[Notes on the geology of the Boundary Waters region, Minnesota]: [specimens] 28950-28978. No. 325 [1899?]

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.

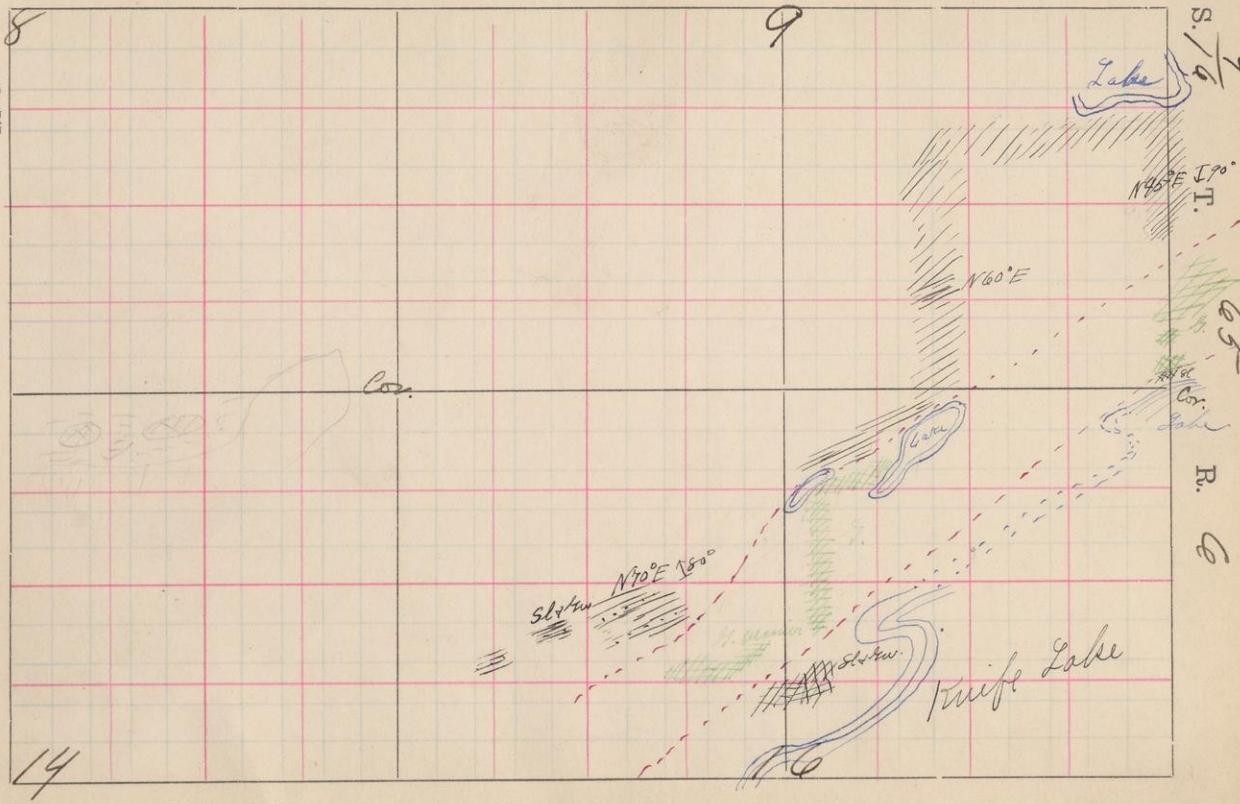
4. On the last twenty-five pages of the book give, as may seem desirable, a general account of the examination of the region mapped in the previous pages, correlation of observations, sketches, cross sections, etc.

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

No. 3

28950-28978

No. 395


8
9
S. 1/2
Lake
N45°E 190°
T.
N60°E
Co.
Co.
Lake
Lake
R. 6
N70°E 150°
Trout Lake
14

On the N. shore ~~to the~~ midway ~~of~~ the S. eastern arm of Knife lake, there is a series of high hills composed of greenstone. The connection between this greenstone and the ellipsoidal and spherulitic greenstone occurring to the N. E. of this place was not made in 1898. I sent Leith in to start at the W. side of this greenstone and I began at the spherulitic greenstone on the E., the intention being to work towards each other and connect these two, if possible, and get their relations to the sediments surrounding them. Starting on the shore on the section line between 9 and 10. T. 65. R. 6. I went N. and then W. traversing the greenstone and sediments, and traced the belt to the S. W. At the place where I began slate formed the talus on the S. side of the hill and occurred in places on the S. slope of the hill. I could not get a strike and dip. Greenstone occurred also on the hill with the slate though I could not determine their relations. The greenstone is fine grained and shows no structure. Passed over exposures of the ~~slate~~ greenstone going N. until I had reached the location about 400 paces N. of the corner. Here there is a valley running about N. E., S. W. The greenstone

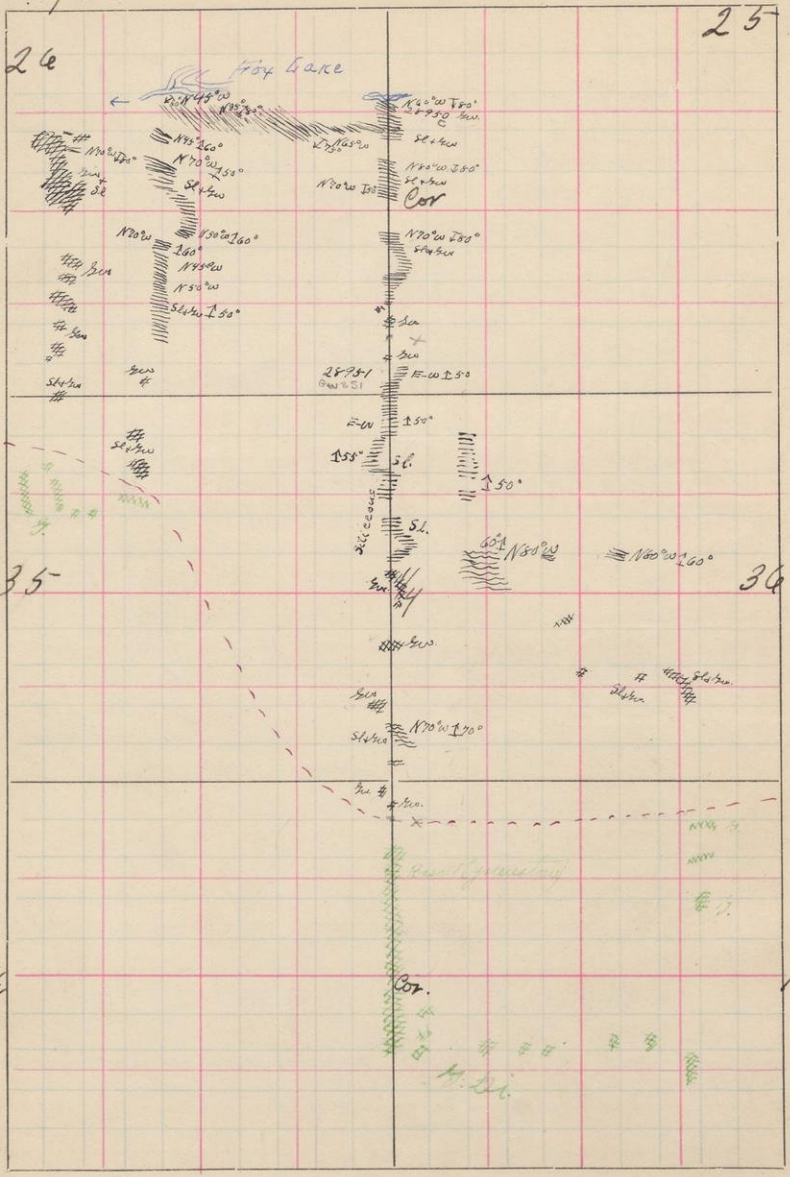
forms the hills on the S. of this valley. The hill on the N. is formed of the normal Knife lake slate and graywacke interbanded and showing a strike of N. 45° E. with a vertical dip. Ran for about 300 paces in this slate having a nearly continuous exposure all the way., Turned W. at the S. side of the small lake and went W. over ~~from~~ very nearly continuous exposures of the same slates with a strike of about N. 45° E. to somewhat nearer E. and W. for 600 paces; then S. to a small lake. On the run S. I obtained at one place a strike of N. 60° E. Ran W. to get around this lake, then S. and at 1825 N. W. 750, N. of the S. E. corner of Sec. 16. T. 65. R. 6, reached the first exposure of greenstone S. of the slates. Ran S. following line shown on map and crossing an area about 450 paces in width in which greenstone is exposed in very nearly continuous outcrops. The greenstone occupies high land. As we come out of the greenstone we go down a steep hil, cross a narrow valley which extends N. E. and runs down into a bay of the lake, and then ascended a high hill on which slate and graywacke is exposed. This topographic depression just crossed continues to the S. W. and appears to separate the greenstone on the N. from the

sediments to the S. N. of the greenstone I find the sediments again as shown on the map. They are there very much silicified and show a beautiful banding. The strike is N. 70° E. with a dip of 80° to the N. These sediments outcrop to the W. along the shore. Leith traced the greenstone within a short distance to the W. on the shore. It thus becomes apparent that these greenstones really belong to what was originally a continuous mass trending approximately N. E., S. W. None of the exposures were of such a character as to enable me to determine accurately the relationship of the sediments to the greenstones; that is, I could not say positively whether the greenstones cut the sediments or whether the sediments lie upon, being derived from, the ~~slates~~ greenstones. Since the sediments immediately overlying the greenstones are in this part of the area slates one would not expect even under the most favorable conditions to find a basal conglomerate of large extent, if the sediments were derived from the greenstones. A few feet or even a few inches of basal conglomerate would be very difficult to find where the contacts are no better than they are here.

