p 51 Contd Next to this, as above noted, is the diabasic rock. See 583. Immediately below the felsitic rock is a much altered schist - a hematitic schist, the alteration has gone so far. In places the schist is completely altered to a soft red hematitic mass preserving the schistosity perfectly however. See sp 580. Other phases are fresher. The strike of the schistosity was N 55 E, dip 52° to the south. The schist was uniformly and perfectly schistose throughout a thickness of 25 ft and showed no signs of a decrease in schistosity or variation in any of its textures. See sp 582.

It would appear that possibly we have here an intrusion of a diabase into the green schists, which is later than Kewatin at least. The aphanitic or extremely felsitic zone is very pronounced and may be a true contact. Rock and soil slides interfered with getting a continuous section from top to bottom. It may be worthy of notice that all the rocks exposed north of the dotted line A-B, p 49 are massive diabase (greenstones ?) and south, green schists and greenstones. This line A-B may be an approximate line of contact between an intrusion of diabase into the green schists. The massive types certainly appear much fresher to the eye and less disturbed - apparently not at all, while in the schists to the south, there was a great number of fractures, contorted schists locally, and masses and stringers of quartz filling schistosity, planes, etc.

pp 52-53 T 46-41 Aug 27. Outcrop EE

In this exposure or group of multitudinous exposures(located as on p 50), we have the largest amount of visible rock seen to date. The south bluffs were approximately 800' long, 25-50 ft sheer face, and were at the top of the steep upward slope 200 ft high. The general direction of the bluffs was E-W with a sharp veering to the north on the west side, which ran N 35 W. There were two main systems of joints, one of which gave the vertical face to the bluff and the other, while it had the same E-W strike, dipped apporximately 60° plus to the north. Other joint planes intersected these at various angles and dips but none seemed to have any pronounced direction. No true schistosity was observed any where.

The rock is apparently the same kind of amygdaloidal trap as occurs in Sec. 5 and 6. It seems to be a series of flows and showed three(?) zones of amygdules with more or less amygdules in a great(?) part of the more massive phases of the rock. Some of the rock was very massive, well crystallized, and without any visible trace of amygdules. See sp 584. Specimens 585 & 589 illustrates the usual amygdaloidal character of the rock and also the peculiar form - pipelike amygdules. The minerals filling the cavities range from white to red and thro various shades of green. Much of the material seems to be red or white quartz and epidote or chlorite-epidote being very pronounced even in the rock matrix. (sp.586) showe usual type of amygdules, No 587 and 588 shows the character of the rock next a dense cherty "vein" like lenses of rocks which ramifies the exposures in sinuous courses. The rock on either side of the "cherty" veins weathers very vesicular. The "vein" material runs at first sight for the felsitic zone next a contact. It will be noticed that the vesicles are on both sides of the dense felsitic zone, The rock in the vein has a decided platy parting parallel to the plane of the vesicular zones, and weathers whitish. Its usual color is somewhat of a reddish brown to dark brown. It has a conchoidal fracture. If it is a plane of contact, why a vesicular zone on both sides ?.

p 53. The distance between the vesicular zones was about 40 feet. The apparent dip of the zones was about 40° to the north. This seemed to coincide with one of the major joint planes noted at the top of p 52. The three supposed flows were not traced for more than 25-30 paces, hence too much stress must not be laid upon their actual existence. Also there were some zones of amygdules which appeared to contradict the above supposition of three flows, as they did not seem to be in line or orientation.

Notes appended after Thurs. Traverse Aug. 29

The south bluffs were more thoroughly explored to the west of the line of traverse and the rock was found to be the same amygdaloidal trap. The E - W direction of the bluffs changes gradually until they run about N 35 W. Throughout the bluffs are very pronounced and 150-200 ft above the creek valley to the south. The "slaty" or "cherty" sinuous bands of rock were much in evidence and ramified the rock locally, though in irregular belts.

To the north the surface gradually rose for 200-300 paces and then a long decided slope to the north began and continued for a 1000 paces or more. The descent was, in general, very gradual, but here and there were sudden terraces 4 or 5 feet high facing the north. Rock was exposed on the north edges of these and on many low rounded knolls. Even on the level tracts, rock so near the surface that a staff could not be set up. All exposed rock appeared to be exactly like that seen in the south bluffs. In one place (see top of p 50) a zone of amygdules dipped northeast at an angle of about 35°. Fine glacial striae were noticed, extending due N-S. There may have been a slight deflection to the westward as the exposure faced the NW.

pp 54-59 Diagrams. P 58. Sp 592. Outcrop GG Low N & W facing bluff 4-6 ft high composed of the same amygdaloidal trap as in Sec. 4,5,6. See 592. No structures except joint planes which were without special orientation.

p 59 Outcrop HH Massive amygdaloidal trap, identical with that in Secs. 4,5,6, No structures noticed. Exposures were low south bluffs at the end of long terraces of south sloping surface. Bluffs only 4-5 ft high. No orientation of amygdules but a fracture system have a general E-W direction to the bluffs which were vertical ± . The bluffs were in two or possibly three terraces and each terrace result from the control by a nearly horizontal joint or bedding plane in the flows. Could not verify. Too much soil and limited exposure.

p 60, 61, 62. T 46-41. Notes and descriptions of outcrops on Trav. of Sept 3, pp 70, 71.

With R. G. Allen, visited pits located 450' N of ¼ corner 13/14. The quartzite and ferruginous red talc schist (Sp. 599-600) Appear to be from rock material in place and not from drift boulders. The point on the bank of the creek from which Spec. 800 (see preceding page) was taken proved to be that of an outcrop (No. ?) of red schist striking across the creek N 55E, with a southeast dip of 65-70°. The dip was estimated. Above the red talcose schist were quartzitic and talcose phases, gradations from the schist to the quartzitic rock. See sp. 801, 802, 803.

p 60. Outcrop 2. p 70. Located 120' E of the pits which were 450' N of ¼ cor 14/13, the beginning of the traverse. The outcrop was a low bluff on the south side of the creek. The rock was the same talcose schist as in No.1(cf. Sp. 800 and 580). The schist ledge also continued diagonally across the stream striking N 25 E, dip 58°. The schist was extremely altered and soft, breaking in fingers.

Book 268 - 7 insert after page 11

p 60 Outcrop 3 p 70. Found 250 p aces E of Pt. Y. The beginning of traverse and also on south side of the creek. Schist ledge struck across the creek at N 55 E. Dip 52

Outcrop 4 p 70.
Found 25' north and east of No. 3. Part of large No.3.

Outcrop 5 - p 70
Found 50' N of No.4 and on the bank of the stream. The outcrop consisted of a bluff 10 ft. high and was badly broken up and gave evidence of much slumping. Red talcose schist as before. (Not see further on p 64. R. C. Allens Notebook No.1, 1912

p 61 Outcrop 6 - p 70.
Consisted of flat lying and extremely disintegrated beds of sandstone and conglomerate. Sp. 805, conglomerate 806. Matrixal conglomerate 812. Bag of pebbles from conglomerate layer.

Outcrop 7 - 70.
A ledge of sandstone and conglomerate on the north bank of the creek 50' N of point X at which traverse began east again. See p 70. Ledge was exposed near waters edge and in bed of stream. Rock was the same as in 6 but was much less disintegrated and altered. See sp 807.

Outcrop 8.
Consisted of a ledge of the same sandstone but exposed at 8 or 10 ft. higher on the bank 80'N, 35 E from Pt.X see sp. 811, a felsitic red sandstone with fine conglomeratic layers of quartz, the size of wheat grains, is well cemented and hard.

Outcrop 9 p 70
Outcrop of red sandstone and cong 35-50 ft high 200-300 paces long. beginning at the mouth of the small creek traversed and extending down the north bank Of the Ontonagon River. The color was brick red. The rock occurs in beds varying from 2-3 in. up to 3 ft in thickness. The lower beds at the waters edge appeared to be hard like sp and upward in the section were alternating soft and hard beds. The first are predominately thicker than the hard. The soft are friable and crumble into the constituent grains between the fingers. Rock shows jointing very faintly in five rectangular directions. No joints extend thro entire section. Beds independently jointed but very faintly. Strike N 78 W, Dip 10° N. Dip was pronounced to the eye, especially on the convex side of the outcrop extending south. See sp. 813, a coarse grayish sandstone, well cemented and breaking much like a quartzite.

p 62. T 46-41. Sep. 3. Outcrop 10.
Consisted of massive cross bedded sandstone on the north bank of the Ontonagon. The bluffs were from 8-10 feet high. Strike N 78 E. Dip was found gentle but pronounced to the north, probably between 10 and 15°. See sp 814, a coarse, grayish brick red sandstone, resembling a quartzite, it is so hard and well cemented. White flecks of lime however appear in the interstices of the grains.

Further notes on specimens. Sp. 810 taken from a boulder at the top of outcrop 5 and is true quartzite and apparently belongs to the Huronian. 809 likewise but taken from a drift boulder a short distance, 10-15 paces north from 810.

pp 63- 69. T 46-41 Diagrams of traverse.

p 69 T 46-40 Sep.2,1912 General remarks.
The whole country from the middle E-W line of 46-40 descends rapidly into main series of declivities to the north and beyond E-W line between 8/9 and 17/16. The country is generall flat, inclined toward being swampy and broken only by deep ravines near the Ontonagon. Very little evidence of rock outcrops in the vicinity of the Ontonagon. Soil is very red, often clayey and filled with rough fragments of sandstone, apparently Keweenawan (?)

pp 70-71 Diagrams.

p 72 Traverse Sept.5. Outcrop No. 1
We have in this outcrop a 10-45 foot bluff of greenstone and green schist. The length is about 350 paces extending S 52 W. The cliffs on the north have a zigzag appearance from the fact that two systems of joint planes are very pronounced, one having a strike of S 60 E and the other at right angles to it. The systems are both near the vertical, dipping to the north slightly. Toward the north, the surface slopes from the base of the bluffs for several hundred paces. On the south the surface rises at about the same slope and then it slopes downward into a parallel valley bordered on the south by a high line of bluffs, which appear to be further rock outcrops. These are on the line of traverse from the east and will be intercepted on the return this afternoon.

The rock is a coarse green schist for the most part, - typical of some phases of the Kewatin. The cleavage is pronounced yet the laminae are thick, resembling a gneiss. The strike is S 52 W, Dip 40° S. See spec. 515. At the top there was a more massive phase, varying from a whitish to gray quartzitic

pp 73-78 diagrams

p 73 T 46-40 Continuing above paragraph. appearing rock. This graded into green schist with hornblendic phases. The schistosity had approximately the same dip and strike as the rock at the bottom of the bluff. The schistosity however was less pronounced, the massive rock predominating. On the whole the rock had the complex character usual to Kewatin greenstones and green schists. See sp. 515. Gr.Sch. and 516 Gr stone.

