 1/2 miles east of Sudbury on the road to Wahnapitae.

45886 45886, quartzite from near Copper Cliff.

See p. 68.

Copper Cliff.

Van Hise. Barlow. Seaman. Sept. 10th.
Notes by Van Hise.

With Barlow and Seaman visited localities in the vicinity of Copper Cliff mine. The norite with the nickel-copper veins was first examined. In general the ore deposits are along the border of the norite rock which is very easy to recognize from its brown weathering and irregular pock-marked appearance. This is due to the weathering out of the sulphides. The larger masses of norite which do not contain much sulphide do not exhibit this peculiar weathering. The ore has been described as a case of magmatic segregation. The evidence for this is that in the norite the sulphides were irregularly distributed like original constituents. The variety of material is further represented
45940 by 45940. However, this is by far richer than the average of the norite The rich ore is plainly along lines of fracture and secondary segregation by circulating underground water.
45941 45941 represents this phase of the material from a vein 5 or 6 feet in width composed of nearly pure sulphide.

For my own part I have no doubt that all of the material which is rich enough to be mined, indeed, even

the part represented by 45940, has undergone secondary concentration by circulating water. Evidence of this is found in the altered character of the r ock and the appearance of secondary quartz. While it is entirely possible that a magmatic concentration has taken place along the border of the norite area and thus produced a subordinate first enrichment, the ore deposits now worked and even the rocks which are thrown away, such as are represented by 45940, have undergone a secondary concentration by percolating water. The facts are very
45942 nicely indicated by 45942, which represents a piece of the rock along the joint. Near the joint, which was filled with ore, the sulphides are abundant and in passing away from the joint the sulphides become less and less abundant until at a distance of 4 inches from the joint filled with sulphide the amount of this material is not 1/5 or 1/6 as great as that near the joint. I called Barlow's attention to this as proving the secondary concentration and he said this was a common fact, but apparently had not given it this interpretation.

The order of succession as near as could be made out from our hasty observations, from what Barlow showed us, and the observations of the previous days in the vicinity of Copper Cliff and Murray mines is:

(1) Quartzite, including both normal and tuffaceous forms. Barlow says the tuffaceous varieties are below the massive quartzite ane he showed us the relation at one locality.

(2) Schistose diorite which is well banded and locally granitized.

(3) Gray granite.

(4) Norite.

(5) Red granite.

In places the pegmatization and intrusion of the gray granite has given it a reddish color and this had led to the conclusion on the prt of Barlow that the granite both intruded and was intruded by the norite.

45943 45943 represents the dioritic schists.

45944 45944, gray granite.

Because of intrusion the quartzite
45945 has been very profoundly metamorphosed adjacent to the norite; indeed so much altered is it that it becomes a gray granular rock with scarcely a trace of clastic texture.

The much metamorphosed quartzite rather commonly grades into a quartzite showing clastic texture, but still much altered. Finely banded tuffs have become metamorphosed into
45946 the micaceous schistose quartzite. From a locality where same dips under massive quartzite.

Sudbury to Thessalon.

On our way up to Sudbury I made rough observations as to the relations of the rocks along the railway, but as I did not know the facts at Sudbury I could not make out the succession, but returning the story seemed reasonably clear at least as to the main elements.

On returning from Sudbury the steeply dipping well-banded quartzite so characteristic of the Sudbury district continued along the railway as the dominant rock to Cutler, 77 miles from Sudbury. This rock is interbedded at various places with bands of a dark colored greenish rocks which I have no doubt, from the many places we saw it in the Sudbury district, to be a dioritic schist or diorite. Shortly after passing Cutler the diorite appeared in great force, but it is here cut by red granite. What was taken to be the dioritic schist with red granite continues from just beyond Cutler to within about a mile of Algoma -- about 18 miles. For this distance the ~~gree~~ green massive schistose rock is predominant; indeed many ridges show nothing but this, but interspersed with it is the coarse red granite, but this is purely subordinate along the line of the railway. After having seen this dioritic schist cut by granite at Wahnapitae and Sudbury I have little

I have little doubt that both the dioritic schist and red granite are intrusive in the Sudbury quartzite series in the order given.