Exposed

26/25

S. 35/36 T. 65 R. 6

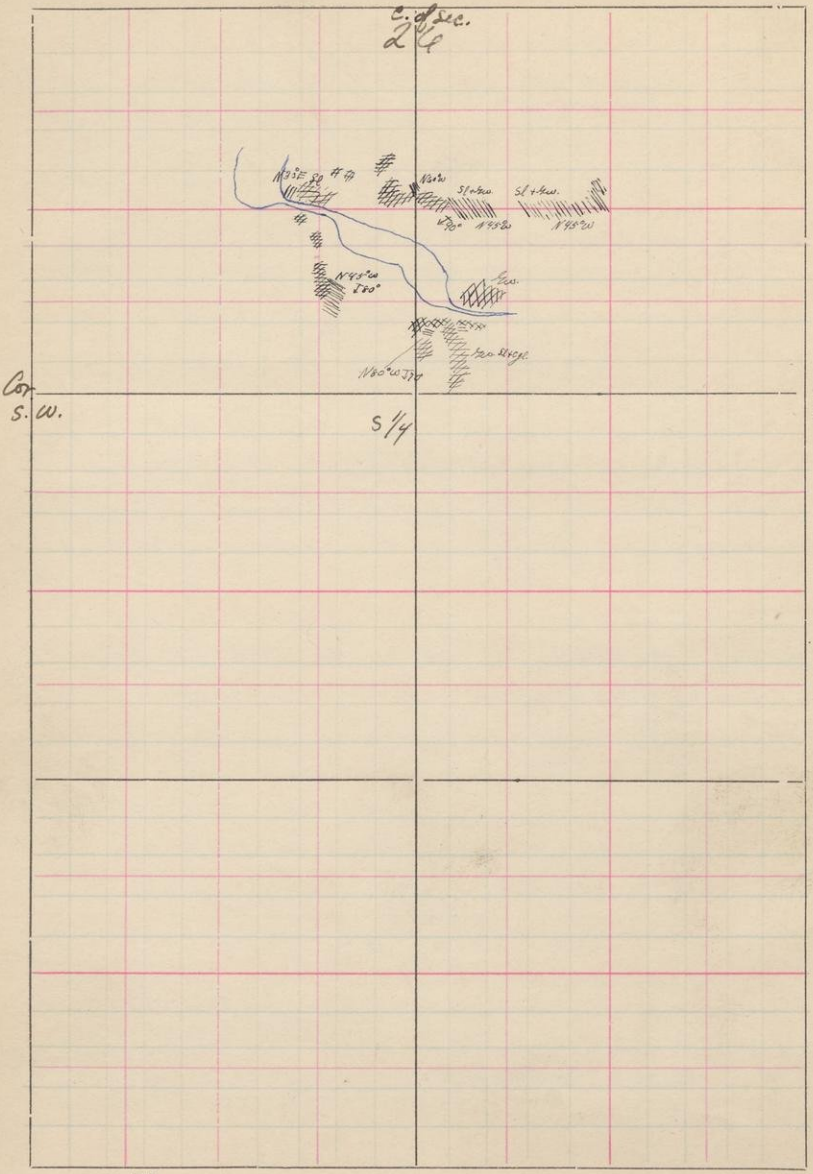


6—747

Our camp is now located upon Ogishke Muncie lake. Upon the last ~~high~~ years field maps the sediments S. of this lake especially along Fox and Agomok lakes are represented as having very rapidly changing strikes. I went in this morning to study this location in order to get a clew, if possible, to the relations of these sediments to the sediments which we have been classing with the Ogishke Muncie conglomerate and Knife lake slates on the N. and to the Animikie on the S. E. I began on the S. side of Fox lake and ran S. along the section line between Secs. 25 and 26. T. 65. R. 6.

28950 N. 275. W. O. S. E. corner Sec. 26. T. 65. R. 6. There is here a coarse feldspathic sediment represented by spec. 28950, which forms the main part of the S. shore of this lake. It is interbanded in very heavy massive beds with fine grained sediments and grades into these. The strike of the beds is N. 60° W. with a dip of 80° to the S. The slates associated with this graywacke are the normal light gray and white weathering cherty slates breaking with a concoid fracture, which ~~is found~~ very commonly on the Knife lake. On fresh fracture these slates

S. 26 T. 65- R. 6



are dark gray or blueish. Some of these finer grained sediments seem to contain very much more quartz than
~~28950~~ 28950. Others are finely conglomeratic. Among the fine grained slaty sediments layers of chert are very common. These sediments show in certain layers considerable crumpling of the bands and are fractured along planes making angles somewhat less than right angles with each other. The schistosity produced by the shearing is very nicely shown in many of these sediments. Going S. I passed over very nearly continuous exposures of these sediments as shown on the map. A little farther S. the strike changes to N. 80° W. with a dip of 80° S. Continuing on to the S. I find the strike bending to the N. 70° W. The dip remains practically constant at 80° to the S. Just N. along the section line between 35 and 36 the slates are strikingly like those which occur to the S. of the great greenstone hills known as Twin Peaks.

28951 N. 1575. W. 0. S. E. corner Sec. 35. T. 65. R. 6. We are now in a depression having gone over a high hill to the N. ~~of it~~. and will soon begin ascending a hill to the S. At this point there is a good exposure of the

interbedded quartzose or cherty slates represented by the specimen. The strike of these rocks here is E. and W. with a dip of 50° N. Going on S. I continue to pass over essentially the same kinds of silicious slates with a strike of about E. and W. and with a dip varying from 50° to 55° N. We seem to have been going over a repetition of the same slates which we have passed N. of here; in other words this seems to be the S. limb of a syncline. S. of the slates the graywackes become more common. Exposures are less frequent and the dip, where taken, is steeper, 70° to the N.

N. 325. W. 0. S. E. corner of Sec. 35. T. 65. R. 6. At this point I come to the first exposure of a medium grained dolerite. The contact between the greenstone here and the sediments to the N. was not exposed. Running S. over the greenstone it is seen to become noticeably coarser with a distinct ophitic texture. Ran S. about 600 paces in this greenstone mass and then E. 800 paces and then N. We are now going down the hill and at 400 N. 1200 W. of the S. E. corner of Sec. 36. T. 65. R. 6. I note the last exposure of greenstone. There is here a very notice-

able topographic drop. Evidently this marks the contact between the slates and the greenstone for after passing across this depression I find the slates and graywackes exposed about 300 paces N. of the last greenstone exposure. These slates were traversed, as noted in the note book, but nothing new was observed in them. It is to be noticed that the strike thus far observed in these slates is very uniform, running approximately parallel with the contact line between the sediments and the greenstone. From my morning starting point at the section line on the lake shore I now ran S. 75 paces and then W. as indicated on the map. The rocks observed were ~~in conjunction~~ connected with the sediments ~~noted~~ studied this forenoon, agreeing with them essentially in strike and dip.

It is true that one can get almost any strike one chooses in here, especially N. and S. strikes which are almost at right angles to the true strikes, and this is due to the change in the direction of the exposures. As a result of the drainage the exposures here run nearly N. and S., the streams immediately along the lake shore having cut very nearly across the strike instead of having run along ~~that~~. The careless observer could readily take a N. W., S. E. or N. and

S. strike. There does seem to be, however, a slight crinkling of the strata and bending around to the W. and N. Thus I find a strike of N. 50° W. with a dip of 80° S.

This morning I started in where I left off yesterday on Fox lake and ran S. Shortly after leaving the lake I found the slates with good exposures giving a strike of N. 70° W. and dip of from 50° to 60° to the N. The strike varies from N. 45° to N. 70° W. just along the N. section line of 35, the dip being 60° to the N.

N. 1915. W. 600. S. E. corner Sec. 35. T. 65. R. 6 Here the slates and graywackes are broken and slightly faulted The fault plane runs N. 10° W. The shearing accompanying the fault has affected a zone about 3 feet wide. In the midst of this zone there is a horse of rock. Around it the material is sheared and brecciated; apparently infiltration of cherty silicia, not of veined quartz, has followed this shearing. The bands on both sides of the fault have been bent. The amount of displacement could not be measured but seems to have been slight, a few feet at the most. The exposure does not permit of measurements.

