Book 264 A - 21 insert after page 11.

Paradox Tunnel. Talbot Bros. Mine. Mine is in zone of shearing parallel to the Paradox Valley. Tunnel in "red beds" so-called, which contain green streaks and mottlings. Shear in movements are strongly developed nearly horizontal as shown by slickensides. See sp. 132 for samples of red and green rock. Strata are so greatly faulted and fractured that close timbering is required. Mine walls have caved badly and tunnel was accessible only a short distance. Last working was in fall of 1916. Considerable ore largely sulphide of copper and silver were taken out according to statements of local residents. Some good ore was in bags. See sample 76 of analytical series. Mine abandoned temporarily on account of bad mining conditions. Mine at the north side of the ridge between LaSalle Creek and Paradox valley is said to be in several hundred feet. Distance from cut through the ridge is said to be about 7000 ft.
76. Sp. 133 of shipping ore at mouth of tunnel.

Horseshoe vein. Course N 26 E, dip 68°E. Small fracture or fault transverse to the Cashin vein. Tunnel about 150 ft long and shows a seam of malachite-azurite from ¼ to 6" wide. Vein apparently of negligible value. Mineralization extends out into the porous beds for 50 ft or more. Elevation of tunnel about 50 ft above LaSalle Creek.

Mand (or Maud) Vein. Cliff Dwellers.
Stations 10 ft apart and numbered from 0 to 70. Zero is at intersection of tunnel with vein.

62- 1 Width 40". Malachite-sulphide mill ore. Rich shoots oxidized, much iron stain.
2. Stoped to 10 ft. no sp. Vein at least 36". masses of mal-sul and shoots in lean rock.
64- 3. Width 38". Masses and shoots of sul-mal in lean ore. Rich shoots and masses in hanging wall which is coarsely fractured to 6 ft.
4. Lagging, no sp.
5. Vein pinches to 4" at 5 but widens upward in a raise 8 ft high to 28". No sp.
65- 6. Width 21". Soft green shaly material. Lean ore. Hanging much fractured and carries little ore.
7. Caved. Too high to sample easily. Soft, green.
8. 34" soft green on foot with thin shoot of black sulphide on hanging.
66- 7½ Width 34". Soft green clay in rock with shoots of black on hanging wall.
9 Lagging. Hanging wall fractured with masses and streaks of black ore. Wall rock with masses and streaks on bedding.
10 Lagging. Soft green clayey ore with thin black ore shoots on hanging.
11 Width about 26". Caved. Bad. Foot badly fractured. Apparently fair ore. Rich shoots of black ore near hanging wall.
12 Vein stoped to 10 ft. Width about 24" but footwall is highly cupriferous. Broken.
67-13 Width 36". Belly in vein to 36" and apparently to 4'. The footwall portion is probably well mineralized. Broken wall rock.
14-26 Lagged over.
27 Air shaft.
28-29 -
30 Gland from wall rock. Beds impregnated.
31-38 Lagged over. Seam soft blue, clayey in places.
39 Ladder. Rich pockets and shoots in hanging wall.
40-55 Lagged over. Rock soft, blue, clayey.
54-56 Fault veers to E from tunnel, vein pinches out. Saunders. Slickensides on blocks. Block faulting. See sample with supposed silver specimen from soft shaly beds.
57-69 Lagged over. No ore said to be in vein beginning 56.
70. Fault plane but no ore seam. A 10' drift to E revealed nothing but hard lean rock.

Tom James Tunnel.

63- 1-90 From rock fall in Tom James tunnel about 60 ft from mouth of tunnel. Tunnel not accessible.

Mouth of tunnel 15 ft above creek at bridge. Tunnel reported to be between 200 and 300 ft long. Begun under easement from J.McBride through Maude vein to get upon James' claim. Never got on his clai, and was stopped by Gordon Galloway.

72- 60-60 On 60 ft level. No. 9 raise. Height above main tunnel 60 ft. Width 36". Carbonate-sulphide. Vein proper only 6" wide but hanging wall is broken out and contains rich streaks and masses.

73- 62½-65 ft level. Cut 29". 25' N of raise No. 9; 65 ft above tunnel. Rich seam of gland in foot. Hanging wall broken, lean but with rich streaks. Width of vein at 18 ft from Raise is about 3 ft.
S 34 on 90 ft level. S of raise No. 9 Cut 25".(Dup. entry).

69- 25-70 On 70 ft level(approx.) Rock brecciated with scattered masses of solid gland but the vein varies from only an inch or so to 1 foot. Ore spotty. Doesnt look promising. Breccia 6' wide on breast. See. 26" Low grade ore in spots in raise . S 31 on 90 ft level. No sp. Vein 2 foot wide and less.

70- 34-73. Titon- Cliff Dweller. On 73 ft level. Vein 4-5" wide, little or coarsely broken but masses and stringers of gland in bedding of fragments and in wall rock. Ore very pockety.

68- 71-D. Rockpile. Quartered sample.