Just before coming into Algoma on the river, the steeply dipping quartzites are seen. They are well exposed at Algoma, were noted in the town at our stop there over night, and continued to a little beyond Blind river, a distance of 7 or 8 miles. Almost the first exposures seen after leaving Blind river were the green massive and schistose rocks which are believed to be hornblende schist and diorite, so abundant in the region, but almost immediately there appears much granite and for most of the distance from Blind river the Dayton the granite is dominant and the dioritic schist the subordinate rock. This is evidenced not only the the exposures, which are typical red, but also by the topography. Instead of the numerous bold high exposures so chara cteristic of the dioritic schist we have a low swampy country out of which here and there stick the granite masses, typical granitic topography for the Lake Superior region.

Then the granite is dominant for about 19 miles, but at Dayton the hornblende rock appears again in which no greenstone was seen, and no greenstone was seen from that point to Thessalon, the only rocks seen for these 12 miles being the dark green rocks which were supposed to be the dioritic schists, but which of course might have other varieties of rocks within them.

Thessalon.

Leith. Sept. 10th.

With Hillyer started north of Thessalon where the road running north from Little Rapids crosses the Bruce mines road. First examined the knob north of the camp and found the same coarse diorite with considerable pink feldspar, making it look granitic in places.

Then worked west along the Bruce mines road which approximately follows the township line, although it first swings somewhat south. About 1 1/4 miles west, i. e., along the southward continuation of the western township line of Kirkwood we struck a road running north and south. In coming west red quartzite may be observed forming the ridge on the north running parallel to the road. The quartzite lies in heavy massive layers showing bedding, striking diagonally to the road about north 60° west and they dip to the southwest at angles varying but little from 15°. At the north and south road referred to we went up onto the ridge and there found quartzite grading into typical jasper conglomerate which comes in south of the red quartzite. The diagonal feathering out of the formations, due to their strike, explains their coming in.

Then examined the little wood-covered hill about 500 steps south-west of the intersection of these two roads and found the knoll to show several low moss-covered ridges
45937 of limestone which appear near its edges. The exposures were so poor and and small that we could not get satisfactory strikes and dips, but from the chert ridges on the weathered surface we supposed the strike to be about north 45° west, and the dip nearly vertical. Then went south along the road for 3/4 of a mile from the corner and examined the knoll there standing and found same to be diorite. No other exposures could be seen for a considerable distance.

Then went on the main road and went west. The quartzite may be seen forming the ridge to the north and always shows the same strike and dip. As we were going diagonally across the strike higher and higher members come in. The jasper conglomererate continues. We did not go up on the hill but it was apparent from the road that the jasper conglomerate continued for a considerable distance. In places it becomes interstratified with reddish layers consisting of red quartzite or of red quartzite containing jasper pebbles. We supposed the latter.

At about 400 paces east of the bridge where the road crosses the Thessalon river the true white quartz ite comes in. some of the lighter la layers seen with the reddish layers just to the east may also have been this quartzite, but these were not examined. (Later I examined these and found them to be a red acid intrusive granite in part, and in part red conglomerate). There can be so little question as to the general nature of the succession that it was not thought worth while to cli climb the hills to the east to see just what phases are shown there. The strike was still as above.

Then went on to the bridge and on the south side of the creek just east of the bridge may be seen limestone intruded by greenstone. The limestone is somewhat contorted, but in general strikes about north 80° west and stands almost vertical. The weathering is to a dull dirty brown as usual. On the top of the hill just to the southeast may be seen more of the diorite and with this a small patch of dirty brown weathering limestone. The limestone in gen-
45938 eral is pure as shown by 45938. The chert layers are not numerous or conspicuous. The exposed width here did not exceed 50 feet. The nearest

quartzite is 300 steps to the north. It is a white quartzite with normal strike and dip for this ridge.