About 200 paces S. of the N. section line S. 35. the strike is N. 45° and from there on for some distance remains the same or reaches N. 50° W. S. of this

place the exposures are rare, consisting of slates and graywackes upon which no strike was obtainable. I reached the greenstone upon this run at about N. 1250. W. 1650. S. E. corner Sec. 35. T. 65. R. 6. The greenstone evidently makes up very much farther to the N. here than it does on the line about a quarter of a mile E. The contact between the sediments and the greenstone was covered. The greenstone is the fine grained greenstone, which occurs upon the borders of the great mass forming the hills of which this is a part and which upon large exposures very commonly shows ellipsoidal parting. I now went W. 300 paces over this greenstone and then N. getting the contact again. There is an area of no exposures, between the greenstone and the slates, ~~of~~ about 175 paces. The slate and graywacke exposures which now follow are small and upon them I could not determine the strike and dip. The graywacke seems to be the rock which predominates. In general it would look as though the graywackes were more common to the S. in the vicinity of the greenstone and slates occurring farther N. nearer the center of the ~~anti~~cline.

Syn

Near the S. 1/4 post of Sec. 26.T. 65. R. 6 the ~~graywacke~~ sediments consist chiefly of graywacke with which are associated fine grained conglomerates. Slates are scarce. These graywackes are very massive and do not show good bedding. The rocks are very much broken and where bedding planes are seen minor faulting was observed. These lines of bedding were rarely exposed for more than a few feet. Moreover they seem to run in almost all directions probably as a result of the faulting and folding. In a few places where the rocks seem to be comparatively unbroken and where the bands extended for 20 or 25 feet the strike is slightly to the S. of E. with a dip varying from slightly S. to vertical. In one place I noticed a distinct faulting in which the western fault plane ran N. 25° W.; the eastern one N. 25° E. These met at the S. in a point. There seems to be a displacement here of about 6 inches. These graywackes lie where the slates would come if they were continued from the E. to the W. Does the appearance of these graywackes here mean that we are going around the W. end of this slate syncline upon an anticline which brings them to the surface? If such is the case, after

passing over this slight roll we would probably find a second syncline of slates lying to the W. I ran on N. up to the river and then W. passing over isolated exposures of graywackes with a strike in some places of N. 45° W. and a dip of 80° S.; then ran N. crossing the river near where it empties into Ogishke Muncie. At the mouth of the river the slate strikes N. 30° E. From here E. the exposures are not good until we reach the high hill overlying the Fox lake, the shoulder of which is crossed by the portage into Fox lake, where good bedding was seen. The strike of this bedding is N. 45° W. with a vertical dip.

~~28952~~

In company with Leith spent the day studying the Animikie and other exposures along the shore of Gobbemichigomok lake. Began at the point on the S. shore of the lake to which attention has been called by Winchell. Here the rocks called Animikie are exposed along this cliff. One can readily see the banded rock with a strike magnetic of N. 10° E. dipping 20° E. This really represents the strike of the face of the cliff more than the true strike of the beds. This banded rock is made up of a very dense grained hard silicious rock like 28952. The bands of this rock are rarely more than 4 inches in thickness and from this on down. Between these bands there is a rotten, brown, coarse grained material which weathers very much like gabbro. It seems to contain a large amount of feldspar and dark bisilicates and is for the most part, I am quite sure, gabbro. However, I have seen E. of here near Paulson's mine rocks which consisted to a large extent of quartz having associated with it olivine and hypersthene which weather in very much the same way. All of the bands over the cliff were not examined and possibly some of these which could not be reached although they look like gabbro might have been this quartzose material mentioned. We went E. along this

? Contact rock
28952

cliff and then up over it. The bands can be distinctly seen ~~it is true~~ in various places along the sea cliff. Going up ~~from~~ the cliff the banding can be seen, though imperfectly. One walks over the higher and higher layers as he ascends and in some places recognizes the hard bands of the Animikie associated with the gabbro. The cliff consists of about equal portions, apparently, of gabbro and the sedimentary rock, possibly a trifle more of the gabbro. The relations here certainly seem to indicate that the sedimentary rock has been either included in the gabbro or else over flowed by or intruded by it. In either of the first two cases intrusion might have accompanied the intrusion and over flow. The normal gabbro comes in on the main shore a short distance back of this headland.

Intrusive (western contact rocks of Bob.)

28953 & 4

We now skirted in the canoe the shore to the S. W. of this point. The rocks which will be here enumerated are shown upon the map made by Leith accompanying his notes. We first reached a conglomeratic looking rock the pebbles of which seem to be dense quartzite, 28953.

Cf. Book 329 f. 33

Gr. & Sl.

28953 Gr? 28954

This is the pebble which is scattered all through the conglomerate. The matrix is represented by 28954 and looks very much like a feldspathic phase of the gabbro. This conglomeratic rock is cut by a sheet of basalt 12 to 16 inches wide which is nearly horizontal showing only slight E. and W. rolls. The basalt sheet is separated into very symetrical hexagonal and quadratic columns. It shows a distinct fine basalt selvage with dolerite center. Climbing the cliff above this conglomeratic rock I find a ~~big~~ coarse brown more or less friable rock which I think must be the rock named by Winchell "Muscavado." This rock grades vertically upward into a coarse normal gabbro.

Continued to the S. W. along the shore passing numerous exposures of this conglomeratic looking rock. At last and near the point we reached the Animikie consisting of distinct bands of iron ore and coarse quartzitic bands. This is like the ~~duplicate~~ Animikie seen around Paulsons and does not contain the gabbro bands observed N. E. along the lake shore. The strike varies very much, from about E. and W. to N. E. and the beds dipping 40° to the S. or S. E. I go inshore over an area containing no exposures

Is not this Gr. a differentiation phase of the Sed.? Have analyses made of a few specimens

and then find the Animikie again outcropping ~~from~~ on the hill about 150 paces from the shore. Following ~~a depression~~ to the S. there seems to be the usual depression which lies between the gabbro on the S. and the Animikie on the N. This depression continues out S. W. to the lake. Going a little N. of W. I passed over the Animikie and then over a gabbro sill which lies in the Animikie with the iron bearing rocks both to the N. and the S. of it. On the N. side of this gabbro it is in contact with the Animikie and here it shows a very distinct selvage. One can trace the gradation from the coarse gabbro into the finer grained dolerite next to the Animikie. The Animikie here dips about 40° to the S. S. E. There are apparently rolls in the Animikie for it seems to roll down to the S. W. under ~~along~~ the gabbro and then comes up again. This gives evidence of the crumpling of the Animikie in this vicinity.

28955 & 6

Going back to the point where we began we now follow the shore to the E. For a considerable distance we pass the coarse gabbro which is seen to be cut in some places by basalt dikes. One of these trends S. 10° to 20° E. and stands vertically. Another runs S. 30° W. with a dip of 70° to

the S. E. Both of these are about 6 feet wide and show very pretty hexagonal parting with the columns perpendicular to the sides of the dikes. See map for location. This gabbro continues on up the E. shore of the lake to a point on the shore N. of the M. C. of the town line between 65. R. 5 and 64 R. 5. Here, after leaving the coarse normal gabbro, we come to a fine grained white to wh brown weathering granular rock like 28954. This is followed by rounded areas which are essentially alike and seem to be all of one kind. This rock is identical in general appearance with that from which specimens 28953 and 28954 were taken. I took from here a chip of one of the pebbles which was also numbered 28953. The width of this conglomeratic rock which is exposed here on the lake is about 50 to 75 paces wide N. and S. It trends S. W. along the line of the gabbro. This peculiar rock can be very well seen upon the island on the E. side of the lake, which is crossed by the town line. On the S. W. shore of this island one can see that this material clearly underlies the gabbro and is the contact of it with some rock lying still deeper down, or on the side of the gabbro, thus making

the gabbro either a flow or a laccolithic intrusion. From the exposures it seems very much as though it overlaid some of these contact phases. As is shown in the accompanying diagram the gabbro outcrops on the S. W. side of the lake at two places. The northernmost outcrop of gabbro occupies a position with the conglomeratic rock both to the S. and to the N. of it. On the N. E. side of the ~~lake~~ island there is only one mass of gabbro and one of the conglomeratic rock. Apparently these two gabbro masses on the W. side of the island join somewhere upon the island. It would thus look as though the gabbro had overflowed the material with which it is in contact and in which there were ~~depositions~~ sessions or else had been infolded in this. On the ~~S~~ S. W. side of the island one can see that there is a ~~splendid~~ zonal change from that rock which we can recognize as the normal gabbro to that which I shall speak of, using Winchell's term, as muscavado. The two are readily separable. Following this muscavado rock away from the gabbro, that is to the N., it contains more pebble like areas. On the N. W. end of this island I first found out what these pebbles were. Here one can see a number of long parallel bands extending for nearly 12 feet

along the cliff. These are folded and very clearly represent included numbers of some sedimentary series. One can see also that these bands have in places been cracked across. The blocks thus formed are in many instances only a few inches long. Sometimes these blocks can be seen to be separated by considerable areas with the muscavado in between them. As these areas become wider, or in other words, as the matrix increases in quantity relatively to the pebbles, the pebbles undergo an apparent fusion for their corners become rounded, possibly partly by melting and also to some extent by friction. The gabbro immediately around some of these pebbles shows a not very perfect banding. These bands are very narrow.