On continuing the traverse eastward along the section line between 18 and 19, the outcrop described above is found to continue eastward to the ¼ post of 18/19 and for 200' north of the same point. The line of bluff continues from the first but these swerve almost directly north and then again to the eastward. These north bluffs are at approximately the same general height as the first but they are fully 40 to 50 ft in height for 400 paces or more. The surface to the north descends by a decided slope for a half mile and more, ending in swamps on a flat country. The surface toward the south is rather flat resembling a terrace, which is at the foot of still higher country south of the section line between 18/19.

The rock is predominantly a green schist but of much finer texture and of little schistosity, there being much more of the massive greenstone than the schist. The joint planes had the same general direction and dip as those in the first part of the description. See sp 517.

Book 268 - 9 insert after page 11.

Pp 78-79 Contd. The bed of the creek which runs parallel but just to the west of the line of traverse in Sec. 18 is filled with angular fragments of sandstone similar in all respects to the outcrops of sandstone found along the north bank of the Ontonagon in Sec. 13, T 46-41. Search was made for an outcrop in the bed of the creek but none appears to be present, though the creek bed was closely examined to fully 500 paces. Toward the upper stretches of the creek, the sandstone fragments disappear and greenstone trap, etc boulders take their place. From the great abundance of the fragments of sandstone and their extreme angular condition it certainly might be inferred that sandstone lies in place but a short distance beneath the surface.

On crossing the Ontonagon, it was observed that the drift of the banks are very red, sandy and often full of red sandstone fragments. Specimens were not taken nor was a very close examination made, it being deemed not worthy of special notice at the time. The general appearance of the angular boulders is that of the sandstone found in Sec. 13, See p 70.

Outcrop 2, p 73.

Here we have a low ledge of rock outcropping along the north edge of a high ridge running approximately S 65 W for 500' paces. The surface above the ledge rises steeply to the crest of the ridge 200 paces south and to the north descends toward outcrop No 1. The joint planes give an approximate direction to the bluff of S 65 W. hence these points, i.e. joint planes and direction of bluff are in correspondence. (p 80). In places, the ledge has a zigzag front from the intersection of the joint planes parallel to the face of the bluff with another set approximately at right angles.

The rock is a very fine, dark green schist, resembling a green slate, but it is harder and gives a clinking sound when struck with a hammer. Ma ny of its gradational phases are pure fine green schists typical of Kewatin schists in general.

General notes on T 46 - 40.

The ridge of high country running through 19,20,21, slopes rapidly to the north. The first sharp descent terminates in a series of bluffs 10-50 (or more) ft high, which extend in general through the southern part of 18,17 and 16. From the foot of these bluffs there is a decided slope northward for a half mile or more, this slope terminating in another series of bluffs forty to 60 ft(often more) high. The surface from the bottom of these bluffs is flat and swampy, but is cut up by bayous, sloughs, etc which are evidences of the past work of the Ontonagon River, which runs through this bottom country. Indeed this land has been made by the river itself. North of the river, the bluffs are however drift, face south, and appear to be generally level, except where V-shaped valley have been cut in the red sandy or sandy clay drift by the various small streams. There is little evidence of outcrops in the way of abrupt slopes, high prominences, etc, except in the V-shaped valleys noted above. The country is so flat and there is so much of the fragmentary sandstone in the drift that it would appear that sandstone lies beneath the surface.

p 82. T 46-41 Sep. 6. In company with R.C.Allen and L.J Youngs, a trip was made north on the ¼ line of Sec. 14 up to outcrops DD and EE. From an examination of DD, it appears that, from the facts that a well crystallized diabase grades into a dense dark gray aphanitic rock and this in turn is next to an intensely schistose zone 200' or more(inferred from data on p 70) in width - the diabase represents a volcanic plug, the aphanitic zone a contact and the schist is a resultant of such intrusion.

p 82 contd. On the other hand the schist may be a shear zone of a great fault, the displacements being along the schistosity planes instead of along one or more major planes as in normal faulting.

A study of the topography was made with the idea of making a profile and a geological section from the Ontonagon, across the green schists and diabase to the traps on the north. The profile and section was drawn along the ¼ line of Sec. 14 and 11, See pp 50 and 52.

In crossing the creek at the foot of outcrop DD there was observed a flat creek bottom, 150 paces wide. This is strewn with boulders of trap, greenstone, sandstone, granite etc. From this bottom land, a steep slope rises to the north to the height of 100 ft. and then it becomes a gently rising slope for 100 paces or more, to the base of a second steep talus slope which rises steeply upwards for 75 or more feet (p83) where it becomes much flatter and terminates at the foot of nearly vertical bluffs of trap 30 to 60 ft sheer. The first steep slope and flat area at the top was notably strewn with sandstone boulders, the second with trap almost wholly. From these facts it may be inferred that sandstone lies below the first talus slope and trap below the upper terrace. While these facts are significant, more confirmatory evidence should be secured before making a positive statement.

From outcrop EE the traverse was made to the creek platted on p 70 and the outcrops from 2 to 9 reexamined. By digging away the small talus accumulation at the foot of outcrop No. 6, the contact between the sandstone and the red talcose schist was found in the creek bed. Thus the actual unconformable contact between the Kewatin schists and the sandstone above confirmed the conclusions drawn on the occasion of the Sep. 3 traverses.

After crossing the Ontonagon river at outcrop No.9, the traverse was continued up stream along the south bank. Outcrops of a massive diabase with gradational ? phases into schists similar if not identical with the red talcose schists in outcrops 1,2,3,4,5 of Sep.3 traverse, were found to be almost continuous from outcrop No.9 to the intersection of the ¼ line of Sec.13 with the Ontonagon River. The river apparently is governed in its course largely by these schists (p84) which are soft and rotten and easily attacked. See sp 820(diab),821,822(schists) 819 (qtztc sch).

Since the diabase grades into the schists, the former can hardly be considered the plug, filling the vent through which the lava was poured forth to form the traps to the north and west. Further, the sandstones to the north lie directly on the schists which seem to be a part of these schists along the Ontonagon river. If so, the diabase and associated schists are older than the sandstones and the traps superimposed on the sandstones.

Specimen 819 was taken from a boulder of qtz por which was found on the lower terrace south of outcrop EE. From the abundance of qtz porphyry in the drift it would appear that there must be associated with the known rocks of the south Trap Copper Range, flows of such rocks.

pp 85-105 Diagrams.

p 89. Outcrop No 1 is a very fine dark green schist outcropped in the road bed half way up a steep north slope, which belongs to a practically E-W series of ridges. Exposures is only 20' but shows fine schistosity, glacial striae. See dip and strike of former and direction of latter. Schist blebby with qtz. Common type of green Kewatin Sch. see sp 824. Cor.21,22,29,28, 35 'S 55 E. from center of road.

p 89 Outcrop No 2 is the same in character as No. 1.

Outcrop No.3

This is a small outcrop, exposed in the road bed through a cut in grading the road. The schist is essentially the same as No. 1 with fine schistosity, blebs and stringers of qtz.

p 91 Outcrop No. 4.

Outcrop No. 4 consists of a small ledge of rock, green schist exposed by the grading of the road bed. It is barely 15' long and 5 paces wide. The schistosity is very pronounced much coarser than in No. 1,2,and 3, and has much of the appearance of specular hematite , or better, micaceous hematite. It is very heavy, apparently high in iron, and has a large number of small crystals of garnets or perhaps quartz, around which the schistosity curves beautifully. Quartz was observed in blebs and stringers. Strike s 75 E, Dip 87° N. See sp. 825.

pp 92-105 Traverses. p 105 Remarks.

This traverse had for its object the finding of the Keweenawan amygdaloidal traps. No outcrops were found nor any indications of such. The high moraine in Secs, 17,18,8 and 9 is entirely composed of fine white or gravelly sand. All the rest of the country traversed was flat and inclined toward being swampy, except that north of the C & NW Ry. This area (?) also appeared to be without outcrops. If there are any traps present, most careful search and much patience will be required to locate them.

p 106. Outcrop no 1.

In traversing westward from the Cor of Sec. 14, point given us by G.B.Corless Book 1, p , there was observed all along the line of traverse a low yet decided rise to the south. At first this rise was noticed to be some 2-300' to the south. At the approximate ¼ cor between 15/14 the traverse was turned south to blaze up nd register a tree on the trail to the deer licks, this point to be afterwards used as a point for starting traverses to the south. The trail was found 355 paces south of the corner and the proper register made. This southward diversion to the south brought us near the rise to the south, so that the north edge of the rise, which ends in a terrace, was near enough for observation. As the strike of the terrace is S 25 E, the line of traverse intercepted it. At the point of interception, rock is exposed along a low ledge four to six feet high for about 75 paces. Rock is undoubtedly close to the surface along the face of the terrace but it could not be discovered except at one place (outcrop 2) where an overturned tree has exposed it for a few paces.

From a point 250 paces east of outcrop No. 1 to the end of the traverse there is a decided rise of level country to the south for at least several hundred paces. There is also a northward continuation of this slope from the foot of the terrace above mentioned and this extends for 200 to 300 paces or even more. The average dip of the (p 107 diagram T 46-40) (contd p 108) slope is from 8 to 10°. The general aspect of the slope, the terrace, salty (or at least mineral) springs is exactly a counterpart of the north slope of outcrop EE p 50.

The joint systems were rectangular, intercepting one another at approximate right angles. One set being strike joints dipping south at about 80°, and the other dip joints being nearly vertical. The overhanging ledge to the north, though low, is most significant when taken in connection with the supposed 8-10° north dip of the traps in question.

p 108 contd. The rock is very massive, fine grained, tough and amygdaloidal, the amygdules being filled with epidote, laumantite (apparently), quartz, etc. The epidote occurs mixed in with other minerals in the amygdules and also all through the rock both in small flecks and in large masses. The laumantite is dark red, finely crystallized, appearing very much like very red orthoclase. In fact, the fine cleavage, dark red color, etc are so strikingly like much altered orthoclase, that it was first thought to be that mineral. In such a basic rock however, it can hardly be conceived that orthoclase could be present. The rocks are so little metamorphosed, in fact, none at all by dynamic forces, that injection by granite or/ and intrusion seems out of the question.

The amygdules occur in great numbers and give a reddish appearance locally to the rock from the abundance of laumantite ? in them. No separate flows could be noted or any evidence of any except that the terrace previously noted may represent the north limit of an upper flow and the rock beneath the slope from the foot of the terrace represents a lower flow with further northward extension.

Diagram.