71- 34-90. On 90 ft level. Vein only 8" but wall rock rich on either side. Cut 25". South of raise No.9.
Then follows 15 pages of diagrams of the above described mines.

Mastodon. Loc. 2 miles S, 80 rods E of Fowler, Clinton Co. Peter Cook farm, in ditch. Cook drain, under sod in sand. Leg bone 30", weight 15 lbs. Jas bone. Shoulder and other bones. 12-15 small bones. Data from Tony Cook, son of Peter Cook. Diagram of where bones were found.

Coal (1917). Grand Ledge. Upper 10 ft above water at W end of dam below islands. 2 ft thick. Lower bed 5 ft below . 18". Dips down river for 5 or 600 ft, i.e. to the northwest. Coal cuts out going up on hill. Bed 8 ft above river 4 miles down stream. Data from Lee Bates, Grand Ledge. Old mines of coal in vicinity of Grand Ledge.

Book 264 B - 1 insert after page 11

R. A. Smith - 1913.

Trout Lake, Aug. 5, 1913.
Rained very hard Tuesday night and was very threatening during the morning following. Planned to go with A. Connors to see the bluffs south of half but the automobile could not be started. Remained at the hotel all day writing up notes, labeling samples and correcting blue prints received from the draftsman at Lansing.

Page diagram - Seaman Quarry - Drummond (see insert)

p 4. Aug. 6, 1913. Garnet - Coffey
Took the early freight (6 A.M.) to Garnet and made a short traverse north of the town where there is a very large boulder covered plain with several prominent outcrops which proved to be of typical Ozark dolomite. The boulders were of immense size and all massive and showing little trace of bedding. Good picture of this boulder field was obtained.

Outcrops are located in the road and to the right of it going north from Garnet. The first outcrop is about ¼ mile and the last about 1 mile. Sp. 165-166 were taken and show the typical blue markings and peculiar manner of weathering, etc.

Returned to Garnet and caught the 10:30 train for Coffey where dinner was obtained at a lumber camp and information gained as to the nature of the local rocks. Went ¼ mile E and ⅝ miles S and E where "flat rock" outcrops in abundance on the fields and along the road. Rock is massive and typically the Ozark dolomite. This outcrop completes a chain of outcrops from Seoul Choix Pt. to Ozark Sand Haff (or Hoff). Outcrops of this rock undoubtedly run eastward in great abundance as the blocks in thickness have the general contour of this heavy dolomite.
Sp. 167 is almost exactly alike 165 and 155 and was taken from Garnet 1 mile SE of Coffey near an old deserted farm house.

p 6 Rudyard - Pickford - Rockview and Hessel. Aug. 7 and 8 1913.
Took the 11:30 A.M. train over the Soo line for Rudyard, dinner at the Rudyard House and took the stage for Pickford arriving there at about 3:30 P.M. Left Pickford at 4 P.M. for Hessel. At Rockview, the first rock was encountered in rather bold bluffs which run E-W in general for many miles as they could be seen to the South nearly all the way from Rudyard to Pickford.

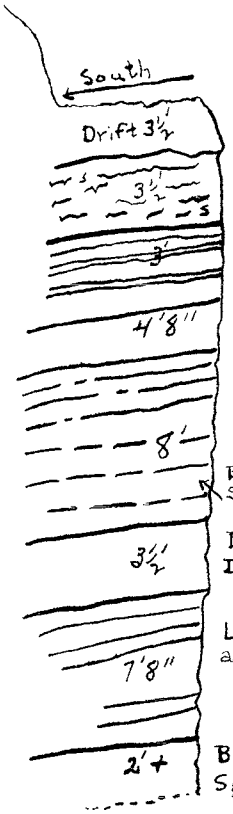
This bluff is typical Ozark dolomite with the white to buff fossiliferous dolomites and dolomitic limestones as noted elsewhere to the westward (Ozark, Engadine, etc). The fossiliferous stone outcrops to the north of Rockview and in low and inconspicuous ridges. These were not examined but samples were picked up from the ledge in the road cut. See Sp. 194-195 . The latter is from the lower yellowish white crystalline and fossiliferous beds showing fossil casts to some extent No. 194 is typical blue mottled Ozark dolomite.

Went on to Hessel where the rock was of the same general character, hence there was no use in using up any time in this locality. Returned to Pickford. Stayed overnight. hen caught stage for Rudyard the next morning. Arrived in the Soo at noon and took the boat for Detour at 2:30 arriving at the latter place at 7:30 P.M.
Left Detour House for a trip to Raber the next morning.

p 8. Detour - Raber. Aug. 9, Sunday.
Took the north road from Detour which place is located on an extensive outcrop of the massive dolomite. An old quarry was once operated in the north part of the town which exposed a ledge 8-10 ft high.

Seaman Quarry - Drummond I.

Section - see pp 13-18



60'± of foss. thin cherty beds above these quarry beds some non-fossiliferous ones.

Fossiliferous, cherty, massive, dolomitic limestone buff to grayish in color. Sp 177.

Massive hard light gray to buff crystalline dolomite Sp. 178 Seam of thin plates or laminae.