Gw
28955 28955 represents a specimen of the banded rock ~~of sediment~~ which lies in this muscavado. This zone of material appears like a friction ~~pressure~~ breccia or flow breccia, at any rate it can be classed as an eruptive pseudo-conglomerate. It is difficult to understand how the great difference between the normal gabbro and this muscavado like form of it was occasioned. This material probably represents the selvage phase of the gabbro which has been very much changed from its original gabbro constitution by the incor-

poration into it of material derived by fusion from the sediments. Some of this muscavado appears to consist almost exclusively of a white weathering feldspar with biotite. Analysis of the various phases of the muscavado compared with the gabbro should furnish interesting material for the study of the endomorphic contact action. A number of the pebble like areas in this muscavado on this island were chipped and will be slided. No. 28953

28956 This specimen is from a band about 4 inches wide and 12 to 15 feet long, folded and lying parallel with the other bands, all of which are included in this muscavado. Are not these sediments the same as those on the N. side of the lake? They do not resemble ~~numbers~~ any of those rocks in the Animikie with which I have become familiar from the exposures between here and Paulson's mine.

Skirting the shore of the lake E. from this island I find the contact rock lying along the shore of the point with the coarse normal gabbro to the S. of it in the bay. On the opposite side of this bay the contact rock occurs again.

28957 This represents as fresh a specimen of the Muscavado [illegible]

of the muscavado rock as could be obtained from the place located by the number. This weathers to a light yellow and becomes very friable. From this point I can see bands of rock striking N. 70° W. and dipping 85° to 90° N. These are very dense and quartzose and are similar to the specimens of pebbles already taken. The strike of the sedimentaries exposed on the point agrees approximately with that of the sediments of Fox and Agamok lakes. Are they not probably connected under the lake with these? The exposure is not deep enough to enable the sediments to be connected with the main mass of rocks to which they belong. The exposure looks as though an irregular surface of the sediments represented by these banded rocks had been overflowed by gabbro which had been forced into the cracks separating and metamorphosing the bands, and possibly in some cases even fusing them and incorporating them in itself. Near the top of the exposure the muscavado contains a few fragments of the rock which below this is in large bands.

From the occurrence of this irregular surface with ~~the~~ pebbles of material similar to the bands in a sandy matrix, it suggests itself to me as a possibility that we may have here a pre-Cam-

brian rock surface, the fine grained sandy material being a sand derived from the sediments below and including some large pebbles of the same sediments, the whole having been metamorphosed by the gabbro; this metamorphism having affected especially the sand. This conglomeratic looking rock might be either a water worn conglomerate or possibly a soil.

Other outcrops in the bay N. of this point show the muscavado. It is overlaid by the coarse gabbro. Just before reaching the head of this small bay there is an exposure of this granular, friable rock which can here be traced vertically in a cliff about 25 feet high into the normal gabbro. This clearly shows that the suggested mode of formation of this muscavado, as offered above, would not hold. The gabbro continues around this bay. On the S. side of the point, called by Winchell Muscavado Point, there is a good exposure of the contact rock and the banded rock represented by spec. 28958 which seems to be a metamorphosed graywacke much like the feldspathic graywacke on the N. side of the lake. The exposures are not good and I cannot be sure of the strike and dip of the banding. In general it seems to be to the W. of N. with a dip to the

Sw
28958
Wet Sw.

N. E. Passing around this point into the N. E. bay of the lake we reached rocks which here show more and more clearly their sedimentary characters. In the small bay just N. of the E. and W. section line, the sediments show a strike of N. 20° to 30° W. and a dip of 80° to 85° E. They are dense black and gray graywackes and slates and resemble very much those to the W. of here along the shore of Lake Gobbemichigomok (Michigamme) and along Fox and Agamok lakes, although of course they are here somewhat metamorphosed. On the N. shore of the lake on a point just a little E. of where the N. and S. section line comes out one can see interbanded feldspathic graywackes
~~28950~~ similar to 28950, and quartzite whose sedimentary characters are unmistakeable.

. From the observations made on this lake it is clear to my mind that the gabbro partly overlies the sediments which I believe to be the same as the Knife lake slates, and that it has in places metamorphosed these. Where it is in contact with them there has been formed a contact rock. It is difficult to get the width of this contact rock. In one place it did not seem to have a thickness much greater than 30 or 40 feet measured

vertically. At other places there is an exposure of this contact rock which has a width of from 50 to 75 paces on the lake shore, but while it could not be definitely determined to be the case, presumably this exposure ran parallel with the long direction of the contact and hence would not give its thickness. In two places on the S. shore of the lake there are exposed the rocks of the Animikie. In a bay between these occurs this contact rock. According to Grant's map these two exposures of Animikie connect behind this bay. The Animikie itself has been very much metamorphosed by the gabbro which also metamorphosed the Agamok lake sediments which have been described. The relations between the Animikie and the Agamok slates could not be determined here, although from the striking difference in lithological character and from the fact that the strike of the sediments on the N. and E. side of this lake is from N. 20° to 30° W. while the Animikie strikes to the N. E., S. W., it would seem possible that they were unconformable. However, the evidence mentioned is not sufficient to prove this.

The day following the study of the lake went with Leith to trace the continuation of the Animikie W. from the

point where he had left it in 1898 N. of the E. end of Peter lake. We also wished to get, if possible, the relations existing between the Animikie and the sedimentaries to the N. We were able to trace this belt for a considerable distance to the W. as shown on Leith's map. To the N. of it there was found the muscavado contact rock so that its relationship to the sediments could not be seen. Within the Animikie there was found a sill of gabbro and the coarse grained mass of gabbro was found lying to the S. of the Animikie. The Animikie disappears on the W. and the next exposure is found at some distance away from the exposures of Animikie and is of the muscavado and sediments with gabbro in large exposures outcropping to the S. These exposures were found near the E. end of Paul lake. We now ran back to Peter lake and then portaged into Paul. The S. shore of this lake is in gabbro. At the E. was seen again exposures of the muscavado and sediments. See Leith's notes for details of these exposures. On the N. shore of the lake the same contact rock outcrops with the sediments lying under it and to the N.

Professor Van Hise and Dr. Grant came to camp to-day. The next few days were spent in revisiting various localities with them, for instance, the Gobbemichigomok area, the Agamok lake slates, and the Animikie along the river to the E. of the camp on Peter lake. Supplementary notes concerning these areas can be found in Professor Van Hise's note book. We also went to Gunflint visiting from there the typical Animikie on Loon lake and noting the contact of the gabbro with it on the E. end of this lake. The gabbro does not appear to have affected the slates and graywackes very much at this place. S. of Loon lake, on Mayhew lake, the titaniferous iron ore was seen. It occurs in masses in the gabbro. Gradations from the gabbro into the ore can be traced. It is to my mind but a segregation product of the original gabbro magma. On our return from Gunflint we noted the characters of the rocks along the railroad cuts.

28959 This specimen is from a railroad cut on the Port Arthur, Duluth & Western Railway near Cross River. This does not seem to show very much metamorphism although apparently somewhat more metamorphosed than the rocks which were seen E. of here. Do these

rocks show a large quantity of actinolite and magnetite with some iron carbonate? In other words do they correspond to the actinolite and magnetite schists of the Marquette area? Is it possible microscopically to determine the gradation from the slightly metamorphosed forms of these rocks with normal chert bands in them into those rocks in which the chert has been metamorphosed into the granular quartz as shown in the specimen and then on W. into the coarse grained granular quartz and ore bands previously collected in 1898 from Paulson's? cf. Professor Van Hise's notes for 1899. Specimens of rocks from the same horizon as this were taken farther W. and N. from the outcrops near Dowman's claim. At this place it is possible to see some structure in the Animikie and Grant's determination is apparently correct which is that there is a double syncline of sediments separated by a small anticline of greenstone which widens to the W. We followed the contact of this greenstone with the Animikie to the W. on the S. side of the anticline. A search was made for a conglomerate but nothing of this nature was found until we reached the pits to the N. and E. of Paulson's

mine.

C?