The springs may have their origin at the base of the terrace and from contact or bedding plane. This could not be ascertained with only a cursory examination made in the rain. As the next traverse north begins at the Deer Lick further observations will be made. Sp. 826 illustrates the general nature of the trap and the occurrence of the amygdules. The rock seems to be identical in texture, structures and amygdule filling as the traps in Sec. 5 and 6, 46-41. Glacial striae were noted and these have a direction of S 35 E.

p 109. Outcrop No. 2 occurs about 150' west of No. 1 and is really only a part of No.1. It is an exposure only of a few paces at the roots of an overturned tree.

Outcrop No. 3 will be described in next traverse. Rain began just as this outcrop was reached.

pp 110-113 Traverses in diagram.

p 114 T 46-40. Outcrop No. 3.
Upon further examination this outcrop is found to be a group of exposed glaciated surfaces of small extent, being brought to view chiefly by the overturning of trees and the trampling of deer, which frequent this place in great numbers to drink the water which oozes out at the edge of the rock. The outcrops are on the south side of a long slope from the south and at a point midway down the slope where there is an abrupt declivity or steep slope. The drift is thin on this terrace-like prominence, hence the exposure is smoothly glaciated, showing only rounded shoulders and surfaces. The rock in fact was so smooth that no specimen could be obtained, but from an examination of the cleaned surface it is very amygdaloidal, the fillings however being apparently epidote and chlorite, instead of the red laumantite, as in outcrop No.1 and 2 of Fri Trav. Sept. 13, see sp. 527. The ice movement was S 35 E.

As a whole the position of the outcrop was very similar to that in No 1 and 2 (trav. Sep.13) and doubtless whatever relations the traps have in those positions, also obtain here. The profile of the slope is exactly similar.

Small diagram of above slope.

p 115 T 46-40. Sept. 14,1912. Outcrop No.1
This exposure located 110' N of ¼ cor at 16/15 consists of a ledge of rock some 8 - 12 feet high, running S 75 W. The ledge occupies the same topographic position in the middle of a long pronounced north slope as outcrops 1,2 and 3 of Fri. traverse, but the ledge is far more abrupt than in No. 3. The rock is an amygdaloidal trap similar to that in No. 3. None of the red laumantite ? was found, the maygdules being for the most past filled with chlorite and epidote.

In "beating" our way east back to the camp our course was along the edge of the line of terraces situated midway up the long slope previously noted. For most of the way the slope is continuous so that all four outcrops appear to be a part of the same flow of trap and that they are only the north edge of a much larger body to the south and west. It must be said however that in one place a long N-S gully extends well to the south cutting into if not across the traps, thus dividing them. The western border of this gully cuts off the end of the ridge of outcrop No. 1, so that there is a low ledge running due south for a considerable distance before it dies out.

Sun. Sept. 15. "All hands" observed Sunday in camp as the last one in which all would be together again for the year.

p 116 T 46-40 Diagram of traverse.

p 117 Sept. 16. Outcrop No. 1.
In company with B. Fellows, compassman, a traverse was made south from Point A, p 107 or Outcrop no 3. The surface rises steadily southward at an angle varying from 8-10 to 12-15°. Trap boulders cover the surface everywhere and indicate the nature of the rock below the thin drift. At 500' south of outcrop 3 above, a high ledge of rock was observed 200' to the west. This ledge extends westward 100 plus paces veers to N 75 W and then to N 35 W where it becomes covered with drift just as at the east end. The south face of the ledge varies from 25 ft sheer at the east end to 60 ft at the center and then decreases to about 25 ft on the west where it disappears under the drift.

There seems to be present two or three distinct flows of trap. At the top of the outcrop and about 25 paces back from the main cliff is a low (8-10 ft) ledge of rock, running roughly parallel to the main cliff until the two cliffs merge with one another where the bluff veers toward the northwest. The relation of the two ledges is that of a pair of steps, the lower one being much higher and larger. Besides this significant topographic feature where the two steps merge on the west there is a distinct scoriaceous zone between the two. The rock in this contact is so rotten, full of cracks, amygdules, that no specimens could be gotten out in whole. Spec. no 528 illustrates this scoriaceous contact, though taken from a similar zone between the large ledge and another ledge still lower. The softer weaker nature of the contact is further shown by the weathering.

The large bluff is made up chiefly of two flows, the larger one mentioned above and another immediately below. The contact between the second and third comes close to the talus slope and disappears under it on the west, owing to the (p118) dip of flows, which appears to be 10-15°. Only an approximation of this could be determined as the contact zone was somewhat irregular and relatively short. The diagram on the opposite page (diagram p 119) illustrates diagrammatically what is observed when the outcrop is viewed from the west.

p 118 contd. The bedding planes dip approximately 10-15° (estimated) N 35 W. The dip is certainly not directly north in this outcrop as appears to be the case, in most of the trap outcrops noted thus far. And there were both strike and dip joints which give a rectangular block effect most noticeable where the face of the large bluff changes from E-W direction to a northwest. In fact, the face of the bluff at this point has a zig zag appearance from the intersection of the two systems.

The rock as a whole is amygdaloidal but the amygdules are few in number toward the base of the two flows or away from the top of each. The top of No.2 and 3 is really very scoriaceous the rock weathering easily, breaks in to a mass of small particles and fragments. This is shown by spec no 828. No 829 was taken about 2 ft above the scoriaceous zone and shows the much more massive and dense character. No 827 is more typical of the massive part of the rock as a whole, and was taken from near the top of the large bluff. See diagram.

p 119 Diagram.

The height of the trap bluffs above the creek bottom was estimated at about 150 ft and the distance from the creek to the face of the bluff 100 paces. Assuming that the outcrop in the creek bed is at the top of the quartzite, it appears that the traps may have here a thickness of approximately 250 feet. As there are traps 500 plus paces north and the north slope from the outcrop under discussion to outcrop no 3 of Sept 13, p 107 is certainly ? less than the dip of the flows above, other flows may be superjacent to these, thus adding to the thickness. To arrive at any good approximation of the thickness of the traps here, a set of levels would have to be run from outcrop No. 3 of Sep. 13 to to outcrop no 1 and 2 of this traverse, and also a better determination of the dip of the flows made.

p 120 T 46-40. Outcrop No.2.

Proceeding south from P(oint) B, p 116, which is at the foot of the high bluff, a talus of great trap boulders was crossed (25-30' wide). Trap make up most of the boulders but there is considerable of quartzite and sandstone with minor amounts of quartz porphyry, granite, etc. A terrace begins at the foot of the talus and extends in a belt 25-30' wide along the edge of the talus slope. The terrace ends in an abrupt descent of 25-30 feet to a river flat of boulders (trap mainly, some of quartzite, SS etc). A few paces from the foot of this descent there is a former channel of the creek which now flows in a parallel course on the opposite side of a boulder ridge a few paces south. The present course of the creek is about 100' from Pt A at the foot of the bluff. The creek bed is really a tortuous water course through or between great masses of angular (for most part) trap boulders, some ten to 15 ft across. Other rocks were in evidence as above but trap predominated. The creek which runs approximately N 35 W from Pt. C was examined for 500' down stream for possible outcrops but none was found. The south or rather west bank of the creek is a typical sandy morainal deposit of every conceivable kind of rock, most of which were well rounded. The drift all along this side of the creek is of the same nature.

Crossing the creek which runs southwest at this point, and proceeding south along the west bank for about fifty paces, outcrop No. 2 was encountered. This outcrop consists of a series of at least six distinct quartzite ledges, striking due east-west across the course of the creek and dipping approximately 20° to the north and under the traps 100 paces away.

The profile on the opposite page(121) viewed from the east, gives a diagrammatic illustration of the conditions obtaining here.

Diagram. p 121

Book 268 - 15 insert after page 11.

p 121. The creek comes in from the west along the strike of bed No. 1, and then cascades down towards the north, over the edges of the six beds represented above. As the top of a quartzite layer could be seen under the water south of ledge No.1, it really is not a questionable bed as marked above. Its edge simply, is covered by the bouldery material (drift ?) to the south where the stream comes in from the west along the strike of No. 1. No 7 bed is doubtful as it is about 100 paces long and allowing an average dip of 20°, the sandstone appears to be in the neighborhood of 100 ft in thickness, probably more.

Spec. No. 530 is a fine grained reddish quartzite taken from ledge No. 6, the topmost bed. No 531 is from No. 1 and is considerably coarser, but otherwise not different.

There are strike ? and Dip ? joints most beautifully developed but they do not intercept exactly at right angles, hence make diamond shaped patterns. One set strikes N 35 W and seems to be more nearly to conform to the dip and the other N 45 E, to the strike. Both systems are at right angles to the bedding and give rise to the sharp ridges of the outcrop. It will be noted that the direction of dip of the quartzite does not accord with that of the traps. This may be due to inaccurate observation rather than to any real discordance.(Special attention was called to the last two sentences above).

p 122 T 46-39. The line of traverse eastward from the ¼ cor of 35/2 was through very morainic country, in which there was observed a great abundance of green schist boulders, conspicuous among which were those filled with blebs and stringers of quartz. The same may be said of the first half mile of the traverse north, and to a lesser extent of the second half. Timber and brush were such as to obscure such observations in the last part of the traverse, although both trap and green schists were noted at various points, but not in conspicuous number.

The traverse east was begun where L.J. Youngs and R.R.Havens began their northward traverse. See L.J.Youngs note book. All three parties, Corless and McElwain, Youngs and Havens, Smith and Fellows, started from the Sec. cor 32,33,5,4, p 90 of this book. Each party set north at half mile intervals in order named.

pp 123-130 diagram of traverse.
p 130. A supposed section line was found crossing just above the large or last fall of the series of falls and rapids, by R.C Allen and C.P.Links. A squared tree was found on this line at the river edge and given us as the location of the N ¼ of Sec. 1. Upon traversing south from this point, it was discovered when near Barclay that the location was neither on a quarter line or from a quarter post, as the traverse of 1½ miles was made with reasonable care. The south course of the traverse was changed to west for 400 paces and then south to the established 1/8th post on the C & NW Ry at Barclay. See Pt A, p 125 of this book. Traverse of Sept 17,1912.

p 131 T 46-39 Sept 18.
In company with G.B Corless, geologist and B.FEllows, compassman (also C.P Links) a trip was made to the falls of the Ontonagon located as follows; 3500 paces N and 425 E of the ¼ cor of sec 14/13, or approximately 1½ miles north and ¼ mile east of Barclay in T 46-39 N. The Big Falls of the Ontonagon consist of a series of cascades over the upturned edges of trap flows and one sheer fall of some 30 ft over the north edge of these flows.

p 131 Contd. In short the river flows along the strike of the traps at first and finally is forced to cut almost directly across the edges of six distinct flows. The traps dip north and the general course of the stream is approximately the same. More exactly the traps dip N 15 W at angles from 15 to 20° degrees and strike N 75 E. This gives rise to a saw-tooth effect with the steep side of the teeth up stream. The diagram on pp 126-127 and the sketch on p 128 shows more specifically the course of the river, the flows, their dip and strike, and the saw-tooth effect, together with the approximate height of the falls, thickness of the flows.