Then went west of the bridge and examined the hills both north and south of the road for a distance of about 3/4 of a mile from the bridg Found nothing but coarse diorite. At the westernmost point, however, we found numerous boulders of slate conglomerate.

Then we returned east of the bridge and went out into the open field about 1/2 mile east of the bridge and 300 steps south of the road where a low flat-topped hill with sharp flanks appears. On the east side of this hill was an excellent exposure of typical cherty limestone with strike varying from north 60° west to north and south, the dip being about 60° to the southwest. Beautiful autoclastic or interformational conglomerate could here be seen on the westhered surface. The nearest quartzite is both red and white quartzite about 500 steps or more to the north. The latter has th usual strike and dips about north 60° west. The dip is 18 to 20° and the strike north 75° west. However, it extends farther to the west and the strike of the limestone would carry it against the quartzite as may be seen by sighting along the limestone layers. This, however, may be but a local bend and I place more reliance on the general distribution discussed on the following page.

In general the limestone seen dur during the day is unquestionably similar lithologically to the lower limestone as shown at Garden River and Echo Lake. It is quite different from the upper limestone. The three knobs found would carry the limestone well across the strike of the red quartzite, the red jasper conglomerate, and the white quartzite, but in each case with 500 to 700 paces intervening. In other words, the limestone crosses the strike diagonally of these three formations. This is just the opposite of what we are supposed to find to the west where the red quartzite is supposed to cross the strike of the lower formations. However, if this is an unconformity, we might just as well have the one or the other. In the one case it means overlap and in the other unconformity.

Thessalon.

Sept. 11th.

Leith.

Went 2 1/2 miles east of camp along the Bruce mines road and then went so south and west along the road as indicated on the map. See results on map. At ..... is a grayish conglomerate with light gray weathered surface. It looks like a conglomerate, but on close examination it is to be noted that the pebbles are nearly of the same material, i. e., a dense, greenish aphinitic substance which is probably basalt, showing a few porphyritic crystals of hornblende (?) and having been weathered out on the weathered surface. Some of them do not show phenocrysts, others show amygdaloidal cavities filled with quartz, and others such cavities which have been again weathered out. The fragments are fairly angular, though some of them are well rounded. The ledge is closely associated with massive fine-grained basalt so I think it is essentially eruptive. The matrix is of the same dense aphinitic material. A few steps farther on the more massive and fine-grained material contains occasional pebbles of fine quartz an inch or more in diameter. On close examination these are believed to be the replacement of tuffaceous fragments or fillings in cavities. On the same ledge unquestioable evidence of spheroidal parting is to be observed. Scoriaceous and amygdaloidal texture in the spheroid is well shown.

Working along the road westward on the ridge north of the road about 1/2 mile west we find white quartzite at several points. The strike and dip of the quartzite are marked on the map. This quartzite is white and shows excellent banding. Examined with a lens it is seen to consist of very well-rounded grains. In the open field to the east of the farm hous is an exposure of white quartzite on the south side of a little diorite knob, and just to the north of it and in contact with it a narrow belt of slate conglomerate, perhaps 3 or 4 steps wide, containing undoubted fragments of quartzite. The main mass of the hill to the north as seen on the drive in the afternoon, is diorite. In working into camp saw nothing more.

In the afternoon drove along the lines marked by red on the map and found mainly diorite. However, west of Little Rapids on the south side of the diorite ridge found quartzite with low dip to the north. This is white quartzite. The quartzite ledges at Little Rapids and on the road just north of Thessalon are described by Van Hise.

Thessalon.

Van Hise-Leith. Sept. 11th.
Notes by Van Hise.