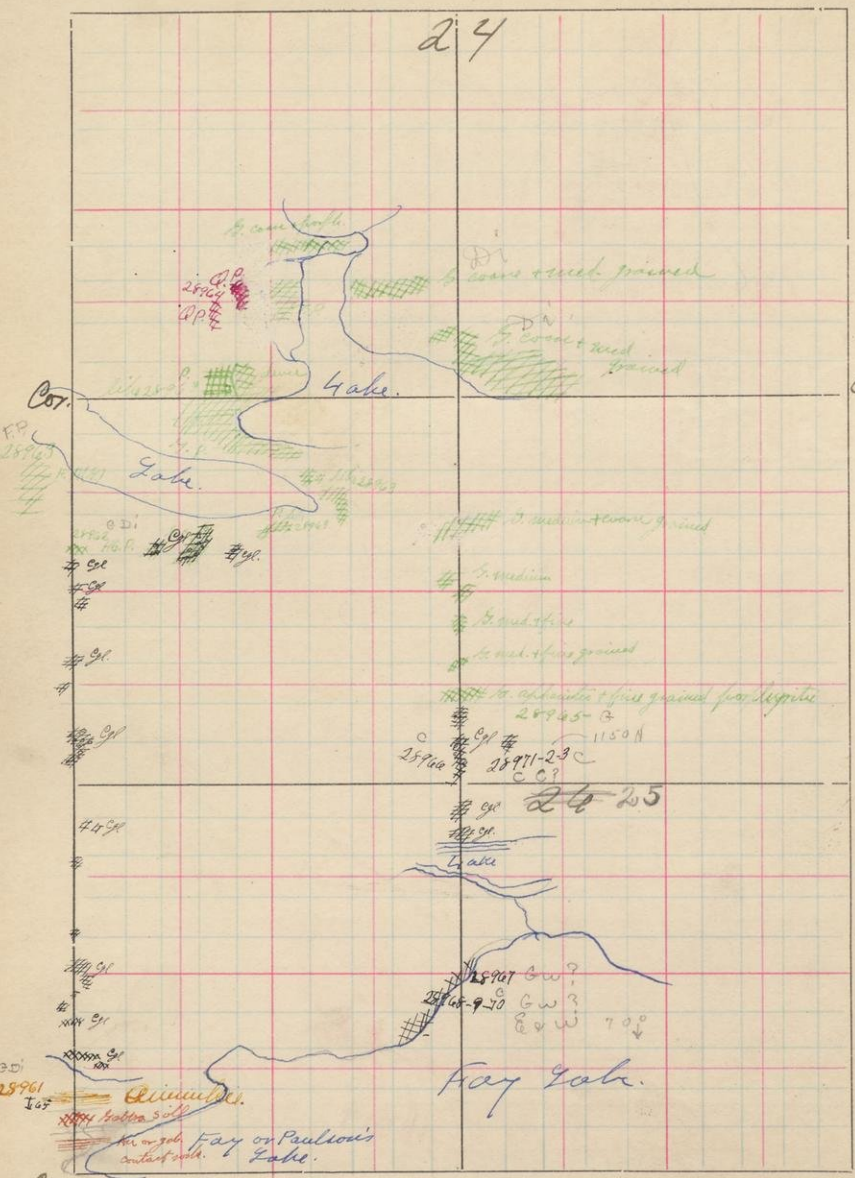
28960 Upon the dump from these pits there was seen the normal Animikie ore and in addition to this a few fragments of a rock which appears conglomeratic. The pebbles are nearly all very full of biotite. A few pebbles were seen which may be of true veined quartz. Is this a true conglomerate or is it merely a conglomeratic looking eruptive rock? The fragments lie near the top of the dump in the case of the two pits upon which they were found. It thus seems pretty evident that this rock was probably the one in which the bottom of the pits were when they were abondoned. This is presumably the basal conglomerate of the Animikie. The Animikie rests here upon the greenstone which in most cases is coarse grained and massive, although showing variation into finer grained forms and into schistose phases. Continuing W. along this contact other pits were seen but they had not reached the conglomerate, or if so, no blocks had been thrown out. See Professor Van Hise's notes for locations and further details. Just before reaching the W. end of the railroad the hill side to the N. shows large exposures of the Animikie. Q con-

siderable area has been stripped so that the exposures are fairly good. The contacts between the Animikie and the underlying rock was, however, not visible. In leading the W. end of the track it was necessary to make a considerable cut in the hillside and here there are some good exposures of greenstone which underlie the Animikie. This greenstone was specimened in 1898. It is usually coarse grained and massive althoughthere are finer grained forms present. The rock has been very much broken up and fracture lines run through it in a number of directions. Chloritic veined material has in many cases been formed along these lines of fracture and upon the weathered surface the rock bears a very striking resemblance to a breccia and in some cases even to a conglomerate. In fact in places one can speak of it as a pseudo-conglomerate.

In a few places a thin skim of ferruginous material which is considered to be the Animikie lies upon this greenstone. The actual contact between the Animikie and the underlying greenstone is here visible. At these contacts, however, no unmistakeable conglomerate could be found. It is clear that if a conglomerate exists below

the Animikie at this point and to the E. it must be very thin. The presumption is that the Animikie rests with a very sharp contact upon the greenstone, giving the relations which one would expect in the case of the deposition of a chemical sediment upon a rapidly subsiding shore line. As this contact is followed farther W. we pass the contact of the Animikie and the massive greenstones and reach the point where a conglomerate begins to appear. This point has been located by Leith. The conglomerate separating the Animikie from the greenstone widens as we follow it to the W.

S. 24 T. 65 R. 5



6—747

28961

N. 160. W. 1975. S. E. corner Sec. 25. T. 65. R. 5. To-day I began work at the S. W. corner of Sec. 25 at the W. end of Fay lake and ran to the N. My object was to get the width of the conglomerate belt separating the Animikie from the greenstone and to determine the relations between the greenstone and the conglomerate to the S. See the accompanying map for the location of exposures and boundary lines. At the above location there is a N. facing cliff of the typical Animikie which contains within it near the top a bed about 3 feet in thickness which appears to me to be a sill of basalt, though it may be a true bed of quartzite. The strike of the Animikie is here to the E. and W. The dip is 65° to the S. The stream here seems to follow closely along the contact line between the Animikie and the sediments to the N. As soon as I crossed the stream I began ascending the hill upon which are exposures here and there of the greenstone conglomerate. This seems to have been very much metamorphosed probably by the action of the gabbro, and in places is almost muscavado like. This metamorphosed character of this conglomerate was noticed farther ~~lower~~ W. of here, along the face of the hills nearest the gabbro. Hence

the conclusion that the gabbro flow or laccolite at one time was very much larger than it is at present and covered the hills for some distance N. of its present contact. These greenstone conglomerates show nothing of especial interest. There is one variety of the pebble which seems to be especially common. This is a light colored rock which seems to consist for the most part of feldspar and biotite. This rock is found in situ on the road E. of Fay lake where it appears as a facies of the normal greenstone. While running over this conglomerate I was on the lookout for any indication of bedding but could find nothing that would give me any clue to this. Neither could I find an alternation of coarse and fine bands or even a gradation in one direction or the other.

28962

N. 1630. W. 1975. S. E. corner Sec. 25. T. 65. R. 5. Just before reaching a small lake I descended a steep hill upon the flanks of which there is exposed a hornblende porphyry. This seems to be very fresh and is the kind of rock which has furnished very many of the pebbles to the conglomerate. These pebbles I noted the previous year

and had never found the exposures of the rock from which they could have been derived. I cannot get the relations of this rock to any of the others. I am inclined to think that it is one of a complex of greenstones forming the basement on which rests and from which have been derived the conglomerates over which I have been passing.

F. P.

28963 N. 1775. W. 50. S. E. corner Sec. 26. T. 65. R. 5. There is here a bold bluff of a feldspathic porphyry projecting into a smaller lake. This runs also for some distance in land but its connection with other rocks could not be seen. This porphyry resembles very strongly many of the fragments which I have previously seen in the greenstone conglomerates but whose source I had not determined. From the lake shore where the section line touched it I ran E. in order to get around the lake and passed numerous large exposures of the conglomerate. In one place upon the S. side of the lake and upon the N. side of the lake the porphyry similar to 28963 is exposed. About 150 paces N. of this small lake there is a second lake around the W. end of which I ran N.

Passed over the same feldspathic porphyry and in one place just between two small lakes and crossed by the N. section line between 24 and 25 a fine grained greenstone comes in lying apparently as a dike in the porphyritic greenstone, although a positive statement could not be made from the occurrence. Continuing N. following the route shown on the plat I passed over various greenstones and also noted two exposures of a well characterized quartz porphyry. Between the two small lakes mentioned which occur in the S. W. corner of 24, the feldspathic porphyry and the greenstone shows most intricate relations. I am not able to determine conclusively which is the younger of the two. In places it appears to me as though the feldspathic porphyry like 28963 is but a facies of the normal greenstone, at least no sharp contacts could be found separating them but on the contrary they seem to merge into each other. This fine grained feldspathic porphyry becomes coarser in places and then is like that relatively coarse porphyry obtained W. of here in 1898. It was at that time determined as cutting the Saganaga granite.

This Q. P. runs S. into the greenstone.

F. P.
~~28963~~

O. P.

28964 N. 250. W. 1470. S. E. corner Sec. 24. T. 65. R. 5. This is the quartz porphyry above referred to. It cuts the greenstone and the feldspathic porphyry including fragments of them. The relations I could not map upon a small scale.

N. 375. W. 1470. S. E. corner Sec. 24. T. 65. R. 5. At this place I come upon exposures of medium and coarse grained dolerite. This is found to have associated with it irregular areas of a hornblende porphyry like 28962. This porphyry shows no selvage as it approaches the dolerite nor does the dolerite show a selvage line. The contact line between them is irregular. Within the greenstone there are also areas which weather showing rather large hornblende crystals appearing all over the surface. This differs from the normal ophitic dolerite. The relations of these rocks to each other I could not determine. They seemed to me to belong together and to be merely differentiation products of the same magma. The dolerite seemed on the whole to predominate. Thus far to-day I have ~~not~~ found in these rocks nearly all of the

Dol
28962
Hb. Andesite

kinds of the basic rocks which I have seen in the conglomerates lying to the S. Hence I am convinced that these conglomerates have been derived from these massive greenstones. The greenstone is almost massive showing schistose facies only along the shearing planes. Ran E. and S. E. around the lake in the S. half of Sec. 24, passing over the dolerite which varies from coarse to medium grained and shows a variety of facies, as already mentioned. This same medium to coarse grained greenstone continued to outcrop upon the high hill S. of the lake. Near the top and on the S. flank of this hill, however, the greenstone changes very noticeably to a medium grained and then to a fine grained basalt. In a few places it shows a very fine grained porphyritic
28965 phase such as is shown in spec. 28965.