A thorough examination of both sides of the river was made in order to ascertain the best place to run a set of levels from the rapids below the falls to the top of the farthest trap outcrop to the south. After this investigation, a series of levels was run on the east side of the river, beginning 70 paces below, the falls to a point 435psouth on a course S 55 E. From the results of this examination and of the set of levels made, it (p 132) appears that there are at least a series of at least seven distinct trap flows, each expressing itself in a ridge of low slopes to the north and a steep declivity on the south. There are two other doubtful flows as indicated in diagram by query marks. These doubtful ones are not in accordance with the dip and contour of the other exposed ledges.

In fact they appear only in the bed of the stream as abrupt or vertical descents, which are in harmony with the nearly vertical strike joints observed in the traps. But this latter fact is not at all conclusive evidence that another or even two flows are not present as there is sufficient room for them to occur between No 2 and No. 3.

The rock ledges, excepting the two doubtful ones noted above, are continued on either side, or at least on the east side of the stream for 100 - 300 paces. Fire has removed the timber and the scanty peaty soil from the rock surface on the east side, so that almost all of the rock is completely bare. This afforded the best of opportunity for a study of the flows, their position, strike, character, etc.

As a whole the flows are conspicuously amygdaloidal. In fact, the rock is in places very scoriaceous and vesicular, the amygdules composing almost all of the rock mass. The amygdaloidal nature was all the more pronounced by the fact that the flows are relatively thin, and dipping at the low angle of 20° show a much greater amount of the amygdaloidal surface than of the massive. Indeed, it was at first thought that there was no massive rock exposed and that the rock was wholly amygdaloidal. Upon careful examination along the steeper face of the ledges, Nos. 1,2,5,6,7, it was found that each flow furnishes a fine example of a vesicular top and a dense or massive base. Flow No. 7 furnishes the best example. No. 4p nearly as good, and No. 2 a poor one, only because of a smaller exposure. All of the others show such distinct and convincing differences between top and bottom, that there can be no doubt about what is the top and what is the bottom of the respective flows.

The - leveling was done by B. Fellows, using his eye height (5 ft, 3½ in) as the unit of measure. This unit was used in platting - the eye height being equal to one tenth of an inch. The height of the falls, using this unit, appears to be not far from 100 ft. From the map on p 128 the width of the trap exposure is about 400 paces. Allowing for dip, the traps exposed do not appear to be more than 100 ft in thickness. Very possibly others lie lower but do not outcrop at the south, as a heavy moraine covers this region.

p 134. Specimens 832 - C 833, C 836 were taken from ledges No 2 and illustrate the change in texture and structure from bottom to top of exposed south face of this ledge. Sp. 834, 835, 837 the same for ledge No 4 which was a small one but had an extremely vesicular top. No specimens were taken from No. 7, the finest exposure of amygdaloidal and massive trap as the face was so smooth that none of the massive variety could be obtained.

The dips on these flows were taken with great care and often checked with the Brunton compass dip level to avoid any error. At first sight the dips were estimated at 25-30° but none of the compasses gave a reading higher than 21, and this reading was thrown out as it was on the surface not accordant with the general dip slopes. No 6 on the west side of the river gave a dip of 25° according to C.P.Links, compassman for R.C.Allen, on the occasion of the latters visit there some days previous to this traverse under discussion.

p 136 Diagram of traverse Sept.19, T 46-38.
p 137 Outcrop 1.

This outcrop extends along the Ontonagon river for some 250 or more paces, striking due W or N 75 E, the strike varying considerably in places as the green schist is much contorted locally. The dip appears to be on the average S 73, varying from that to a vertical one. This schist outcrop with greenstone phases extends east and west under drift which on the east side of the river forms a high moraine. The schist is the typical form of the blebby, quartzitic green variety such as found in 46-41 (see sp 1-5, p 70-71).

Diagram

The schistosity however is very perfect cleaving like a sericitic slate. R.C. Allen visited this outcrop hence see his notebook for description etc. This traverse, owing to a lack of a good map, was made under a misconception that traps might exist in an outcrop in the north part of 46-38. The general line was directly through continuous swamps and of wide extent on either side. The swamps finally became a series of impassable bayous and bogs so that further attempt at progress north was not worth any possible advantage to be gained. After fording the river at the junction of the Dead Mans Creek and west branches of the Ontonagon, a trail was found that led to Calderwood Mills. Corless and Links were found at this point having encountered the same sort of topography. After dinner Links and Fellows were sent to camp and Corless and self continued the traverse from cor of 6/7 on Calderwood Logging Ry to west and north to the sandstone outcrops in 47-39 (near center of Sec.36) as shown by Corless notebook No.2, p 107-108.

p 138. The sandstone outcrops along the east bank of the Ontonagon for a distance of some 50-75 paces and again in a railroad cut 134' beyond (north) this point. It is a very flat lying, coarse to fine grained red to yellow white, friable sandstone. The red is a very dark brownish tone, often mottled with white spots or the red and white occurs in bands. One specimen, No 839 shows the white in contact with the red variety. Sepc. NO 840 shows a large pebble of quartz in a much finer matrix of red sand grains. On the whole this sandstone bears little if any, visible lithographic resemblance to the Keweenawan sandstone observed in Sec.13, 46-41. Outcrop 9-10 pp 70-71 of this book. Sp 841 is a specimen of the coarse friable white variety taken at the bottom of the exposed ledge.

pp 140-147 Diagram of traverse.

p 148. T 46-38 Sept. 21,1912 Outcrop 1.

This outcrop lies in the bed of a creek and was about 50 paces east of the line of traverse. It was only discovered (high water) through noting that the sandbars were largely composed of fragmentary shingle of green schist and greenstone. On making an investigation up the creek, a ledge of greenstone and green banded schist was found extending across the bed of the stream. The ledge on the east side is made up of a very fine green banded schist and on the west side of a massive greenstone showing little or no evidence of schistosity. The strike is N 81 E, dip 88 S or vertical. The greenstone locally seems to show a slight cleavage parallel to the schistosity of the schist and the weathered surface indicates the same thing. Great blebs of quartz, one 2 ft across and the greenstone nearly parallel to the schistosity. The schist and greenstone is the typical variety with quartz in blebs and stringers. It differs in no detail from that found at the Upper Falls of the Ontonagon (p 136 of this book) and at many other localities farther west. See spec No 842 which includes a piece of the schists and one of the greenstone in actual contact. Sp. 843 shows the banks to be different in color, texture and weathering properties.

A second ledge of greenstone and green schist blebby with quartz and similar in all respects to the one above was found 100 paces farther up stream. Beautiful glacial striae were found on the first ledge and have a direction of S 28 E. Evidently this ledge is the higher point of greenstone at this particular locality as the glaciated surface dips rapidly steeply to the north and west.

pp 149 - 153. Diagram of traverse.

p 154 T 46-38. General remarks.

The region 2½ miles east of Barclay is the seat of the junction of several streams, consequently it has been much worked over by the Middle and West Branch of the Ontonagon and two large creeks. A succession of bayous, oxbow lakes and river courses together with numerous very wet swamps make up almost the entire area from the Little or upper falls of the Ontonagon to Calderwood. The high land is entirely composed of low sand hills and ridges, bruned bare, and giving little evidence of the presence of rock outcrops. To the north of Calderwood is a high moraine apparently extending east and west and in line of the traps found at the Big Falls of the Ontonagon. (See p 128 of this book). As the surface timber is cut and burned for the greater part of the region the morainic ridges, hills, etc stood out in fine relief and gave very little evidence of the presence of rock ledges. The comparatively deep river "gorges" seem to afford the only chances of finding rock. The sandstone ledges about 2 miles north and west of Calderwood were found along the channel of the Ontonagon. See p 138, where the valley is far below the general level of the surrounding country.

From conversation with the postmaster and grocer at Calderwood, who is an old timber cruiser, it appears that the only known rock ledges are at Little and Big Falls of the Ontonagon and on Dead Mans Creek which is south and east of Calderwood. From descriptions it may be the outcrop on the creek platted on p 46"granite" is said to be associated with green schists and the granite may be the enormous pinkish blebs of quartz found with these schists described on p 148. The above remarks do not apply to the several outcrops along the railroad south andeast of Barclay.

The timber has been cut clean and the whole country afterwards burned over several times in the region around Interior. The surface is only a succession of morainic hills, ridges, ravines and kettles. The same and more may be said of the region from Sec. 11-12 south to the town line.

p 155 Contd. The knob and basin type of topography is seen in its extremes. (See traverse p 151-153 of this book). The only outcrops found were in deep stream valleys where the creeks had cut their course through the moraines.

From what could be inferred from a general view of the bare hills, and from a reconnoissance trip of 6 miles across country by G.B Corless and R.A.Smith, it was decided to make the traverses 1 mile apart with a cross country reconnoissance on the way back to camp, in order to pick up possible outcrops along streams not on line of traverse. The barrenness from outcrops of the traverses afterwards made seem to justify the wide spacing of the traverses.

R.A.Smith.

Then follows a list of specimens.

Book No. 273 O.R. Hamilton 1914. Reports on mines in Marquette County and Menominee Range. Stamped Board of State Tax Commissioners , Mine Dept.

Book No. 274 O.R Hamilton 1914. No.2. Description, output and reports on Ashland, Tilden, Puritan, Royal, Geneva, Davis, Norrie, Aurora, Vaughn, Pabst, Bonnie, Palms, Colby, Ironton, Winona, Yale, Mikado, Pilgrim, Eureka, Asteroid, Brotherton, and Sunday Lake mines.

Book No. 275 B. Hubbard 1915. Traverses, diagrams and specimens. T 46, 47, R.37,38 pp 122-124 4 nice photo views of Ontonagon Falls.

Book No 276. 1915 Bela Hibbard, Book 2 Traverses and diagrams of T 47,48, R 31, 35,36

1914 and

Book No. 277 1915 O.R. Hamilton No.1 Mine reports and information on the same mines as book No. 274

Book No. 277 1915 O.R.Hamilton Book 2 Mine reports, information, output, valuation of the mines mentioned in No. 274

Book No. 279 Season of 1916 Book 4, I. D. Scott. T 50,51,52, R. 29,30,31,32. Diagrams of traverses with description of specimen and where found.

Book No. 280 Missing (Found. See next below 281).

Book No. 281 L.P.Barrett Season of 1916. T 50,51,52, T. 30,31,32. Traverses with diagrams and description of mineral specimens and where found. with list in back. D.T McKane and J. Tobin, assistents.