From camp went east along the Bruce mines road for a distance of 2 1/2 miles. From the point where we left Leith we went northeast about 1/2 mile where we found a ridge of coarse
45947 red syenite or diorite, 45947, doubtless called syenite by the Logan survey from the fact that it weathers red and has a different appearance from the green diorite. This belt we followed in a northwesterly direction (for perhaps 1/3 of a mile) and saw it continue for some distance further. We then cut diagonally to the northwest to the road on which we found massive diorite ridges at various points until we got about 1/2 a mile west of the southwest point of Lake Wahbiquekobing. Here we found slate conglomerate in a broad belt with numerous exposures for 1/4 of a mile or more. This conglomerate has a great variety of granite pebbles, contains what we took to be novaculite or quartzite pebbles, showed large fragments of what we supposed was the red syenite or diorite first struck, but this was not certainly determined, and pebbles of other kinds. The strike of the conglomerate at one place was north 70° west and the the dip 18° south. The pebbles and

boulders of this diorite vary from very small ones to one 6 feet in diameter. On a crest of the ridge another mass of similar granite was seen which was 15 feet across and a little ways from this another area of granite was seen about 30 feet long and 8 or 10 feet wide, narrowing to a point at one end. It seems to me that these very large areas are not boulders but are the beginning of the granite upon which the slate conglomerate was deposited, showing at the surface at the present stage of erosion.

45948 45948 represents the finer phase of the conglomerate showing two kinds of granite and one pebble which was supposed to be quartzite or novaculite.

The conglomerate is cut by fine-grained granite parallel to the bedding. As the south slope of the granite corresponds with the bedding and these little dikes were fractured diagonally in many places they presented a most curious irregular appearance, on the surface appearing to be like great boulders with irregular fragments running in and out in the most curious way, but when they were found as injections parallel to the bedding the distribution was explained.

45949 45949 represents one of the fine-grained granite dikes.

We now continued in a northeasterly course along the road to the east of a small lake but found nothing but diorite. We then returned across the conglomerate belt and went in a general westerly course until we reached a large ridge of diorite. This ridge has a steep northern escarpment and a gentle southerly slope. At the base of the northern escarpment was exposed 8 or 10 feet of black carbon-
45950 aceous slate, 45950, showing a beautiful banding and having a strike of north 70° west and a dip of 6° to the south.

We then went in a course southeasterly to the bend of the river where there is a logging dam. Here found the diorite cut by red granite. Following this diorite ridge west of the river large masses of red granites come into contact with it and cut it in the most intricate fashion. The diorite for some distance about the granite masses is filled by red feldspar. All of the diorite seen during the day is of the dark green massive kind, having no schistose structure and therefore of entirely different aspect from the schistose diorite of the Sudbury district.

We now continued northwest for some distance and just south of Thes-

salong river (little branch) found a
blet of red quartzite. This quartzite
ridge was followed for 1/3 mile along
the river. It was difficult to get
the strike but it was thought that the
strike of the ridge corresponded ap-
proximately with that of the rock
and this was found to be north 50°
west. The dip was determined at one
place to be 8° south. This quartzite
is peculiar in that it contains red
45951 feldspar, 45951, so abundantly that
upon the weathered surface it resembles
granite. Indeed, in places it was
hard for me to make myself believe
that it was quartzite until I exam-
ined same with a lens. However, its
structure and general appearance were
that of quartzite so that I presumed
the ledge to be red quartzite 1/2 mile
before I reached it. The rock differs
markedly from the red quartzite near
camp in that it has no conglomeratic
bands and is very massive and in it it
is very hard to determine the true
strike and dip. The abundance of red
feldspar can readily be explained by
the supposition that it being near the
base of the formation had a more a-
bundant supply of granitic debris.

We now went south by west to the
quartzite examined by Leith on the
previous day. Here the quartzite was
found to outcrop as far north as the

south side of a little creek where it was found to strike north 70° west and to dip 20° to the south.

We then went over the quartzite ledges to the south continuously to the place where examined by Leith.

Thessalon.

Sept. 12th.