Massive, hard, crystalline, light buff dolomite similar to 178

Hard, crystalline, buff dolomite, densely crystalline Sp 180

Brittle with conchoidal fracture in 2 lower layers Sp. 182

Dark buff, hard crystalline at top & bottom. Sp 181 at top Drusy portion with fossils in middle. Sp 183 middle.

Light gray to buff, finely crystalline, banded and well bedded. Sp 184 lower part

Bluish, hard, fine grained dolomite, weathering quite blue. Sp. 185

Vertical joint planes at right angles, hence block stone quarried natural.

Joints also { S 40° W. / S 5 E / S 25 E.

The stone in no way is different from the Ozark-Engadine outcrops. Sample 169 is leached and faded somewhat. No very fresh samples were obtainable as my hammer had become very round faced and also loose on the handle. Fresh specimens was seen in the centre of blocks were typical in general appearance of the Ozark variety.

Ledges of this rock were in sight for most of the distance from Detour to Gatesville and sample 170 was taken ½ mile east of Gatesville where the Ozark stone rises in a prominent bluff and ridge without cover for miles to the SE toward Caribou Lake. Fire had destroyed the freshness of the outside of the long joint blocks and no very good samples were obtainable. Arrived in Raber at 1 P.M. Stayed overnight at a boarding house and made the following trip the next morning.

Dip of rocks at Detour SE1½° but this is only an undulation. Fractures S 42 W and S 51 E.

p 9 Aug. 10, 1913. Raber - Pittsburg Landing.
Took the road leading north from Raber about 2 miles then turned eastward and skirted along the old elevated shore line, along which a road had been made. This road ran E-SE then E and finally N-NE going around the peninsula in 43 - 3 E. While many boulders were seen the greatest number were of pre-Cambrian age and rock was nowhere seen in outcrop. Two or three boulders of the Blaney-Fiborn high calcium bed were observed in the drift showing that this bed runs through this territory somewhere to the north of Pittsburg Landing. The site of the old coal dock of the P.Coal Co. The traverse extended into Sec. 10-43-3 E and there being no sign of rock outcrop, it was retraced into Sec. 15 in an attempt to reach the old coal docks of the Pitts. Coal Co. A long swamp precluded the possibility of rock being exposed , so further attempt at finding the the Blaney-Fiborn outcrop was given up. Possibly along the south shore of Grand Lake rock may outcrop somewhere.

p 10. Aug. 10. Tues. W. H. Murner Lumber Co. Camp 11 miles W of Raber in Sec.8-43-3
Took log train out to lumber camp 11 miles west of Raber and slightly north. Rock was encountered at various places on the way out in the form of boulder tracts with here and there a ledge. The stone was typically the Ozark dolomite as shown by Sp. 196 which is a fresh blue sample from a ledge exposed in making the log road bed. Walked back by way of Galesville and encountered other ledges of this Ozark stone.

Aug. 12. Wed. Lime Island.
Left for Lime Island in the afternoon by motor boat. Visited the old lime kilns which are located a few hundred feet north of the new dock of the Pitts. Coal Co. and on the shore. The rock used to be burned for lime but it made a gray lime not well liked. When wood became scarce the kilns were abandoned. The stone is a light gray to brown or buff in color, the lighter color being at the top, very densely crystalline and hard, well but massively bedded. The joint planes were such as to allow the stone to be taken out in blocks almost any size, The rock outcropping from the water's edge up to the height of at least 30 feet where there was an old cut and built terrace of talus. The bluff beyond this rose to the height of 25 or 30 ft. higher but it appeared to be all drift material or the latter had slumped down off the drift covered ledge, concealing everything.

p 11. In the trenches dug for the lead pipes of the heating plant for the hotel or boarding house there was an abundance of fragments of the hard, densely crystalline buff and light colored dolomites with an occasional boulder of the Blaney-Fiborn high calcium stone.
The finding of the latter caused me to stay overnight in an attempt to locate the stone on the island. A search the next morning showed nothing except that the drift was largely composed of the fragments from the dolomites mentioned.

See sp/ 171, taken about 10 ft from water's edge, which shows the buff type of densely crystalline dolomite. Sp. 172 was taken directly back of the old kiln 20 ft above the lake and No 173 at 28 ft. The latter shows the white or lighter colored dolomite.

As the island is more than 80 ft above the river level, it is quite possible that the upper part may have in it the Fiborn stone, but the abundance of surface rocks of different kind altogether would seem to mitigate against this idea. It would seem more reasonable to find the stone farther to the north, perhaps on the western shore of St. Joseph's Island where rocky shores are reported.

Caught the boat to Detour, stayed all night at the Detour House, making arrangements for passage over to Drummond I. the next morning.

p 13. Aug. 13, 1913. Ft. Drummond - Drummond I.