Book No. 280. Season 1916 L.P.Barrett T 49,50,51, R 29,30,32,33,34. Traverses and diagrams with description of specimen. (p119) Sat. Oct.7,1916 Packed camp to town, met Leverett at 6:40 P.M. Mon. Oct.9, With Frank Leverett went to Arvon, Taylor switch, Skanee and observed beaches of glacial lakes.

Book No. 282 O.R Hamilton, Season 1916. T 49,50,51,52, R 29,30,31,32,33,34. Traverses, diagrams and sometimes a description of the exposure.

Book No.283 O.R Hamilton T 50,51,52, R 30,31,32,33 1916. Traverses and diagrams almost entirely. (p 52) "Black flies to beat the Dutch".

Book No. 284 Field notes of transit lines run in field season of 1916 to determine hprizontal control for topographic map of properties of Mich. Limestone & Chemical Co., Calcite, Mich. Under direction of R.C.Allen. by E.E. Havens. T 35 N, R 6 E. Survey figures only.

285 Book No. 1916 O.R.Hamilton. Reports, output, valuation and description of mines listed in book 274.

Book No. 286 O.R Hamilton No. 2 1916. Continuing reports on mines same as above.

13 - books in vault.

Book No. 287 - 1916 Field notes of R.A.Smith on lands of Michigan Limestone & Chemical Co. Rogers City, Mich.
Instructed by Mr. Marsten to aid in locating corners and section lines, ledges of stones, etc. Went with Mr. Dultgeon along the west side of Swan R. valley to determine the plan for running the quarry ledge south and east. Made a reconnoissance thro sections 25,36,35, and 26 and then returned to Rogers City, arriving at 6:25 P.M.
pp 3-42 - July 11, 1916. Traverses Secs 25 and 36. Traverse is given in paces with description of surface coverage and diagrams of same.
Aneroid determinations;
Office floor elevation 35 ft above Lake Huron. Floor of quarry at face south of office 55 ft at 7:30 A.M. eastern time; at top of face 103 ft. Aneroid reading too high.

Book No. 288 Traverse Book No.1. 1916 R.A.Smith. on above described location. (See page inserted for description of outcrops).
Book No.288A, Traverse Book No.2, Same as above. Foundlater.Typed in full. Inserted

Book No 289 Notes of R.R. Havens on same trip and locations. Readings and diagrams.

Book No. 290 Notes of R.R Havens on same trip. Same information.

Book 291 I. D SCott Book II, July 1916. T 51, R 30.

pp 4-10 Diagram of traverses with following notes.
p 7. At Loc. A, Sp. 463. Light reddish grey slate, strike N 35 W, Dip 10 N. Slate characterized by dark purple finely banded. Layers coming in about every 5 inches. In addition there is a prominent banding parting plane running about every 2 ft.

At loc. B. falls 30 ft over grey and banded slate striking N 60 W, dip 10 S. Schistosity Strike N 80 W, dip 45 S. The slates are characterized by rather even spaced major (?) beds from 8 in to 2 ft, thence average about a foot perhaps, separated by the darker fine banded layers.

Sketch.

Sketch showing relation of bedding and schistosity also relation of gray and fine red bands and major bedding sites (?).

The occurrence of fine banded layers separated by wider beds for the most part devoid of bedding lamellae differentiates these slates from those seen farther north on the same river. North wherever bedding was seen the slate was observed (p 9) to be finely banded throughout. Finally there are no black phases found here and the absence of black slate flood (?) in the stream bed renders it unlikely that more of this will be encountered in proceeding upstream. The slates show no evidence of metamorphism and from that produced by folding, the(or no) quartz vein indicating (or indicates) much crumpling. The changes in dip below the falls indicates folding but probably not close folding. The slate has a reddish appearance due to banded (?) stains in the cleavage planes. Some of the fine banded phases (or planes) are purplish colored. The grey phases are coarser in grain and contain fine spots probably some small(?) peculiarly(?) developed porphyritic mineral like stausolite. Certain of the thin layers are pretty highly ferruginous slates Sp. 466. This particular layer was only one inch wide. It is probable that to such layer is due the red strain.

pp 11-40 diagrams of traverses 50-30 and above.

Book 291 contd.
p 41. Loc.I Outcrop in Huron R. (see p 39). Greywacke. Water cascades over an even surface dipping 20 N which may possibly be bedding planes. Rock is very hard, dark colored, relatively coarse grained containing visible rounded dark glassy grains of SiO_2. This rock is very similar to dark quartz and Gw found west of Arvon which were called trap on the old maps. Also contains considerable feldspathis material. (Exposure looking S.) sp. 480.

Two diabase cross greywacke at foot of falls. Strike E&W, dip vertical. Contact of southerly dike shown in photo as an apparent well developed vertical joint face at foot of falls. Wide(width ?) of S dike is 9' separated from a similar dike to N by 6-7' of greywacke. Wide of N. dike not found. Diabase fine grained #481. Diabase somewhat softer than greywacke.

Diagrams.

At locality II dark quartzite and greywacke massive and hard, strike about E and W, dip 60, average N. The rock is in massive beds from 4 to 8 ft thick usually separated by a quartz zone or thin fine grained slaty layer. Certain horizons are conglomeratic. Spec. 483. Spec. 25146 is the fine grained phase. These rocks are similar to those seen at Locality I. At this point is the water falls 20 ft over the dip of the rock. No fish in this branch of the Huron above this waterfall. The rock in general is dark in color, hard, and made up of disintegrated igneous rocks. Contain some pyrite. One bed contains quartz veins cutting across the strike that end abruptly at the boundaries of the bed. This bed is entirely under water.

pp 43-87 Diagrams of traverses. T 50, R 33.

p 87. Outcrop A. Fine grained, light greywacke exposed under roots of windfall. Massive character and could not determine bedding. No sp. taken.
Outcrop B. Similar to above. Sp. 25147. Exposure in swamp margin. Rock is close grained and very hard, containing much SiO_2.
Outcrop C. Small exposure of greywacke. Same as two above. No sp. taken.
Outcrop D. Dark basic dyke rock. Exposure about 100 paces long . Strike N 60 E. Diabase is even grained. Appears to be on line with high knoll S 60 W some two or three miles away. Sp. 501.

pp 88-91 Aug.30, 1916
p 92. Outcrop A. Exposure of greywacke, a few feet in diameter. Greywacke exhibits similar texture to that found east of this locality. It is a fine grained, hard, and dark grey. No strike or dip taken.
Outcrop B. Long, low-lying ridge some five or six feet high of greywacke. Strike N 40 W and dip about 60°S. It is a little softer than the one above and develops in places a sort of schistose character. The same rock continues to outcrop at frequent intervals for about 100 paces down the hill.
Outcrop C. Same material as above. Indications are that strike is about N 40 W and dip 60°S, but it is questionable whether the rocks are in place.
Outcrop D. Greywacke exposed in shape of "hog-back" in swamp. Rock is grading continually into a softer type and shows a decided schistose character. It is compact and fine grained.
Outcrop E. Slate quarry. The old quarry is located on a sidehill, sloping to the north and is 25 paces square. Some idea as to its depth may be gained from the fact that the dump is about 50 paces x 25 x 15 ft. high. Schistosity is dipping about 40°S, while the bedding is probably dipping north at a very slight angle. The beds change in character from one side of the pit to the other.

Book 291 contd.
15 - books in vaults.

Book 291 Contd.

Spec. 502 shows the green phase on the south and east sides. Spec. 503 shows the black slates on the west side. The thin schistose beds alternate with the heavy layers; the latter being merely a schistose greywacke. There is excellent material for roofing slates on the top of the dump.

pp 94-103 diagrams

p 104. Outcrop A. Rounded- dome-shaped exposure of Arkose about 25 ft in diameter. Bedding is probably striking very nearly east-west and has practically a vertical dip.

The bed at the south side of the outcrop has developed a phase very similar to the outcrops of gneiss north of Herman, along the road. Sp. 504, showing arkose.

Outcrop B. Exposure several paces long extending apporximately S 60 E and dipping nearly vertical. The outcrop is practically continuous and evidently makes up the entire hill. The arkose is probably a gradation phase between quartzite and gneiss. Sp. 505 shows this gradation. On the cliff face of the exposure, there is at some places a distinct gneiss banding showing that some contortion to the arkose has taken place.

pp 105-109 Diagrams.

p 107 Outcrop A. Outcrop of gneiss about 30 paces long and 15 paces wide. Strike is S 30 E. and dip nearly vertical. Sp. 506 shows more quartzitic phase with banding. The banding is very striking and is undoubtedly gneiss. There is a pseudo-arkose texture in some of the beds. The outcrops described on the preceding day are undoubtedly of the same material, i.e. gneiss.

pp 111 - 114 Index and specimen list.

Book #88 - insert after page 13

Field notes of R.A.Smith, Presque Isle Co. Rogers City. 1916

p 3 Introductory note. Under instructions from R.C.Allen, Lansing, Mich., the writer in company of R.R.Havens left Lansing, Sunday July 9 for Rogers City, Presque Isle Co. to undertake a geological survey of the lands of the Mich. Limestone and Chemical Co. in Presque Isle Co. Arrived in Rogers City Monday morning. Obtained quarters at the Kitchen House and reported to Mr. Marsters, Supt. who upon reading letter of instructions to the writer asked that the geological examination of Adams Point be preceded by a reconnoissance survey of the eastern or southeastern extension of the calcite ledges to or toward Adams Point to determine if possible, whether or not the ledges in whole or part were continuous. The following traverses were made in carrying out the reconnoissance work.

p 4. Calcite quarry and SE. July 10, 1916 Monday.
A preliminary examination was made in the afternoon to get the "lay of the land" before attempting regular traverse work. Mr. August Dultgeon, a former timber cruiser with much local experience was made permanent guide and assistant in locating corners, roads, areas of limestone, etc. The traverse began at the SE end of the new extension of the calcite quarry and extended through the lands lying SE, south and west of this. The W¼ cor. of Sec. 25, T 35 N, R 5 E was chosen as the most favorable point for beginning the traverse work.
Then follows key to symbols and abbreviations.

pp 5-21 Diagrams of traverses in Sec. 25 and 36, R 5 and 6 E. Outcrop No 1.
p 21. Outcrop No. 1. Low ledge about 150 paces long running NW-SE and largely covered by angular boulders. Rock is near the surface over a considerable area judging from the abundance of angular boulders in the drift which in many places is a mass of limestone fragments with no soil admixture. Quarrying conditions are very favorable but the stone is at a considerable distance from water transportation Sp NO 4 is gray crystalline limestone typical of the Dundee.