28965 N. 1225. W. 1000. S. E. corner Sec. 25. T. 65. R. 5. At this place just on the S. crest of the hill this fine grained greenstone is well exposed. Upon examining its surface I find that it is broken up by a number of cracks. Further examination shows these cracks to be filled in places by fragments

derived from the adjacent greenstone thus forming a friction breccia. Still farther shearing has produced in places a beautiful pseudo-conglomerate. The fragments in these cracks are all of the same kind of rock which is identical ~~along~~ with that forming the sides of the cracks. These fragments have suffered a zonal alteration which results in producing a rock with light gray weathered surface. This zone of weathering is about one-sixteenth to one-fourth of an inch in width around the larger fragments. In some cases very small fragments have been completely altered and are entirely white upon their weathered surface. In such instances it looks as though we had two kinds of fragments in the conglomerate but, as already shown, this is ~~not~~ the case, ~~of~~ both kinds of fragments having been derived from the same rock

The matrix of this breccia or pseudo-conglomerate seems macroscopically now to consist essentially of chlorite. It is probable that it represents the very fine material produced by the shearing of the basalt which has been altered by the action of infiltrating water. See the photographs and specimens of this occurrence. From the examination in the field I find that the greenstone area seems to be coarsest near thecenter and there also

shows the greatest variety of differentiation products. Upon the margin, in the case examined to-day, on the S. side the greenstone grows finer and finer grained until it becomes very nearly a basalt. This possibly represents the surface of a flow, submarine or otherwise, which is immaterial. This surface portion naturally suffered many vicissitudes and among other things was very much cracked. Upon the surface of this flow and occupying the cracks there was formed a breccia of which the specimens above collected are samples. Deposited upon this flow and derived from it there was then formed a greenstone conglomerate. In some places it is highly probable that the true conglomeratic material dropped down into the cracks in the basalt and in such cases it would be impossible to determine which was of sedimentary origin and which was derived by brecciation. The only criterion perhaps would be in the fact that in the breccia only we would expect all of the fragments to be alike as in the case here described, whereas in the sediment the fragments would probably be of different kinds although they might all be alike. Continuing S. along this hill there is found practically in contact with the greenstone showing brecciation the

normal greenstone conglomerate, at first in very large boulders. The occurrence in situ I could not find here nor could I get the dip or strike. The pebbles, however, are all of such greenstones as occur to the N.

28966 N. 1100. W. 1000 S.E. Cor. Sec. 25 - 65 - 5 .....
..... Here there is a greenstone conglomerate with various fragments of greenstone, coarse, fine, and porphyritic. The specimen shows a pebble of the very coarse greenstone with the surrounding matrix.

N. 1100. W. 875. S. E. corner Sec. 25. T. 65. R. 5. Here the contact of the massive greenstone is followed to the S. by the greenstone conglomerate of rather coarse nature consisting of the greenstone pebbles of the varieties seen and noted.

This morning went with Professor Van Hise and revisited certain of the outcrops on Fay lake and to the N.

Contact rock

28967 This was taken from an exposure on the N. side of Fay lake as located on the accompanying map. The rock, which seems to be a medium grained graywacke, shows a phases of the metamorphosed sediments.

contact rock

28968 Somewhat farther W. along the shore there is exposed this rock which is moderately fine grained and apparently grades up to the N. into a rock

~~28969~~ like 28969. N. of this occurs a conglomerate which probably represents a still coarser phase of the gradation. At least such appears to be the case from the position of the exposure although an absolute gradation could not be traced. If such is the case then the bedding in the rocks must be approximately E. and W.

Contact rock

28969 This is a phase of the contact rock somewhat coarser than 28968. It is followed to the N. by a coarse greenstone conglomerate which is so common over this area. As stated, the gra-

dation cannot be followed on the exposures but is judged to be so from the position of the exposures. The rocks break along planes which may be bedding planes or may be parallel to the bedding planes. These planes trend to the E. and W. with a dip of 75° to the S.

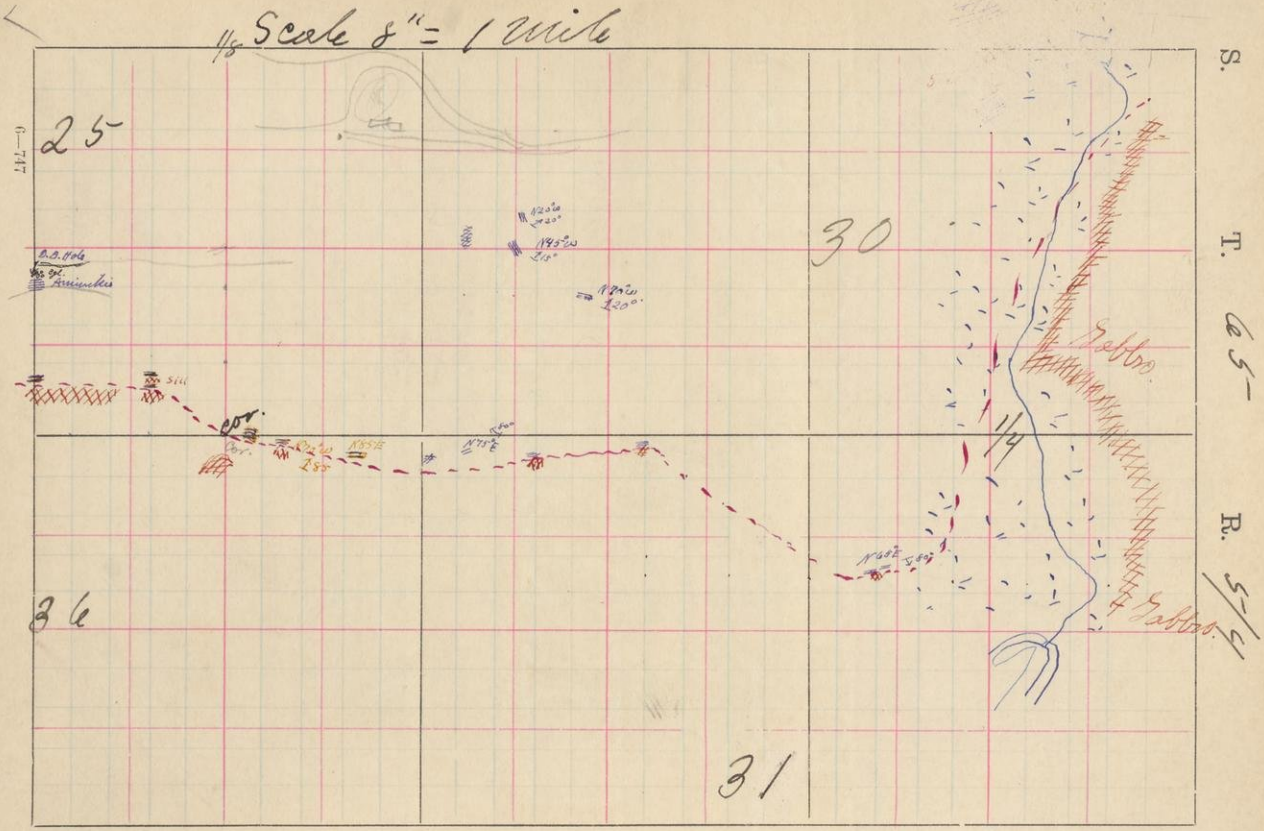
C
28970
contact rock

This is a specimen of the conglomerate which occurs near the top of the ridge on the N. side of Fay lake. It occurs higher up and more to the N. than specs. 28968 and 28969. This rock has, like the ones just mentioned, been very much metamorphosed by the gabbro which occurs to the S. across the lake, and which, probably at a former period, was vertically over these. The conglomeratic character of this rock is very clear upon the weathered surface although it is very much less so upon the fresh surface.

Studied these rocks ~~here~~ with especial reference to the kind of metamorphic action which the gabbro has carried out.