Was taken by Mr. L. Seaman by motor boat to the landing at the west end of Drummond I., on the winter mail road. Proceeded 1 mile E and then made a detour S-SE to old Fort Drummond. Bed rock was sparingly exposed and was both crystalline and fossiliferous like some of the beds directly beneath the Ozark dolomite. Ozark dolomite covers parts of the southwestern side of the island and probably the southern This latter could not be affirmed as it was not visited except at old Fort Drummond.

Returned to the main trail, continued eastward through a country in which the soil was largely boulders, no bed rock being encountered until Sec. 25-42-5, about 3 miles southwest from Drummond. The rock was thin bedded, fossiliferous, crystalline dolomitic limestone. This stone is similar to the fossiliferous beds beneath the Ozark dolomite, especially those at some distance below the base of the latter. These are undoubtedly a part of the fossiliferous beds observed(later in the day) in the upper terraces above the massive dolomites of the quarry beds at Drummond. Outcrops of these fossiliferous beds were observed at various places east and north to Drummond.

p 14. Drummond Quarries Aug. 13. Ludlow Seaman Quarry.

There are 3 old quarries near Drummond of which the Seaman has been operated the more recently. In fact block stone has been taken out within the last 2 or 3 years. The Seaman quarry lies along the lake shore on the western end of Drummond Harbor. The rock here forms a pronounced terrace reaching to the shore and thence back to the distance of 100 to several hundred yards, depending upon the particular place west of Drummond that one is in. This rock terrace or shelf extends along the shore for several miles and all three quarries have operated in its beds. At varying distances from the lake front, the surface rises in a series of terraces to the height of 60 to 85 ft or more. These successive benches are old cut and built beaches in which the rock is exposed in low bluffs, but more or less continuous.

The section and profile on the following page shows the relations between the quarry beds and those of the upper terraces. For description of beds 5 to 11 inclusive see page 3.

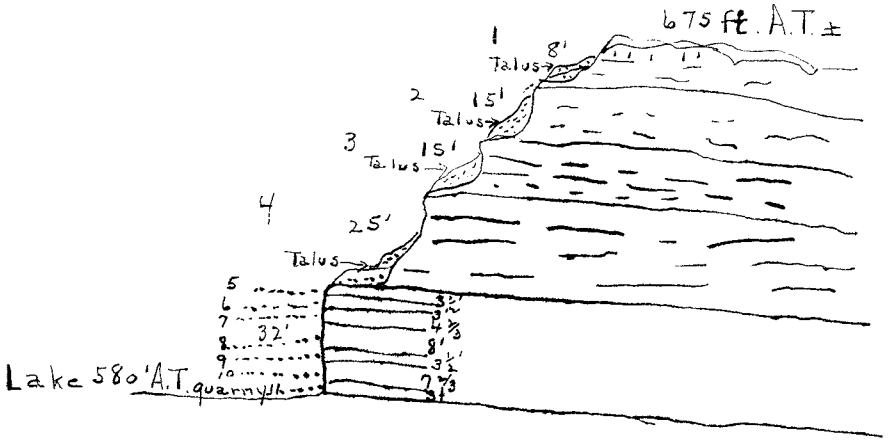
Sketch. (see insert)

Bed no 1.

This was at the very end of the hill south and west of the quarry at Drummond (Seaman). The ledge was only 3-4 feet high, being only about 8' above the top of the next lower terrace. The rock was a light buff to a grayish buff, crystalline, fossiliferous, dolomitic limestone full of druses from fossils, mainly pentamerus. It is in no way different in character than Bed No.2 excepth that it was more weathered and perhaps was not quite so fossiliferous. See sp 192. Thickness 8'.

Bed No. 2.

Similar but fresher and the pentamerus more numerous, the rock being largely composed of the casts of this fossil. See Sp. No.1 1. Bed apparently a part of No.1 but it may may separated by beds of different character. Thickness 15' plus.



Profile and section at Seaman Quarry
Drummond - Drummond I
For description of beds 5 to 11 inclusive, see p. 3

Bed No. 3

The terrace from top down to bed 4 was about 15 ft but only the upper part was exposed. The same is true of No. 2. In this way the lower part of each is concealed by talus. Probably 5 ft of rock is exposed and this is quite similar to the beds above except that the fossils appeared to be less numerous, the stone somewhat less coarsely crystalline and the stone weathers into a mass of nodular fragments. See sp 190.

Bed No. 4

This was at the top of the first terrace above the quarry and some 5 or 6 feet was exposed at the top of the 25 ft terrace. The stone is very dense resembling novaculite or perhaps lithographic stone. It is a grayish buff, dense fine grained dolomite, very hard and breaks with a conchoidal fracture. This stone resembles the massive fine grained non-fossiliferous beds below in the quarry proper. The stone weathers into thin slabs. (See Sp 189, also 185.) Separated by fossiliferous beds of No. 5.

p 17 Seaman Quarry. Beds 5-11

These beds are described on p 3 on the section as given. In general they may be described as hard dense to finely crystalline, massive dolomites, buff to gray or bluish in color. All of the stone occurs in heavy beds even to 5 or 6 ft through and since the fracture systems are on the whole almost exactly at a right angles, the stone is quarried out in blocks with a natural face. The perfection of the joint planes has led to the quarrying of much stone for the massive block stone work on the Soo locks.