Outcrops 2 and 3 are similar to No. 1 except the areas are slightly larger. Sp. No. 5 was taken from outcrop No. 2 and Sp. No 6 from outcrop No. 3. All of the stone contains agastropod - Euomphalus ? Sec. 31, T 35 N, R 6 E.

pp 22-23 NW ¼ Sec. 32, T 35 N, R 6 E. Outcrop No. 4.
Limestone bluff on west side of D & M RR about 400 paces S-SE of NW cor of Sec. 32, T 35 N, R 6 E. Bluff between 35 and 40 feet above tracks. Ledge exposed for some distance along top of bluff. Elevation above lake level apparently 70 to 75 ft. This bluff is the eastern termination of the Rogers calcite ridge of limestone, for stiff boulder clay occurs in the bed of Swan river 15 to 20 ft lower and to the SE. Sp 7,8 and 9 were taken in order from top of bluff down and about one foot apart. Base of bluff formed of talus.

pp 24-32 Diagrams of traverses. Outcrop No. 1, p 32.
Low ridge of limestone running E-SE about 500 paces N and 500 paces E of S¼, Sec.31, T 35 N, R 6 E. The surface in the vicinity of the exposure is largely of angular limestone boulders and is indicative of the thin character of the overburden Other exposures of limestone occur to the NW, N and NE in this section, hence it appears very probable that the southern half of the section contains a considerable area of limestone with very little overburden.

p 33 Calcite. Sec. 31,T 35 N, R 6 E. Diagram.

pp 41-44 Diagram of traverses July 17,1916.

Book 292 O.R.Hamilton, Tax Commission Book No.1, 1917
Report on property, tonnage, methods used, geology and general remarks of the following Mines.
Morris, Lloyd, Sec.6, Chase, Austin, C & NW, 19,21,29, Sthphenson, Francis, Gardner, Gwinn, Jopling, Mackinaw, Princeton, Barnes & Hecker, Lake, Salisbury, Erickson, Imperial, Nelly, Webster, Athens, Angeline, Holmes, Republic, American, Boston, Empire, Volunteer, Angeline, Cliff, Stegmiller, Sec.16, Sec.21, Prince of Wales, Maas, Negaunee, Breitung, Bucky Star, B.H. No 2, Hemrod, Mary Charlotte, Wakefield, Mitchell, Forbes, Isabella, Cambria, Balkan, Wilkinson, Channing, Hemlock Michigan, Warner, Baltic, Bengal, Caspian, Fogarty, Youngs, Chatham, Riverton, Berkshire, Hiawatha, Chicagon, Rogers, Munro, Delta, Ohio, Davidson and Purcell.

Book 293 O. R. Hamilton Book 2 1917. Same general information on the following mines:
Bristol, Fortune Lake, Odgers, Dunn, Richards, Tobin, Great Western, Baker Tully, Quinnesec, Hilltop, Bates, Penn, Aragon, Dober, Isabella, Cottrell, West Chapin, Chapin, Osana, Wauseca, Pewabic, Indiana, Zimmerman, Carpenter, Monongahela, Ravenna, Judson, Amasa Porter, Carpenter, Goodman, Longyear, Homer, Virgil, Wickwire, West Chapin, Millie, Castile, Meteor, Eureka, Asteroid, Wakefield, Plymouth, Norrie, Brotherton, Sunday Lake, Mikado, Pilgrim, Ashland, Yale, North Norrie, also East Norrie Pabst, N. Pabst, Aurora, N.Aurora, Vaughn, Tilden, North Newport, Davis, Geneva, Royal, Winona, Ironton, Colby, Newport, Bonnie, Palms, Anvil, Keweenaw.

Book 294. Expense accounts, Statements of mining properties with Historical data regarding Pewabic, Franklin, C & H. Quincy and Osceola. First ten pages.
Clark property Keweenaw Co. The manganese deposits are in the form of lenticular masses of pyrolusite quite impure and of irregular occurrence.
Ten pages follow of more data on mines. Notes of L.P.Barrett, Securities Com.Exam .

Book 295. Looks like handwriting of O.R.Hamilton , 1918. Same mining information covering many of the mines above listed. Yale, Ironton, Eureka, Asteroid, Castile, Wakefield, Lake, Cliff, Angeline, Athens, Morris Lloyd, Chase, Francis, Jopling Princeton.

Book 296. Initials on back O.N.W. (?) No name or date that seems to be definite. One reference is made to May 1918 about closing a mine. The same mining information covers the same mines as Book No. 293 above.

Book 297 Initials O.W.W. No. 1, 1918 Same information about mines as in Books 292, 293.

Book 298 Initials O.W. No. 2, 1918. Same information about mines as in Book 292,293

Book 299. O.W.W. No. 3, 1918 Same mine reports as one just above.

Book O.R.Hamilton 1919-1920. Trip to Cumberland Mines Co. Fargo Oil Co., Casper Wyoming. Dattner Oil & Refining Co. Bowling Green Ky. Presumably to check up on the stock being offered for sale in this state.

Book 301 L.P.Barrett. Copper mines 1919. with data about the Ojibway, Phoenix, Seneca, Allouez, Osceola and C & H. mines.

Book 302 L.P.Barrett. Copper Mines of Ontonagon Co. General information. Michigan, White Pine, Victoria, Mass, Adventure, Indiana, Lake, N.Lake, S.Lake, Bohemian, Knowlton, Merchant, Butler, Ogima, Evergreen, Lake Superior, National, Carp lake, Flint Steel.

Book 303. O.W.W. 1919. Contains a few pages only with notes on the following mines; Davidson No.2, 1 and 3, Osana, Wauseca, Townsite, Francis. Isabella,.

Book 304 1919. L.P.Barrett, Quincy, Hancock, Franklyn, Descripti n of mines,etc. only a few pages.

Book 305. O.W.Wheelright, 1919 Copper notes. On Wolverine and Ojibway mines for valuation purposes. Only a few pages.

Book 306 O.W.Wheelright, 1919 Copper notes as above. Butler, Lake, Michigan, White Pine, Mass, Nonesuch, Howell, Adventure, Indiana, Algomah, Flint Steel and Winona mines.

Book 307. O.W.Wheelright, 1919 Copper notes. Baltic, Trimountain, Champion, Isle Royale, Wolverine, Superior, LaSalle, Ahmeek, Wyandotte, Adventure, Toltec, Flint Steel, N. Kearsarge, Osceola, Michigan, Baraga, Mass and Naumkeag. Same information as above.

Book 308 O.W.W. 1919 Same information regarding Jones & Laughlin Ex.,Cambria, Clifford, Hemrod, Lucky Strike, Breitung, Mary Charlotte, Tracy, Penn group, Vulcan, Central, Loretto, Russell, Aragon, Dober Isabella, Homer, Bates, Delta, Hiawatha, Chicagon, Zimmerman, Baltic, Bengal, Caspian and Warner.

Book 309. Leith 1920. Misc. information from the vicinity of Vulcan, Groveland and Loretto Mines. See additional extra sheets about this book.

Book 310 W.L.Robinson 1920 N½ Sec. 27, T 40 N, R 30 W.
See additional sheets inserted under this number.

Book 311 L.P.Barrett. Book I, 1920 Appraisal of Iron Mines. Chapin, Hamilton, Keweenaw, Wauseca, Penn group,, Brier Hill, Vulcan,, E. Central, Loretto, Aragon, Townsite,, Riverton, Yale,Bonnie, Newport, Palms, Anvil, Oliver Gogebic, Norrie, Aurora, Vaughn, Pabst, Davis, Geneva, Royal, Puritan, Tilden, Colby, Ironton,Winona, Plymouth, Sunday Lake, Mikado, Hiawatha, Rogers, Delta,. General information.

Book 312. L.P.Barrett. 1920 Book 2. Appraisal of Iron Mines. Republic, Cleveland Cliffs, Oliver, D.S.S. & A., Sec. 16, Lloyd, Francis, Gwinn, Joplin, Princeton, C & NW, Stephenson, Clifford, Breitung, Mary Charlotte, Himrod, Jackson & Tully, Athens,Negaunee, Maas, American-Boston, Meteor, Castile, Asteroid, Mikado ,Eureka, and Townsite. General information.

Book 313. L.P.Barrett 1920. First page marked "Stratigraphy of Vulcan series". diagram follows on next page. Balance of book devoted to appraisal and general information about the following mines: Wapama, Davidson, Osana, Homer,Cardiff, Bates,Brule, McKinney, Tully, Tobin, Dunn-Richards, Odgers, Bristol, Carpenter, Monongahela,.

Book 314 A. Johnson, 1921. T 43N, R 32 W. Entire book is made up of diagrams of traverses with sun observations and specimen lists in back.

Book 315 . W. I. Robinson, geologist, D.S. Ball, compassman. 1921 Sec.32-43-31,32 Sec.1, 42-32,31. Entirebook diagrams of traverses. p 23 the following note: Intrusive rock near 1/8 S. 500 paces E of SW cor. Sec. 32-43-31 Dolerite ?. Slates lay up on southern face. Contact metamorphic rock. Sample R10. A larger bluff of greenstone some 100 paces north lies E 15 N from a similar ridge on the west bank. This is an intrusive. Sample R10.

Book 309 - 1 insert after page 15.

Leith - 1920.
p 1 . Chemical contents of iron of Loretto Mine.

p 2. ? Expect compression fractures 45° to schistosity (Hanbury slate) developed at time of formation of schistosity.
? Drag folds of 2nd and 3rd orders act in same way i.e., 3rd order anticlines do not converge to crests of 2nd order.

small diagram.

Traders. Bright red, small rectangular blocks, relatively oxidized, contains traders quartzite, weakly magnetic. platy
Curry. Dark purple, large blocks. Rel. unoxidized. No definite quartzite horizon. Very magnetic. Fine banded, fine red spots in jasper.

p 3 Diagram East Vulcan No. 3 shaft, looking south. Curry I.F. with ore body.

p 5. No. 1 tunnel, E. Central Mine.
At 484 jasper and ore Curry
474 " " " " Cross slip
450 " " " in shattered zones and quartz veins. Folded zone quartz probably in axis anticline. Small bands of ore along quartz veins and slips.
435 Curry jasper
429 " " involved in slickensides.
358 " " and brier slate.
350 - 210 Brier slate

p 9. N.R.L. exploration Hole # 3. Ledge at 133.

	to
Formation porous in spots	233
Weathered zone running into talc rock	266
Talc rock	370
Conglomerate	430
Formation, magnetic in spots	435
" red oxidized fractures	610
Slate red not banded dense	635
Dense green slate Hanbury	660
Talcose calico red and green slate	670
Red slate "Curry" ferruginous	964
Formation cherty	985
" "	1027.