Van Hise-Leith. Notes by Van Hise.

Strike of conglomerate north 40° east, dip 40° to 50° northwest. Dip of quartzite on the next knob to the west 6° to the northwest, strike north 50° west. This is at the last point to the west before the greenstone comes in. From the base of the conglomerate to the top of the gray quartzite is about 1/4 mile.

We visited localities to the east of Thessalon where the contact is found between conglomerate of the Huronian and the more ancient gneisses and granites. All the observations of previous years were completely confirmed. The ledge in which the granite grades apparently into the conglomerate was very well seen. This apparent gradation I have explained as due to the breaking up of the ledge, some of the fragments of which have moved but slightly, others more, and others still more, until within a few feet the detached fragments have been worn and we have a conglomerate, the boulders of which are dominatly like the underlying granite, and the matrix of which is graywacke. This was the island where the contact was first seen by Irving.

The island where the contact is exposed between the conglomerate and

the ancient schists injected by gran-
45952 ite, 45952, first described by Pumpelly and myself, was again visited, but no new facts of consequence were noted. The strike of the conglomerat is north 40° east, dip 40 to 50° northwest.

On the third island to the south of the island where Irving saw the contact there are phenomena which are the same as those on the island found by Pumpelly and myself, only that the relations, instead of being clear, are obscure. Here the granite injects the ancient schists producing an eruptive breccia, then there are 2 or 3 feet without exposure, and beyond this the ledge seems to have been simply broken up by the wave action, as is the case in the island discovered by Irving, and this broken up ledge passes into the true conglomerate. The facts here here, therefore, combine in general the facts of both of the islands previously described showing both intrsive phenomena and the gradation between the broken ledge and the conglomerate. If this island were the only one in which the relations could be observed, there might be some possible excuse for interpreting the entire conglomerate as eruptive conglomerate, provided the person did not ask himself the question as to how a conglomerate having well-worn boulders of subjacent rocks in a fine-grained clastic matrix can be produced by igneous action.

We found on the northwest side of the big conglomerate island, which is northwest of the third island above mentioned, that the rock is a gray quartzite interbanded with conglomerate, and on the next point along the coast to the west we found normal
45953 gray quartzite. The strike is north 50° west and the dip is 6° to the northwest.

In previous years I had noted that the dense fresh diabasic rock intersected the conglomerate on the big conglomerate island. We today found similar material cutting the gray quartzite also, and then beyond the
45954 gray quartzite (45954),which dipped toward the next point,we found today
45955 the same dense greenstone. (45955).

On our return to Thessalon we saw the amygdaloidal textures which had been noted before and also the ellipsoidal structures which Leith had seen in the continuation of this belt inland. These greenstones were too dense to get strike and dip, but the abundance of the amygdaloidal texture made one think it probable that a large part of this broad area is probably composed of thick diabasic flows.

It is not impossible that close observation might reveal little bands of clastic material between them. After leaving the quartzite these greenstones continue all the way to Thessalon, a distance of more than 6 miles, and on the road from Thessalon north for fully a mile. After the last ledge of these rocks was passed we found on the road going north quartzite with strike and dip roughly the same as that of the conglomerate and gray quartzite bands along the coast and conformable to the upper belt of Logan's shloritic schist. After we found the quartzite we found intrusive into the quartzite coarse-grained diorite, but after the quartzite we found no more of the dense fine-grained amygdaloidal looking material which was seen on the road passing north, although Leith found the continuation of the same belt at a point north and northeast of us. This suggests very strongly that the Huronian for the day's succession is

(1) conglomerate.

(2) Gray quartzite, into which the conglomerate grades.

(3) Volcanics, and

(4) Quartzites in normal succession, all of which are, of course, cut by the later diabase and diorite dikes.