The quarry has been idle for two or three years, having been operated only intermittently by various contractors, who lease it from the owner, Mr. Ludlow Seaman of Drummond. Several fair to good pictures obtained.

p 18 Old Lime Kiln Quarry . Loc. On shore of Drummond Harbor ¾ mile E of village.

The stone in this quarry appears identical in all characters with that at the Seamans Quarry. One draw kiln must have been in use a considerable time as the quarry face is some 25 ft high and the quarry 250' long. The lime is reported to be a slow setting gray lime not well liked, although it made a very strong mortar when set. No specimens were taken as the stone was so similar to that at the Seaman quarry.

Quarry near Sam Island.

About one mile west and south from Drummond another large quarry has been opened in the lower massive dense to finely crystalline dolomites, the stone being transported down to the lake by a tram railway and loaded on barges. The stone is apparently just like that in the Seaman Q., except that the extreme upper beds toward the northeast end probably belong to those found in the first terrace above the Seaman quarry beds. No samples were taken. Fair picture of the quarry obtained.

p 19. Raynolds Bay - Drummond I. - Birch Point.

In company of Mr. L. Seaman Jr. took motor boat trip from Drummond to Raynolds Bay on the NE shore of Drummond I. where rock outcrops for miles in low bluffs ranging from about the water's edge to 25 ft high. The ledge examined was from 15 to 25 ft. high above the water and similar rock could be seen for 4 or 5 ft beneath or more.

The stone as a whole was characteristically different from that at Drummond, being very bluish and shaly, full of fossils and having a very considerable quantity of bituminous matter as the burned fragments were all black from the charring of the carbonaceous matter. Fires have burned off the vegetable mulch and thus there was much of this black rock. See sp. 188

Book 264 B - 5 insert after page 11.

p 19.
Sp. 186 was from about 5 ft above the water and is from a bluish shaly limestone filled with large coral heads with brachiopods, zaphrentis, bryazoa, etc. The corals were especially abundant, often composing a large part of the rock and giving a buff yellow mottled appearance to the blue rock, the fossils being yellowish white to buff in color in contrast to the blue matrix. Stone thin-bedded.
Sp. 187 was taken just above the water's edge and shows the character of the shaly limestone where the fossils are less abundant.

p 20. Birch Point Aug. 14.
From field relations and the character of this rock, it would appear that these beds must be in the lower part of the formation and therefore presumably at a considerable distance below the Blaney-Fiborn bed. In this case the latter bed ought to occur somewhere north of Maxton. The evidence however must be supplemented by other facts before drawing a hard and fast conclusion

p 21. Returned to Drummond, stayed overnight and caught the mail boat for Detour arriving there at about 11 A M. Found letter from R.C.Allen directing me to return to Lansing at once. Caught the Chippewa to the Soo arriving at 2:30 PM. Left for Lansing at 5:30 P.M. arriving at Grand Ledge Sat. morning Aug. 15, where I stopped off until Mon. morning.

p 22. Dec. 6 ?, 1913. Limestone memoranda. Given by G.M.Ferris, Rock Products Co. Charlevoix. Home address, St. Louis, Mich.
Mr. Ferris visited the office of the survey and gave the following information:
1. Mr. Ferris has a complete history of the lime companies in northern lower Michigan, ready for publication.
2. Has an accurate map. Is to send blue print of tracing, showing limestone deposits.
3. Sloan of Rock Products Co. has record of all drillings in NW region. One drilling 420 ft with 11 ft shale at 20-23 ft in 2 beds.
4. 300 ft exposure of blue shale at Ellsworth in R.R. cut. Big slide of earth made exposure.
5. Old man Gage was original "lime" man in district. Built kilns for H.O.Rose.
6. Leon Chichester, banker of Petoskey knows much of limestone conditions.
7. See also Curtis of Petoskey for drillings.

Book 266 - 1 insert after page 11

G. B Corless No. 1, 1912.

pp 1-16 Diagrams. Notes by G.W Crane R.I Dick, compassman.
Note on p 16. No. 1. Outcrop 70' long (see sketch) schistose greenstone, fine grained, much jointed and folded in places, also contains quartz seams. Outcrop badly covered with moss and strike about 40 E of N. Dips nearly vertical. Sp.901

p 17 46-42 Outcrops of rock. These outcrops are located and mapped to scale on pp 12,13,14 of this book. They are a series of parallel ridges striking about N 50 E and form the sides of the Ontonagon River valley in the SE corner of Sec.30 46-42. The cliffs that face the river are often vertical and range in height to (or from?) a few feet to as many as thirty or more feet. On the side near the river the surface is marsh and all the outcrops are partly surrounded by this marsh except the outcrop nearest the section cor 29/30/31/32 which was found in the hardwood.