Slates from 610 are probably brier. (Barrett).

p 11 diagram
p 13 Diagram. West face of pit, Groveland mine near Metropolitan.
p 14. Diagram. About ¾ mi N of Loretto Mine. Sharp fold of fault in Quartz & Dolom.
July 24. Sat. Dolomite S. of Loretto. Western end(beyond pine grove on road at schoolhouse) shows many sections with anticlinal minor drag folds whose axes incline toward the west. This may be supposed to be the eastern flank of an anticline whose pitch is in general southerly. East of pine grove and past the M.R.L. exploration shaft crossing the railroad at the water tank, the axial directions vary at the eastern end beyond water tank and in swamp the majority incline east. Hanbury slate crop south of town east end strikes E and W. Near western end a strike was seen N 45 W. Fault or fold ?

p 15. Dolomite crop N of trenches in traders & Curry strike E & W. Folds overturned to west. Slate crop 220 paces SW on Bergam derail switch W & N. Near dolomite crop. Dolomite hill west of mine ¾ miles ? axial places overturned toward the east. Anticlines south.

Book 309 - 2 insert after page 15.

p 16. July 25. Fished (12 bass) with Bill Rader.
July 26. Monday. Exposure Hanbury slate 50 paces S of C & NW. Ry, SE ¼ Sec.13 Very dark grey, dense laminated slate, slaty cleavage more prominent than bedding. Dark green and dull reds on cleavage planes. Green oftener than red. Differential erosion in direction of schistosity,
Minor folds with axes pitching in direction of the schistosity or major cleavage. Minor folds (12" > <) not isoclinal, fat. Small diagram of above. (N 62W. The outcrop strikes in the direction of the schistosity N 62 W (variations noted of 70°. Direction of a secondary cleavage of a later date (?) N 67 E and N 35 W. ("Danbree cracks").
A quartz vein of an intermediate age strikes N 60 W. Diagram. N 80 W. The minor folds pitch easterly at an angle of circa 60°.

pp 17-21 Diagrams near Loretto.

p 22. July 27. There is a characteristic grey and black banded slate about 300' from the Curry in the hanging to the south called by Barrett "coarse banded slate". Appears (?) in M.R.L. exploration holes beneath the upper iron formation.

July 28. Dolomite east of water tank South of Loretto. Bedding N 70 W. (L P.)
Joints N 55 W (L.P.) Axial plane minor folds strike N 75 E (L.P.)
July 29 Doping diagrams.
July 30. Underground.
July 31. Mapped dolomite.
Aug. 1. Sunday. loafed. Read "The Hound of the Baskervilles".
Aug. 2. Mapped dolomite.

pp 23-24 Majority of minor folds are overturned easterly. Diagrams.

p 25. Bergam Switch. 300 paces SE on switch slate and dolomite crumpled.
789 paces(beginning of curve) massive dolomite.
815 paces. Dolomite crumpled and faulted.
875 " dolomite crumpled.
1253 " trail E & W.
1315 " county road.
410 " E on county road to bridge
500 " N to W & M bridge
70 " across bridge
430 " N to slate
690 " last of crop
1058 " Bergam switch
400 " N from Bergam to Dolomite.

pp 26 - 38. Diagrams and traverses.

p 39. Tues. Aug. 3. Waucedah. The west cave shows a fold pitching SE. The east cave is filled with water and exposes I.F. only on the NW side where there is a vertical cliff 50' high.
Diagram

The red slates immediately south of the I F. are relatively competent while the black slates farther south are crinkled.

pp 40-45 Diagrams of outcrops.

p 46 Mon. Aug. 9. Ran Mags. Sec. 12 & 2, NW of Loretto on RR NE¼ Sec.11-39-29.

p 46 contd. Found an unusual fold 10 or 20 ft in height in the conglomerate(breccia) corresponding to that S of Bergam on the W & M.

Diagram.

The drag folds of such dimensions are overturned consistently westerly and apparently do not follow this fold but the major structure. The large anticline on the other hand, is overturned easterly. Some slate comes in in the dolomite. South of the large fold is a quite massive bed but with some thin slaty partings which is not affected by the large fold at all, showing that even the large fold is a drag.

Tues. Med. and Thurs. Ran Mags. Friday. With Smith to Iron Hill and Turner Exploration

pp 47-56. Diagrams.

p 57. M.R.L. Exploration. Loretto Iron Co. Hole 1 ∠58$\frac{10}{2}$ North.
134 Surface.
To 169 Dark gray chertz. I.F. Weakly magnetic, blue steel ore and bunche(or bands) of gray and purple chert. Curry in appearance
173 Slaty gray I.F. magnetic " " "
252 Cherty gray I.F. " " " "
268 Gray banded Fe slate (magnetic) alternate bands of of medium coarse detrital matter with fine bands of blue steel hematite.
382 Hard gray banded magnetic slate. Finer banded in general than preceding phase.
511 Green fine banded slate brecciated with quartz vein from 410 to 472. Slightly magnetic.
513 Quartz and breccia.
534. Iron formation gray granular chert and bands of blue steel or chert predominating. Chert may be fragmentive. Smooth sides are characterized by black spots which appear to be fragments. Some fragments are bright red like fragments of jasper.
To five pages at end of book balance of pages contain description of cores from Loretto Mine.

Thurs. July 8. To Old Indiana and Cuff mines at Indiana. Traders member exposed in pit. Talc schists reached in shaft. Characteristic red color in formation due to weathering on joint planes. Formation brecciated and at intervals schistose, at other places granular. No veins or seams of calcite or quartz prominent. Dip southerly 45°.

Old Cuff. Traders and Talc schist. Dip northerly circa 45°. Small diagram. There is evidence of normal faulting at the southern rim of the Cuff.
July 10. Looking test pits around L. Antoine. 11th. Sun. to Horseshoe Lake.12th to Quinnesec. Small diagram. Detailed work may be done here on basis of minor drag folds. 13th. Tues. To greenstone area on Menominee south of Quinnesec and back to R.R bridge via River. 14-15th. To Loretto. Sun table for July 16th. 17th. Ran Mags south to Hamilton Lake. Checked drill cores and went to Metropolitan during that week.

The contact between trader and brier comes at 50. The contact cuts across the drift at right angles and the dip N 65. From 25 ft above the contact the brier slates are more platy altho thin bedded, seldom above $\frac{1}{2}$ inch and $\frac{1}{4}$ or less is more common. However the jaspery seam comes in. The actual contact is very fine and is marked by a thick band of chert 6 to 8 inch with part of the traders. The contact is a wavy surface and the slates follow the rolls. Diagrams.

Book 310 - 1 insert after page 15.

W.L.Robinson. N½ Sec. 27, T. 40 N, R 30 W. Sept 13, 1920.

pp 1-25 Diagrams.

p 26. Sept. 24. To Forest mine 250 paces S of center Sec. 25, T 40 N, R 30 W. Dolomite ridge NW of old shaft shows contact of dolomite and a conglomerate containing angular fragments of iron formation (Cambrian). The dolomite shows concretionary concentric structures commonly supposed to be Algae. At the contact of the cgl. and dolomite near the southern edge of the ridge a brecciated quartz vein six inches wide and showing a separation drag of five or six inches between the fragments and severe closed folding in the dolomite itself indicate a complicated local structure.

Faulting is therefore an hypothesis not to be disregarded in explaining the sudden petering out of the magnetic belt at the lake(Fumee) just east of the Forest mine. At the contact of the dol. and cgl. there is no slate suggesting (a) erosion interval, (b) different succession of dolomite beds than at Loretto.

SE of this ridge are other exposures of dol. and ½ mile SE is a large ridge of another kind of cgl having rounded pebbles of chert (white and grey) occasionally stained red, elongated by lateral pressure. This cgl looks like the cgl in the Sturgeon quartzite. A more reasonable correlation would make it Hanbury. It does not however contain the amount of slate or dolomite or iron formation pebbles which would be expected in Hanbury. But although no unaltered dolomite pebbles were seen, some altered (sericitic) pebbles may have been originally dolomite. Some red jasper pebbles and a very few pebbles containing ore dots.This cgl is certainly later than the earliest Vulcan sedimentation.

p 28. Locality C 7 above shows two kinds of secondary material, a very basic kind in lenses and an acidic with ? pegmatitic structure (feldspar gone) along joints. Diagram above note.

pp 29-41 Diagrams.

p 42. Diagram I. Origin of water courses.
Force A > force B causes movement toward right, i.e. an actual transfer of material from left to right. Given a layer in the series at D which is competent enough not to entirely yield to the compressive force bedding planes in region D would tend to open up just as in the ordinary case at E.
II. Tension faults. (note) In a closely compressed region readjustment due to some kind of "creep" or an actual transfer of deep seated material transverse to the acting stresses would cause these faults to parallel the acting force and be ⊥ to the greatest strain.

Conditions governing the accumulation of iron ore by descending water should be the reverse of conditions governing the accumulation of oil. e.g.; syncline verans anticline, impervious stratum below verans above; porous stratum above verans below.

Some of the best ore "looks like stove polish" and is composed of platy particles of specular hematite all of a size which is easily caught up into suspension by moving water. This ore which is very desirable occurs in "pockets" suggesting deposition from an underground circulation through irregular cavities. . In an intensely folded formation containing competent members such as the Vulcan I F. containing heavy layers of chert and jasper such cavities could be reasonably expected.

Book 310 - 2 insert after page 15

p 42 a. I. Along the crests of anticlines by tension cracks both across and ll (parallel) to the bedding.
? II In the synclines of diagonal folds by a "plucking" force developed by drag
III along faults.

pp 43- 68 Diagrams. Intersection of RR & N-S road, E.line Sec. 36

p 68. From about 500 paces S. center Sec. 35 (where creek crosses old RR grade) set N 30 E along RR grade 326 paces to dolomite outcrop striking circa N 75 W. Large pieces of phyllite on the surface here. At 420 paces, slaty dolomite outcrop with much silica.

pp 69-72 Diagrams continued as above.

p 73. Capt. Carbin on the Traders Mine says that in the late 1880's a pocket of rich ore (around 50%) was located in the Cornell workings and that this is the only pocket which he has encountered although they have worked along a half mile of the formation. This relatively rich ore was not the black platy "stove polish" ore common in pockets in the Menominee Range but a harder and bluer kind. This pocket was bounded below by slanting walls of slate forming a sharp angled trough and above it extended into a "chimney" which was followed some distance.