After having found the quartzite with low dips and unquestionable character as shown by ripple marks, we passed an interval of 1 1/2 miles with no quartzite exposures, but with diorite. We then came to the quartzite and diorite ledge at Little Rapids. Here to the west Leith had found the quartzite with a low dip on the south side of the diorite and on the north side of the diorite ridge had found steep dips. These observations were confirmed, the dips being found to be 55° to vertical and dips of 80° to the south were seen as marked by conglomerate bands immediately under the bridge at Little Rapids. pebbles up to one and two inches are very common. The quartzite here shows conglomeratic bands, the pebbles of which are mainly composed of ferruginous chert, banded hematite material, and subordinately of red jasper. However, the little characteristic narrow bnads of conglomerate interstratified with the granular quartzite are identical in structure with the kinds of banding which the quartzites and conglomerates show on the next ridge to the north described by Leith.

The facts seen during the day, combined with the succession which Hillyer and I worked out the previous day and the facts of distribution of the various quartzites worked out by Leith west of camp, all suggest that the east end of the Huronian belt mapped in detail by Logan is a westward plunging synclinal opening out to the west, the succession on both sides being substantially the same. The only important point of difference is that the volcanic material so strongly developed along the coast, was not noticed on the north run, but it may exist, as at that time no attention was paid to discriminating the volcanic material and the massive diorite. However I feel certain that the larger portion of the igneous material seen on our trip of the previous day was intrusive diorite rather than volcanic material. This statement does not take into consideration the facts with reference to the limestone, the localities of which I have not yet seen and which might modify the conclusion.

At Little Rapids the strike of the conglomerate is north 80° west and the dip 50 to 78° to the north.

Thessalon.

Sept. 13th.

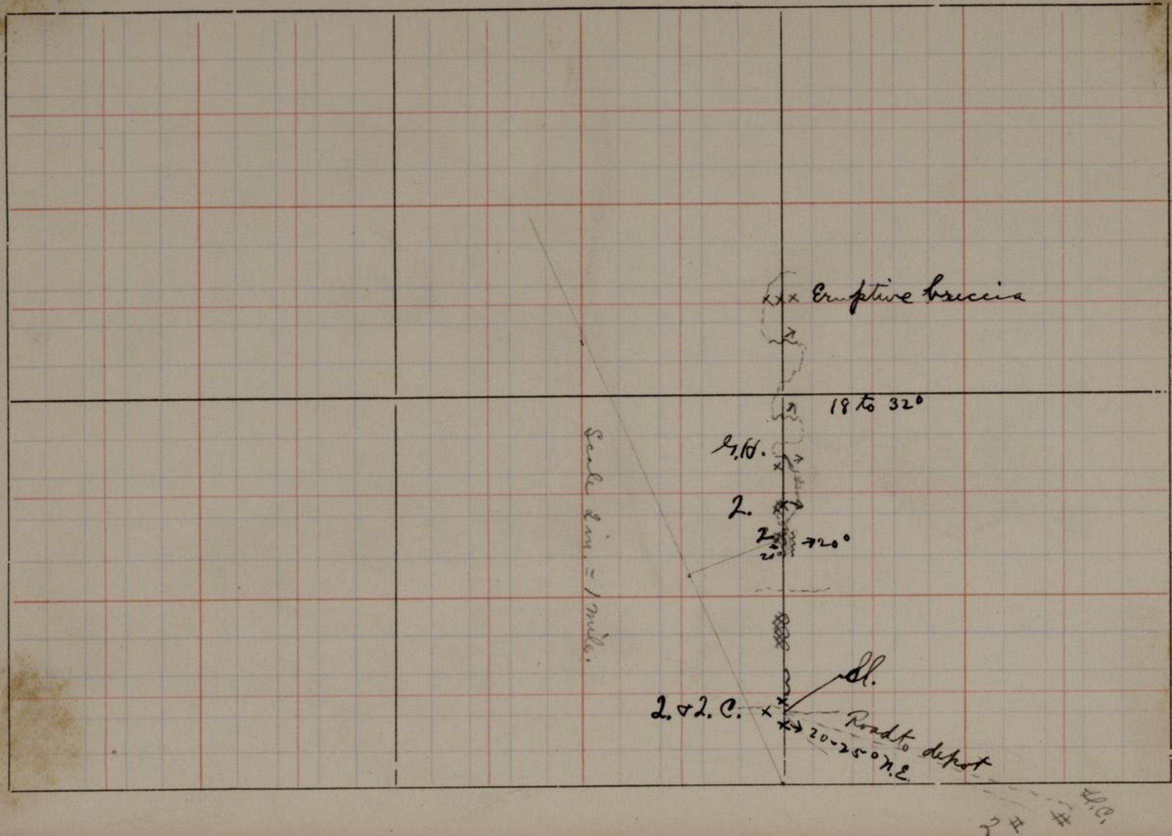
Van Hise-Leith. Notes by Leith.