C
28971
Contact

N. 1100. W. 975. S. E. corner Sec. 25. T. 65. R. 6. This is a specimen of the greenstone conglomerate occur-



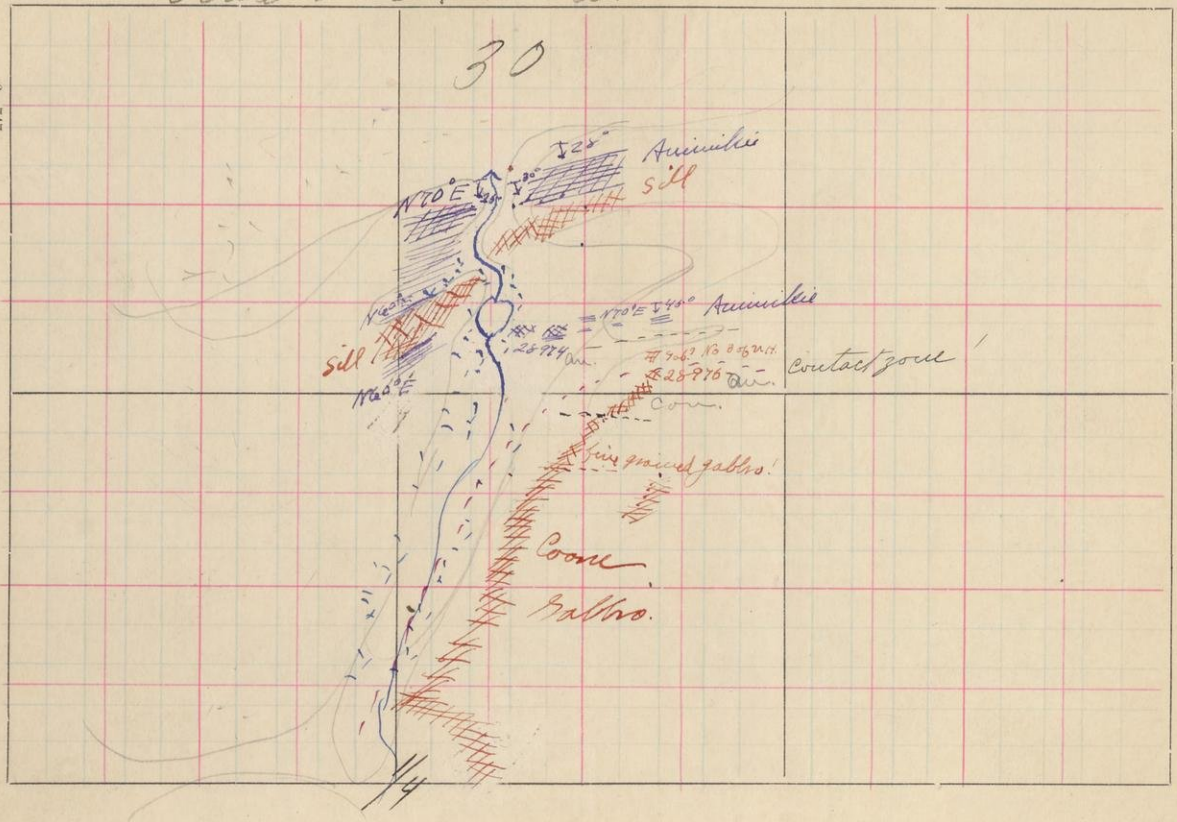
N 1100 W 975 - SE Cor. Sec. 25-6S-5E

ring just S. of the contact of the greenstone on the S. slope about 3/4 of a mile N. of Fay lake. This specimen shows varieties of pebbles.

28972 N. 1150. W. 975. S. E. corner Sec. 25. T. 65. R. 5. This rock upon the weathered surface resembles very much a tuffaceous rock. Compare the sections made from this with the tuff from Kakekabic lake. It may possibly be a conglomerate. Upon fresh surface it resembles very strongly a massive greenstone.

This afternoon, with Professor Van Hise and the compassman, traced the contact of the Animikie and the gabbro to the E. beginning near the drill hole S. of camp. While Professor Van Hise was ahead locating the contact I mapped the exposures with the compassman taking the strike and dip wherever possible. The exposures are fairly numerous but it is difficult to get a good strike upon them as the surface of the rock is so badly broken up. ~~on account of the apparently broken character of the exposures~~. The strikes vary considerably within short distances as do also the dips, indicating that the Animikie is by no means an unfolded formation but that

Scale 8" = 1 mile.



S. 30 T. 65 R. 4 Co.

6-747

there are many small rolls in it. Following this line to the E. it is found to bend down somewhat to the S. E. and the last exposure there observed strikes N. 65° E. and dips 70° to the S. To the S. of this exposure the gabbro occurs. Continuing E. from this point crossing low ground instead of finding Animikie, as one would naturally expect were it an unfolded formation, continuing straight across the country we reached at the point shown on the map a N. and S. trending cliff of coarse grained normal gabbro. The line was now run to the N. outlining this exposure of gabbro. In one place there was noted in the gabbro a dike of coarse grained red rock consisting apparently essentially of feldspar. This was about 25 paces wide and ran N. E., S. W. This is the normal red rock, is it not, of the Minnesota Survey which occurs abundantly about 15 or 20 miles S. of here? Is it not also the same as that described by Bayley from Pigeon Point?

This coarse gabbro continues N. to the point indicated on the map where it begins to become finer grained. This can be followed for some distance. This fine grained gabbro is fairly well exposed and can be clearly recognized up to the point on the map indicated by the E. and W. dotted line.

Am
28974 This is a specimen of a rock showing large plates of hypersthene with it which is recognizable as belonging with the Animikie. Associated with this rock there are some exposures of the recognizable Animikie on which a strike N. 70° E and a dip of 40° to the S. can be recognized. Going back S. E. an attempt was made to locate the contact between the Animikie and the gabbro. The exposures being poor it was impossible to draw sharp lines. Between the clearly recognizable Animikie and the next rock S. there is an area of no exposures of about 20 paces. Then comes an exposure of a fine grained gabbro from which Professor Van Hise's specimen, numbered in camp 3, was taken. S. of this and separated from it by about 5 paces there is an exposure of fine grained gabbro banded with a coarser crystalline quartzose rock which is recognizable as belonging with the
Am
28975 Animikie. Spec. 28975 is from this outcrop. S. of this then comes a
Q. Gabbro
analyze
doubtful rock which it is difficult to place with the Animikie on the one hand or with the gabbro on the other. The area in which the exposures of this contact phase of the Animikie and the gabbro occurs is about 60 paces in width. To the S. there is found

the clearly recognizable fine grained gabbro. Upon the map this intermediate area has been separated from the Animikie on the one hand and the gabbro on the other by dotted boundary lines. Going back into the Animikie I now ran N. with the compassman and located the N. side of the Animikie exposures. This ends in an almost vertical cliff overlooking a marsh; ~~there ran to the N. crossing a dolerite sill~~ on the N. side of which runs the old wagon road. I could not get a good strike upon the exposures here but took the strike of the cliffs as indicating the proper strike. The cliffs trend N. 70° E. The dip at right angles to this is about 25° to 30° to the S. I now ran W. and then S. with the intention of tracing the boundary line of the Animikie. The outline of this is shown upon the accompanying map. It is marked better by the topography than it is by exposures although the exposures of the Animikie are very nearly continuous upon the tops of the hills. There is a N. flowing stream which marks the line of contact between the gabbro on the E. and the Animikie on the W. The sharp turn of the strike of the contact between the gabbro and the

Animikie from a strike of nearly E. and W. to that of N. and S. makes itself very noticeable in the topography as evidenced by the fact of this stream flowing along it. One might be inclined to consider this sharp change as the result of a fault which has resulted in a block of the Animikie dropping back into the gabbro. It is difficult, however, to consider this as the true explanation, for near the point where the stream cuts across the Animikie preparatory to flowing on its northern boundary, it crosses a sill of dolerite. This sill does not show any faulting whatever but is absolutely continuous on both sides of the creek, trending to the N. 60° E. If these rocks have been faulted then it must have been prior to the introduction of this sill. The sills are of the same age as and were derived from the gabbro or else but slightly younger, having been introduced during late Keweenawan times. So far as we know faulting has not been a very common occurrence in this area since the formation of the Keweenawan. Ran S. back to the S. westernmost exposures of Animikie in order to trace out the eastern boundary line of the Animikie and also to check up the run. We checked very closely. From this