Cuff mine. Same grade of ore as the Indiana and Traders, around 35% Fe. Cross-cut north possibly 50 ft, did not crosscut south.

p 75. A possible reason for peculiar conditions around L. Antoine is a thickening of dolomite west and less close folding. A vertical hole (not surveyed) at Cornell pit penetrated 830 ft of dolomite.

p 77. Traders has never found soft ore pockets. One hard ore pocket running up to 60% in NE end of Cornell pit. Blue specular hematite.
From records kept by Capt. Carbin it seems to be true that the ore is higher in phosphorus at the western side of the Traders and Clifford pits.

pp 78-90 Diagrams.

p 90. Estimates from projections would indicate dolomite at very shallow levels in hole 103. It was not encountered at 380' where the hole is temporarily stopped. Expect dolomite outcrop about 600' NE of Hole 4, or at maximum estimate allowing for height of slope under SS hill at 800'. Drill hole 103 is about 525' NE, measured on a line at right angles to the projection of the dolomite strike in hole 4. This strike line (?) with an assumed direction parallel to the iron formation strike lines.

The western edge of Traders mine has material higher in phosphorus than that at eastern edge.

p 91. There are at least three prominent series of folds at the Traders mine. The whole trend of the formation here changes from NW to N with the suggestion of a turn under the SS to the east. (Small diagram). The usual series of drag folds follow down the dip. (in this they differ from those seen elsewhere). A cross section of the formation taken as shown (Small diagram) exposes a third series of close folds.

p 91 contd. It is evident that the formation here wraps around the Lower Menominee beds in a manner which closely resembles a similar structure several miles NE where the Sturgeon quartzite wraps around the granite complex.

p 92. Very good drawings.

p 93. If the slates encountered in drill hole 103 are really brier, clearly there is either a great overturned fold as below or an overthrust (underthrust ?) fault. A reasonable conception of the forces and reactions involved in either of these structures can be deduced from the general arrangement of rocks at the west end of the Menominee Range.

Diagram.

Hypothesis to explain Brier slate in drill hole 103 E of Traders mine. Width of Brier and Curry much exaggerated. Just S. of the diagram the I.F. swings SE.

pp 94-95. VanHeise and Leith, Mon.52, mention the /a symmetrical character of folds in Michigan Huronian; the steeper side toward the north. They conclude that the present evidence indicates a thrust from south to north.

The Traders mine structure suggests a case of under thrusting. Bayley noted the thinness of Brier W of the T M. (possibly P.M, or intended to abbreviate Traders mine). If a thrust fault split the formations it would follow the weakest(Brier) member and drag it out into a thinner strip. Dolomite encountered in drill hole No.4 at about 1000'. Appears in test pits N. of L. Antione about as shown. Fig. I. Probable arrangement of stresses shown in Fig. 2 would give an actual movement around the Traders mine as the formation is here exposed to an active stress from the south. If there is an underthrust its plane lies above the dolomite probably in Brier.

Diagram

pp 96-97 Diagrams of Traders mine holes.

pp 98-100 Description of drill cores. Note at end. This hole wandered in the dolomite and ended at something like 45° from the vertical.

pp 102-09 Diagrams and description of drill cores as above.

pp 112-19 Diagrams of traverses. Greenstone topography in this area.
Note on p 113. It is worthy of note that the long axis of this outcrop (parallel to schistosity) projected touches the northern theoretical edge of the I.F. at Traders mine.

16- books in vault.

Book 315
p 23 contd . At the foot of the bluff a contorted black slate much altered and schistose. Schistosity strikes W 60 N. Dip 76°. See plat p 24.
p 48 Bird Mine. 100 paces W. greenstone tuff conglomerate with jasper pebbles, strike N 10 W. Poorly assorted material usually rounded but occasionally with angular fragments of both red jasper and greenstone. The tuff in the eastern part of the outcrop is coarse and poorly banded. Farther west a band of slate containing angular tiny fragments of jasper and showing cross slip cleavage. Farther west finer banded tuffaceous conglomerate. The top band is wide and again with large fragments. Schistosity about N 60 W. (W). Diagram of above.

p 126. Oct. 21. Norway pits.
Near NE end of Norway pit (150 paces westerly) a small dike with partly altered diabase appears on the north wall intruded into red and green slate and black slate. These slates probably rest on the dolomite. The black slate is ferruginous. The dike and stringers persist for 15 paces westerly where it can be seen intruding jasper. Just S of the N wall at this point is a series of Traders jasper. The S. wall is a slate with schist probably from Brier slate and a slate probably (210 paces to end of this). At about 350 paces from E end of pit a large block of breccia and gouge(gorge) crosses the pit northwesterly (apparent strike of this hypothetical fault N 20 W). At about 375 paces W another rubble zone crosses nearly N & S. The rubble that indicates a fault may be a feature of the intense folding.

Specimen list in back of book.

Book 316 L.P.Barrett 1922 General information about mines, with diagrams and traverses and description of drill cores. See additional sheets inserted.

Book 317 . No date or name. Comparisons are made for 1921-22 so I assume this book is 1922. Misc. notes in connection with appraisals of mines as listed under Book 311. Includes some appraisals.

Book 318 Same information continued as in above book.

Book 319. L.P. Barrett. 1924. Only a few pages of diagrams with descriptions mentioning feldspar and diorite on locations 12- 47- 28, 18 - 47- 27, 19 - 47- 27 20- 47 - 27, 19- 46 - 26, 13 - 47- 27. Also a sketch of Paint Slate structure M 69 about 2 miles north of Iron County line, looking east.

Book 320. L.P.Barrett 1924. N.H Stearn, Geol. D.M. & M. Land Co. Traverses and diagrams with specimen lists in T 46, R 30,31,32,33,34, nearly all sections. See additional sheets inserted.

Book 321 L.P.Barrett May 23, 1924. Traverses and diagrams T 45,46- 33. with note at end that the notes had been transcribed . Note on last page used says T 43-27. Not examined. Probably all Laurentian granite with some Paleozoic covering in SE corner. All land probably is(or in) mineral

Book 322 . L.P.Barrett, 1924. Traverses T 43,44- 31,32. See additional sheet inserted.

Book 323 1924. L.P.Barrett. Notes of C.O. Swanson. T 46,45- 33,32, 34.
See additional sheets inserted.

ook 316 - 1 insert after page 16.

L.P.Barrett 1922.

pp 1-11 Miscellaneous information about Barron Mine followed by diagrams.
pp 12-13 " " Mass Mill.
p 15 " " with traveling expense account.

p 18- 19 Diagrams with following note.
Note A. Pit in typical Curry spotted jasper. Reddish spotted chert with alternate bands of black finely specular hematite. Wavy bedding.

pp 21-24 Diagrams with notations.
Note A. Chert pit in Curry jasper. Formation dips 65°S. Prominent joint planes with slickensided faces cut strike of rock about as follows; (Diagram).
Note B. Pit in Curry Jasper. Considerable vein quartz on dump, also some slate. Probably near contact with Hanbury.

pp 25-27 Diagrams and note.
Note A. Fine grained gray green slate. Strike of schistosity S 75 W, dip 85°N. Bedding not clear but possibly parallel to schistosity just described. Secondary strike N 75 W, dip natural. Bedding may be parallel to latter direction. I am inclined to think it is. This rock is Hanbury slate.

p 28. Note A. Townshi mill dump shows gray green vulcan slate with mottled red stain. Rock is stained(?) but presents evidence of bands of probably Brier, but may possibly be talc slate.

Note B. Open pit is Traders jasper, typical red bands and red color with black schistose (?) bands of Fe_2O_3. (?). On SE corner of pit, formation is all smashed up into a rubble and re by silica and iron oxide. South side of pit is badly sheared brier slate. On west end of pit Traders jasper bed with one (?) phase having wavy (many) bedded thick purple chert bands that resemble Curry jasper. A small fault cuts them west, formation is badly sheared and folded or faulted. On West end banding is even and not ?. Rock is typical fine banded traders.

pp 28-29 Diagrams.
p 30. Note C. Sma l outcrop of gray slate. Banding indistinct. Surface is flat and polished, and small granite veins are present and also blebs somewhat parallel to schistosity. These are affected by small cross faults as in diagram (which follows.) Usually the east side is down these beds, occasionally it is up, then (or them) the dip of fault planes is practically vertical. Dip of schistosity is vertical.

Note D. Mouth of tunnel running about N 75. Mouth in river, Strat. dip 85 N. Dump at mouth of tunnel shows practically all slate (or strata) with only a few fragments of formation which may not have come from tunnel.

Note E. Outcrop of gray banded slate in railroad cut. Outcrop so broken that structural measurements are not reliable. Appears to dip steeply N. at mag. reading (or reaching 80 N. pole points south.

p 31 diagram.

Book 316 - 2 insert after page 16.

p 32. Note F. Pit in (or is) fine banded gray iron formation. This rock might be called a gray magnetic slate and greatly resembles Curry iron formation at Lobetto mines where it is difficult to say whether rock is a jasper or slate.

At G is another tunnel. The mouth of the tunnel is in wavy banded jasper with spotted purple chert bands. At this point the jasper is in conformable contact wi th banded slates typically Brier. The general appearance of the jasper is Curry but the position is such as to indicate Trader. Rock dip N. 80.

Just back of the entrance the ground is caved and ? but I succeeded in getting a specimen which is reddish banded slate so this shows conclusively that the jasper at the mouth is only a thin seam not more than 5' thro. The dump shows considerable iron formation (or found) particularly on the farther bed, mainly it is Brier slate.

pp 33-39 Diagrams with description of several specimens found on various mine dumps.

p 39. Note. Searched carefully for traces of iron formation in SE part of SW/SE - 35 as mapped by Bailey. There are many test pits but they apparently encountered only slates. One or two show iron formation fragments but these appear to have come from glacial drift. Of course Bailey may have seen these pits when they were sinking but judging from the general character of his words he took some explorer's word for it and probably mistook (?) red slates for iron formation.

pp 40-43 Diagrams.

pp 44-56. Examination of cores with descriptions from the McKensie drilling.

p 57. Note E. This pit consists of two parts separated by a ridge not mined. The west pit has a wall of sandstone exposed on north side. This sandstone is unevenly bedded and contain what appears to be shear zone containing boulders and masses of rich blue ore. The very top is a capping of unconformable above the lower sandstone inasmuch as this ore zone does not penetrate it. The bedding in the upper is horizontal and regular. In the lower sandstone the bedding is irregular and can not be traced thro the ore zone.

Diagram of above.

The south side of the pit is only exposed in a few places. It appears to be and ore breccia. On east end is dolomite.

p 58. Is this post-Cambrian faulting or the Cambrian sea depositing jasper and ore in the crevices of the old Huronian shore (?). It is very puzzling. Practically all the iron is pure (or fine) ore. Jasper and sla(te) bed is present in fragments on the old dumps. Mainly old dump contains ore fragments imbedded in the sandstone.

pp 59-63. Diagrams.

p 71. Officers of Jasper Investment Co.

pp 73-85. Diamond drill records of Robinson exploration near Quinnesec
pp 86-94. Misc. information of specimens found in dumps at Keel Ridge and Verona mines with some diagrams.