With Van Hise and Hillyer went west along the Bruce mines road to the Thessalon river again and examined the limestone outcrops there. Went across the bridge and south onto the diorite ridge. The only new points are the finding by Hillyer of limestone on the north side of the Thessalon river near the bridge, thus adding considerably to the width of the limestone. It is difficult to judge of the thickness because of intrusives but in the open field we must have 100 feet and in the river bottom somewhat more than this, possibly 200 feet.

North of a little opposite of the limestone in the field again exam-
45956 ined the red granite, 45956. Van Hise was struck with the fact that the granite is similar to the red granite found cutting almost everything else in the Lake Superior country. It cuts both the quartzite and diorite. The quartzite is very much metamorphosed, and the structure is still in doubt. Van Hise arrives at the conclusion that we have either a fault or the material is upper. He noted that fact of the occurrence of the yellow cherty material which he thinks characteristic of the upper. On

the whole, however, he thinks the roc rocks have the same characteristics as the yellow limestone just as we do.

6—747


Eruptive breccia
18 to 32°
G.H.
2.
2
20°
21°
Scale 2 in. = 1 mile.
Sl.
2. & 2. C.
Road to depot
20-25° N.E.

S.

T.

R.

Bruce Mines. Sept. 15th.
Leith.

Reached Bruce mines at noon and in the afternoon went with Hillyer to the northwest. We crossed several exposures of coarse diorite until we reached a point a little north and west of the shaft house (see map), where may be seen a low north-south ridge with low eastward facing escarpment of limestone, with chert bands and autoclastic phases and weathering characteristic of the low limestone. The limestone is dipping in general in a direction a little east of north at angles varying from 18 to 25°. It is folded in a minor way so that it really consists of a series of rolls pitching in this direction.

Running about 100 steps west we came against a ledge of fine-grained greenstone which at first looked like slate conglomerate. However, on examination it was found to be something on the nature of an eruptive breccia. Fragments like itself, some of them banded, were enclosed in a similar matrix. Portions of the matrix were banded and bent and broken in a complex manner. To add to the confusion a large amount of vein quartz has been broken up and been left standing in veins, angular fraguments, and in pieces more or less rounded. The rock is quite different from the normal coarse diorite and se seems to me to come under the head of eruptive breccia as this term was used by Hobbs and myself in central Wisconsin.

Going to the east and a little north, perhaps 100 paces, is another low hill of the same character in which the same conditions may be observed. The folding, however, is perhaps a trifle more marked. Dips were found to vary from 18 to 32°.

Continuing east still another of this character is found which shows a considerable amount of intrusive diorite and a consequent contortion of the limestone. Dips almost vertical may be seen locally, but in most places it is difficult to tell what the general dip is. However, in the hill as a whole it is clearly northerly and thus varies from the northern exposures where the dips are more northwesterly.