The most striking feature of the entire group of outcrops was the parallel grey bands of alternating light and dark material. These bands have a strike of N 41 E in almost all cases. In a few cases there is a massive rock of diabase texture (which) has cut across these bands. In one place place stringers of a dark green chloritic material is found in the banded rock parallel to the bands (sp). Some quartz in the shape of stringers and small blebs were noted and in an exceptional case there was a block of quartz that measured approximately two by five feet on the surface. The surface of this rock, the schistose character and the massive intrusive rock as an associate are all very similar to the rock described by R.S.Allen p 27, Book 1.

pp 18-23 46-41 Diagrams.
p 23. Outcrop A. p 23. Ledge of dark green dense rocks. Schistosity of N 60 E noted in a few instances. Sp. 723 but the rock was chiefly massive and apparently non-schistose. In one place the outcrop was decidedly vesicular (sp 723) and on the surface was weathered into a pitted appearance. Little or no quartz was present but the surface was flecked with a white mineral probably feldspar. The texture of the rock was coarser than the massive rock found associated with green schist northwest of Thayer but otherwise this rock was very similar.

pp 24-27 46-41 Diagrams.
p 27 Outcrop of rock B. This is an outcrop of dark rock showing a schistose structure of a black mineral that looks like hornblende. Sp. 726

Outcrop A. p 27. This is an outcrop of rock 200 paces long with an escarpment facing the southwest. The strike of the ledge is about N 75 E. The rock is almost entirely a dense non-schistose rock. Sp. 724. It has an excellent cleavage N 45E and at right angles to that direction. This cleavage may be due to schistosity but the rock is so fine-grained that no parallel arrangement of the minerals can be seen. In one place the rock is plainly schistose N 45 E. See sp. 725. The main body of this outcrop is similar to the outcrop of rock found just south of the magnetic belt near the cor. 26/27/34/35 of 46-41.
p 28. Outcrop C similar to A., p 27.

pp 29-32. Aug.8,1912. Gordon Links, Compassman. 46-41

Outcrop A. p 33. This outcrop forms a steep narrow (15 paces) ridge in the low ground bordering the Ontonagon River. The trend of the ridge is about N 60 E. It is entirely covered with small trees and moss and was noted as an outcrop until the magnetic belt was crossed at fifty paces north. The rock is probably homogeneous tho this was verified only in a few places where it could be dug into, and is of the type represented by Sp. 729.

p 33 Contd. It is a dense basic rock with a suggestion of a porphyritic texture. Schistosity could not be obtained and little other information was available about this outcrop.

The position of this outcrop only a few paces south of the maximum magnetic reading suggests that this rock bears a very close relationship to the rocks found in a similar relationship in Sec. 33-34 ,46-41. I believe that it is the same rocks. It should be noted that the falls are north of the maximum magnetic line about 180 paces and hence we have apparently a series of three rocks in the immediate vicinity of the falls - namely the greenstone of the falls as described by Mr. Rane and Mr. Allen, the iron formation giving a decided magnetic disturbance and this rock which outcrops at A.

p 34 46-41 Outcrop A. p 34. This outcrop like A of p 33 was found a few paces south of the maximum magnetic line. The strike of the outcrop was about N 60E and this seems to be the direction of best cleavage. The rock however, did not give the appearance of schist. On the other hand the first impression of the rock is that it is a green schist chiefly from its gray-green color. Sp 730. It is my opinion that this is another outcrop of the same rock that has been following the strike of the magnetic belt, at least as far to the east as the NE corner of Sec. 34-46-41.
Note added about sp 730. Also located in T 46-42 S.P.B. See next page. Specimen therefore worthless.

p 35. Aug.12,1912 Outcrop A . This is an outcrop of dark grey schistose rock but not as fine grained as the rock found associated with iron formation at the Falls on the Ontonagon River (46-41) for instance; the outcrop was almost entirely moss covered and the direction of schistosity could not be determined. There was no banded schist present. It is probable that this outcrop is the same as the green schists that are so numerous NW of Thayer. Sp 730. See comment above paragraph.

p 36. Outcrop B p 35. This outcrop is located S 20 W, 78 paces from point C. Besides the outcrop there are two pits. Number one about ten feet deep, is outside the field of magnetic disturbance. Number two, the dip is about 30° (N 13). Find this working has been carried to a considerable depth. The outcrop is located about 20 paces due east of pit No.1. It gives a dip of 50°. The rock is well represented by Sp. 731 and 732. It is highly silicious and gives a glistening appearance due to the presence of quartz. The rock is quite porous but most of the cavities are filled with hematite or limonite, - sp 731 shows limonite on the surface. Sp. 732 is also highly silicious specimen and shows in particular the magnetic crystals well developed. It is probable that this is the same iron formation that Mr. Allen found near the large pit that is almost 200 paces W of here.

Outcrop D. p 35. This outcrop shows both phases of the rock that has been described repeatedly under the term green schist. Sp 733 illustrates the massive dense rock that apparently makes up the almost entire outcrop and 734 illustrates the plainly schistose phase. There this specimen (734) was taken there was a very large bleb of white quartz in the schist. The strike of the schistosity was about N 60 E.