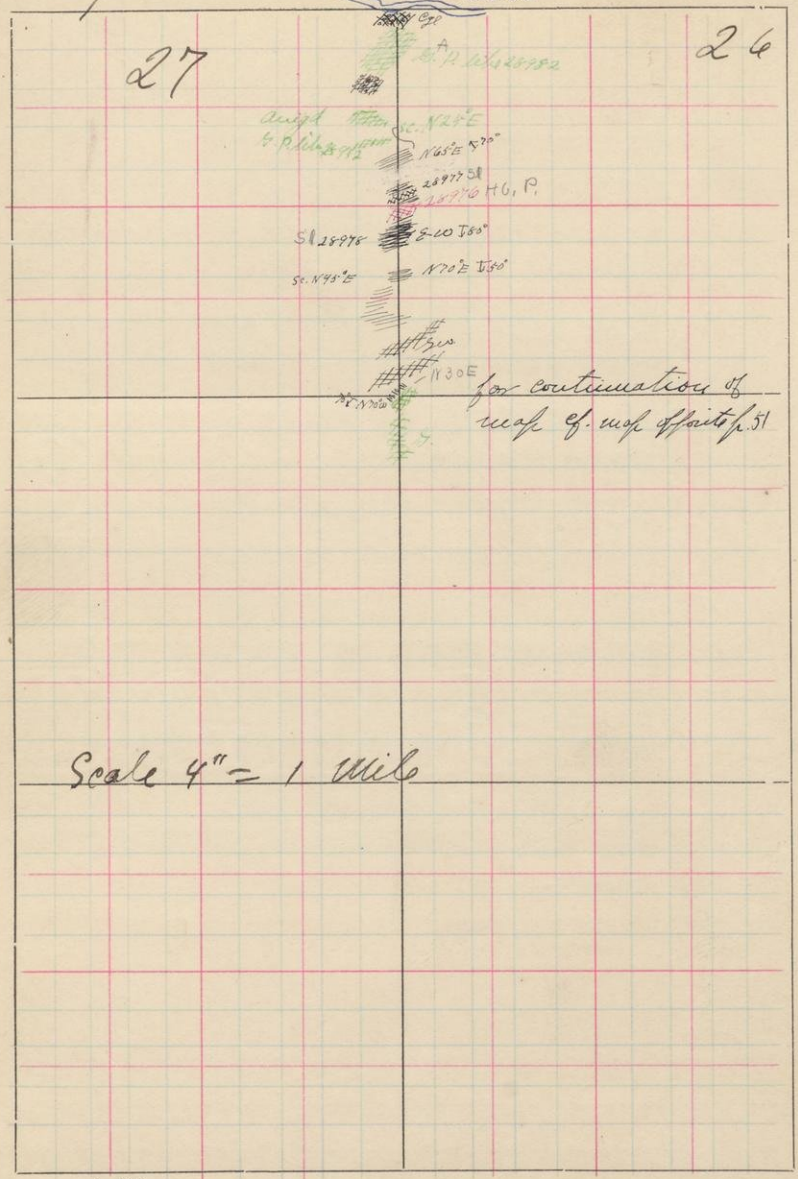
point now ran a line N. 45° W. It was now late in the afternoon so that I am somewhat doubtful as to the correct trend of this line. This is, however, not very essential as the only rocks passed over were those of the Animikie. Just before leaving the Animikie we reached some exposures, shown upon the map, upon which the dips and strikes were very different from those we were accustomed to get ~~from~~ in this area. They are platted upon the map. The strike varies from N. 70° W. to N. 45° W. and then to N. 20° W. with a dip of from 15° to 20° to the E. I am much inclined to consider these strikes as due to the fact that they were taken upon the sides of exposures and represent more nearly the strike of the face of the exposure than the true strike of the rocks. However, if correct, they indicate normal folding in the Animikie. A fact which the strikes already taken clearly proves. That the Animikie is not a perfectly straight formation is shown by the way in which this elbow of Animikie, traced out this afternoon, runs down into the gabbro. Having finished the work at the camp upon Fay lake we moved back to Ogishke Muncie. On ~~leaving~~ moving day Professor

Van Hise, Leith, and I visited the exposures N. of Paul lake. Here we found indications of a syncline of sediments, the Agamok slates, bending around the greenstone conglomerate and running to the N. into them. Moreover certain bands in the greenstone look like graywackes and resemble very strongly the Agamok sediments. It looks very much as though the greenstone conglomerate would be found grading up into these slates.

The slates show in places a spotted character. Similar rocks, if not these, have been spoken of as pepper and salt rocks. Is not this spotted character the result of the metamorphism of them by the gabbro to the S.? Do they not correspond in all respects to similar rocks mentioned as occurring S. W. of Snowbank lake?

Visited also the Animikie exposures on Gobbemichigomok lake. See Professor Van Hise's notes on this occurrence.

S. 26/27 T. 65- Ophiolite Mineral R. 6



G—747

Started in this morning near the M. C. between Secs. 26 and 27. T. 65. R. 6, on the S. shore of Ogishke Muncie and ran S. Near the shore greenstone conglomerate is exposed. This continues for a distance of about 75 paces. At this place there is a clearly recognizable amygdaloidal lava. Amygdules are formed chiefly of chert with chlorite to a less extent. White feldspar phenocrysts are noticeable on the rock showing an imperfect flowage structure. This lava is about 100 paces in width and is then followed to the S. by a large exposure of the greenstone conglomerate or tuff. Below this 1.2 & 5 after the amygdaloid again occurs and, ~~eventually~~ a marked topographic break separating them, is followed to the S. by Agamok slates. These strike N. 65° E. and dip 70° to the N. The schistosity of these slates strikes N. 25° E.

H.P.
28976
Vogesite?

S. 500. W. 0. From M. C. on the lake shore....At this place a knoll of porphyritic rock represented by this spec. was observed. Does this cut the slates here or is it overlaid by them? I think pebbles similar to this rock were seen in the Ogishke Muncie conglomerate.

sl

28977 S. 450 W. O. from M. C. on lake shore. At this point there is an area of E. and W. trending cherty rock about 50 paces in width lying in the slates. Is this merely a cherty slate or is it an igneous rock? It resembles somewhat the cherty rock found last year S. E. of here near the greenstone of the Twin Peaks.

sl

28978 carbonaceous S. 575. W. O. from M. C. corner on lake shore. In the midst of the normal slates there is found here a cherty slate which I suspect to contain considerable carbonate. The slates at this point strike E. and W. and dip 80° to the S. From this point I continued S. over enormous slate exposures followed by massive graywackes.

S. 1000. W. O. from M. C. on lake shore. ..... Here we find an exposure of normal finely banded Agamok slates. The strike of these slates is N. 70° W. with a dip of about 70° to the S. Lying S. E. of these slates there is found a fine grained massive greenstone which is traversed by numerous cracks. Between the greenstone and the slates, showing contact on both sides, there is an intermediate zone

Agricola Mercur
N.E.

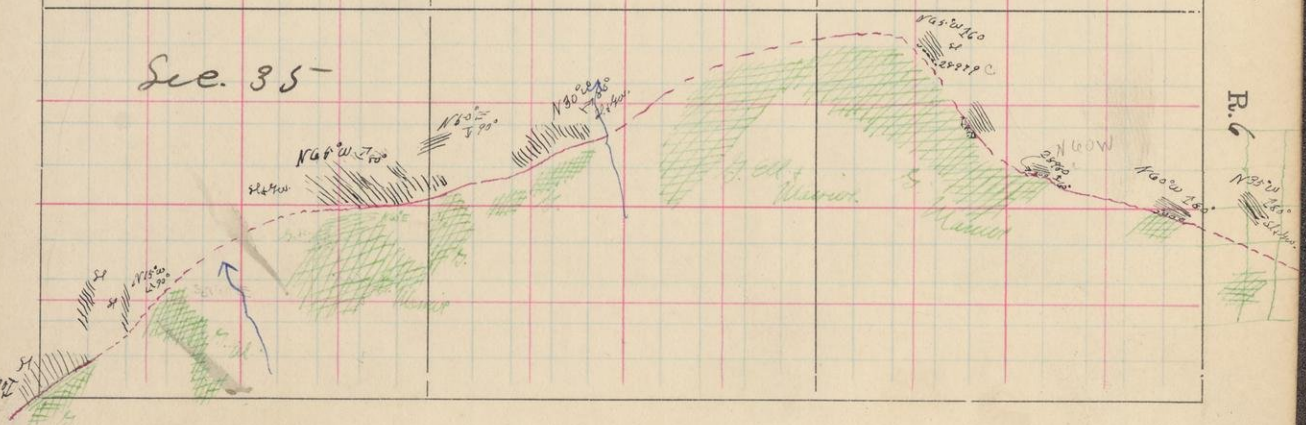
Scale 8" = 1 Mile

27

Sec. 26

Sec. 35

S. 35 T. 6S R. 6



about 3 paces in width which has a marked schistosity. The strike of the schistosity of this intermediate zone is N. 30° E. dipping to the S. E. As is seen the strike of the bedding of the slates is perpendicular to the strike of the schistosity of the intermediate zone. The exposure extends for about 40 paces N. E., S. W. and about 20 paces N. W., S. E. This contact does not give absolutely clear evidence of igneous relations between the greenstone and the sediments although it is strongly indicative of this. However, extreme folding might bring the rocks into such relationships. The fact that the greenstone is finer grained near the contact than it is when one goes much farther S. would seem to indicate that the relation was an eruptive one.

It was stated above that the greenstone was much broken up. This is so to such a degree that in places the surface of the greenstone looks much like a pseudo-conglomerate. From this place ran N. E. following along the contact line between the greenstones and the sediments with the object in view of determining their relationship. The exposures found are shown upon the accompanying map.

S. 900. E. 185. from M. C. on lake. At this place there is a large exposure of massive fine grained ophitic greenstone followed to the N. by a border of schistose material in which the schistosity strikes about N. 60° E. N. of this but not in absolute contact with it there occurs an exposure of interbanded slates with narrow bands of graywackes. The strike is N. 65° W. with a dip to the N. of 80°. The schistose material here is exposed for about 3 paces in width. To the N. of it there comes then a narrow valley and on the opposite side of this, distant about 10 paces from the schist there begins an exposure of the banded slates and graywackes. There is on this exposure a rapid alternation of the slates and graywackes and I could get no gradation upwards or downwards. Moreover I could recognize very easily the slates on the one hand and the greenstones of the intermediate zone on the other. Minor faults of 4 inches are common in the slates. The absolute contact of the slates was not visible.

with the schistose greenstone