A fourth knob still farther east and across an open field was found to show the usual contorted limestone but the minor folds in general pitching a little east of north. In no cases were there over perhaps 55 feet of limestone exposures, i. e., actual thickness. On the southwest corner of this knob are two exposures of

45957 a gray quartzite somewhat feldspathic. The ledges were broken but there was at first some doubt as to their being in place, but closer examination satisfied us that they were in place. The dip could not be determined, although the major parting planes seemed to dip into the hill to the north of it. Just above them and north of them comes in the limestone. The distance between the quartzite and limestone is less than 5 steps horizontally and vertically the top of the quartzite comes as high as the bottom of the limestone. There can be no question that the quartzite here underlies the limestone.

On the hill across the open field to the south of this knob we looked for quartzite but found only diorite.

Going east across the usual small field, limestone appears cutting through diorite, the contorted dip varying from 20° to vertical. As far as there was any pitch here it is northerly. Worked around the south base of the hill and found quartzite, but found none in place, although found a considerable amount of large angular fragments where the quartzite ought to appear. Crossing the next field and the old road now used as a cowpath, one low knob was found showing limestone and diorite with the usual contortion but in general with northerly dip.

Still farther east on the knob, the eastern continuation of which is crossed by the stage road from Bruce mines to the C. P. station, is limestone with its minor synclines pitching in general a little east of north. Where the road crosses, the dip is 20 to 25° to the north. On the south side of this hill on the low ground are several low flat exposures of quartz-
45958 ite and quartzite conglomerate, the pebbles of which seem to be mainly granite. This to be further studied. The attitude of these rocks could not be determined because of the poor exposures. The quartzite shows somewhat different features from the one to the west and is similar in its dark quartz eyes to the quartzites observed north of the limestone. After striking the road, we went north and east across the great open field east of the road and up the hill to the west of the railway spur crossing this field. This is perhaps 500 paces north of the limestone. This material
45959 is quartzite with dips varying from ... to 68° and strike east and west. The strike and dip were plainly shown both by the bedding and parting planes Going north this material was soon covered by soil. This quartzite has the dark quartz eyes similar to one phase of the quartzite associated

with the quartzite conglomerate south of the limestone. Then went north of the spur of railway track and in a low cut just before reaching the
45960 C. P. depot is slate conglomerate in typical development. Pebbles of granite of at least two kinds were observed and pebbles of slate. The fresh surface is mainly a dark green or black one, but the weathered surface is a cherty white or yellow color. Limestone pebbles were looked for without success. One granite boulder several feet across was noted. Finer slate phases with a dark color were interbanded with coarser phases commonly of a lighter color and these lighter phases were similar to the quartzite observed just to the south.

45961 45961 shows the interbanding of the dark slate with the coarse quartzite material.

I am satisfied, therefore, that the quartzite observed just to the south is a part of the slate conglomerate series, especially as the latter contains no pebbles of quartzite.

The afternoon's work would seem to show a monoclinal series. In going north the succession was, neglecting the diorite,

(1) Gray quartzite and quartzite conglomerate.

(2) Limestone.

(3) At least 500 paces of no exposure which might be occupied by anything, and

(4) and (5) Gray quartzite grading up into slate conglomerate.

However, there is still an alternative, that the quartzite and slate conglomerate north of the limestone may be the same as that south and therefore stratigraphically beneath the limestone. We know the southern one is beneath and the similarity in the two quartzites and the occurrence of similar conglomerates suggests that possible alternative. In support of this alternative, however, no southern dips were noted and further the limestone was not again brought up on the north side of the syncline, which would have to be intruduced between the northern quartzite and the limestone north to give their present dip. The uniformly northern dip of the series except where disturbed by the limestone and even here northerly or the reverse absence of any southern dips would seem to indicate that the series to the north of the limestone is above the limestone. No limestone pebbles were found in the slate conglomerate, but it is likely that if we had exposures of conglomerate close to the limestone such might be found.

At one place we found the white quartzite within 100 paces, limestone and slate conglomerate not exposed. Assuming an average dip of the quartzite about 15 to 20°, the maximum thickness of the slate conglomerate would be less than 100 feet and probably less than 75 feet.