Outcrop E p 35. Long narrow ridge of rock similar to the massive phase of Outcrop D, p 35.

pp 37-39. 46-42 Aug. 13, 1912
p 39 Outcrop A. This is a low-lying ridge about 30 paces long striking S 52 W. It is located in hardwood and it is entirely moss covered.

p 39 Contd. But one rock was found in this outcrop . The rock is a very fine-grained dense rock with apparently no schistose structure. The rock is so dense that the individual minerals cannot be determined except in the case of the feldspar which gives the rock a grey-white tint. It is my opinion that this rock is the dense rock found associated with the more schistose phase of the green schist NW of Thayer. Sp. 735.

pp 40-41 Diagrams. Outcrop A. p 41. This outcrop forms a very prominent ridge striking N 65 E approximately and rising to 50 feet or more in height. It is covered by a growth of hardwood. The outcrop is made up of rock that illustrates two phases of green schist. Sp. 736 illustrates the schistose phase and 737 is the massive rock found so commonly as intrusive in the schistose rock.

pp 42-45 Diagrams.
p 45. Outcrop A. p 46. This is an outcrop of rock striking E-W for about 35 paces. The rock possesses a perfect cleavage that amounts almost to slatiness. This cleavage (schistosity) dips 70°S and strikes N 60 E where it could be determined. The rock is so fine-grained that the individual minerals could not be determined megascopically. The grey color and the perfect cleavage together with the nearness to the Slate River Falls where Keewatin green schist outcrops all point to the probability that this rock is also Keewatin Green schist. (No quartz or banded rock was found at this outcrop). Slate, belongs to series , determined as green schist but plainly a slate. L P.B.

46-51pp Diagrams. Outcrop A, p 51. Here is an outcrop of rock some 65 paces long and half as wide striking N 30 E. The rock shows no schistosity or other characteristics of a metamorphic rock. The principal constituent of this rock is orthoclase feldspar. This mineral is so abundant that it gives the rock a characteristic pink color. Further evidence of the presence of orthoclase is the good cleavage. Quartz is also abundant in this rock both as primary or disseminated quartz and as secondary quartz in the form of veins. See sp 742. Quartz sometimes occurs in pieces as large as the fist. There is also a minor phase of this rock in which the feldspar is almost white and thus giving a distinguishing color to this part of the outcrop. According to the accepted classifications of rocks, a quartz orthoclase rock is classed as a granite and that is where I would place this rock.

p 52 Diagram. Outcrop A, p 52. This outcrop is similar in most respects to A,p 51. Sp. 744 is similar to the white phase of A. p 51 except that it is fine grained thc the orthoclase crystals are still distinguishable. Sp 745 illustrates the development of a black mineral hornblende not shown by previous specimens

p 53 46-42 Outcrop A, p 52. Sp. 743. Here is an outcrop of rock the main body of which is granite similar in all respects to the rocks described yesterday on pp 51 and 52. Near the center of the south ledge however there is a narrow band, a foot or less across of a more basic rock. The feldspar shows the parallel striations of the plagioclases and the ferric minerals give the rock a dark color. I was unable to find quartz in the rock. The light color of the feldspar seems to favor Albite so that I am of the opinion that this rock is not more basic than a diorite. No line of contact between the granite and this rock could be determined on either side. There are two possibilities in regard to the origin of this rock, It may be a basic dike cut thro the granite or it may be a differentiationof basic material from the acid magma that furnished the granite.

p 54. 46-42 Outcrop A. p 54. Here is an outcrop over a 100 paces in each direction. It has steep cliffs over 8 ft high on its north and west sides and a gentle slope on the south and east. A small outcrop of granite was found some 50 paces south of the main outcrop. This granite does not differ materially from the other outcrops found to the south of it. One vein of secondary quartz, are rich thick, was noted. sp 753.

The main body of this rock is a dark, dense chiefly non-schistose rock. It forms the cliffs mentioned above. Sp. 752 represents almost the entire outcrop It is so fine-grained that individual minerals cannot be distinguished but the color of the rock - dark grey, gives the idea that it is not more basic than a gabbro (Labradorite feldspar). Sp. 751 represents a minor schistose phase. It has a good cleavage striking S 65 W and dip S 45°E. From these relations I believe that we have here a contact of the Keewatin Green schist with its massive associate Sp 752 and the Laurentian granite intrusive into the Keewatin. No actual contact could be found but the proximity of the granite to the rock that looks very much like the greenstones found north of Thayer is good evidence for a contact being there with no intervening formation.

pp 55-58 Outcrop A, p 59
p 58 46-42 Here is an outcrop of rock about 15 paces square. It is less than 100 paces east of a rock that is granite such as A 57. This rock is dark gray to black in color. The feldspar is like one, the more acid plagioclases, albite, etc. Quartz is abundant. There is little biotite and hornblende appears to be the predominant ferric mineral. I would classify this rock as a diorite. Sp. 757.

p 58. Outcrop A, p 58. The bed of Marshal Creek at this point is paved with granite similar to those described on pp 51-53. One rock jutting from the north bank had bands of the pink granite in a darker background. Sp. 755

pp 59-60 46-42 Aug.1912. Outcrop A p 60 . Sp. 758.
Here is a rock that outcrops in the south bank of the county road 1100 ft east of the quarter line thro Sec. 7. The outcrop is about four paces long. The rock has a very perfect cleavage striking s 65 W and having a vertical dip. Most of the rock cleaves in places like a slate but one piece was found that showed folding and the cleavage surface was warped. Sp. 758. A small amount of quartz was found in one place. (Pencil note - slate L.P.B.)

p 60 Outcrop B p 60, Sp. 759
This outcrop is 600 ft east on the county road curve from A, p 60. It is located on the north side of the road. The rock has been broken up considerably by blasting It has a schistosity N 70 E with a vertical dip. The rock is similar to A above except that no evidence of folding could be found. Sp. 759. The edges of the specimen show the parallel arrangement of the minerals. Chlorite is especially abundant and gives a silky luster to the surface. I would classify both A & B as chlorite schists. (Pencil note - Slate L. P.B.)

p 61. Outcrop A p 61. This is an outcrop of rock about 6 ft square and standing about 10 ft high in the center of the road. The schistosity strikes S & W. and dips 29°W. The rock is a light grey rock with considerable light-colored feldspar. . The cleavage is not nearly so perfect as that found at A p 60. No quartz was found. Chlorite is an important constituent. About 10 paces to the east is another rock similar in size and of the same material as A. I would classify these rocks as a green schist of probable diorite composition.

Outcrop B. p 61. Here is a small outcrop of rock just west of the creek. It is distinguishable from A. p 61 as being softer, more schistose and by the presence of a stringer of quartz. Strike S 60 W, Dip 35 W. Sp. 761.

p 62 Outcrop of rock at Nelson Canon. The creek at this point has cut a gorge about 20 paces wide and 25 ft deep thro a green schist similar to the schist described at A p 60, sp 762. The dip of the rock to the south gives overhanging wall on the south bank and a slope on the north bank. (Pencil note. Plainly sedimentary. Above is a slate. L.P.Barrett).

pp 63-64. 46-42. Outcrop of rock A p, 63. Here is an outcrop or rather a series of outcrops striking about S 60 E. The main body of the outcrop is granite that varies from a bright pink to white and grey in color. Sp. 764 is a specimen that looks like hornblende granite. At one place the granite ledge is crossed by a dark grey rock that resembles the green schists found in Nelson Canon for instance; Sp. 763 shows the contact of the granite and the darker rock is about 24 inches in width at the surface. Considering the relative amounts of the granite and the greenstone it would appear that the latter were the intrusive. But there is nothing about the granite to show that it has withstood the forces that metamorphosed the darker rock. Hence the darker rock is the older and the granite is the intrusive.

Outcrop B p 64. Sp. 765. Here is a ledge of rock about 15 paces long striking N 45 E. The rock is a dark grey non-schistose rock of probable diorite composition. Sp. 765.

pp 65-68 Aug. 23, 1912. Outcrop A. p 68
Here is an outcrop of rock 65 paces west of the 1 mile post on the Marenisco Twp road. The rock strikes N 90 E, and dips 23°S. The rock is a grey green color and has the silky luster due to chlorite. Quartz is present in short stringers and blebs but is not nearly so prominent as in other outcrops of rock that this one resembles. Over the surface of the outcrop there are small spots as large as the hand or smaller of a lighter colored material than the main body of the outcrop. These spots are full of holes and look like worm-eaten wood. The main body of the outcrop is highly schistose but the lines of schistosity all curve around these spots. Besides these light colored rock there are other spots of similar shape and character except that they are darker than the main body of the outcrop.

pp 69-70 46-43. Outcrop A p. 70
Here is a ledge of granite about 150 paces long striking S 75 W. This granite is similar to the ledge found in 46-42 west of Gogebic Lake. The orthoclase is of two varieties- pink and white. Nearthe south side of the outcrop there are dark bands striking S 85 E across the granite. They vary in width from an inch to two feet. These bands appear in a belt about 8 ft wide and extends the full length of the outcrop. Sp. 768. Between these dark bands there are bands of granite of about the same width. These bands of dark rock narrow and play out in the granite and the granite is also found in stringers giving a dovetail effect. The main dark bands are continuous however. About 50 paces west of the east end of the outcrop there is a rock similar to the bands.

The bands themselves are made up of a non-schistose dark grey rock. It is apparently igneous but it is so fine-grained that the individual mineral cannot be made out. From the way that the dark rock and the granite are intermingled, I am of the opinion that they are of the same age and that the dark rock is the basic material that collects near the edge of a cooling magma.

pp 71-77 Diagrams. Note. Aug 28, 1912. Rain all day. Rode out to the exploration. that R B. Whiteside of Duluth is making in Sec. 21 of 47-43. The exact location is about one tally east and 1600 ft north of the corner of 28/29/30/31, 47-43. About $100,000 worth of drilling, so report goes has been done at this place. One drill hole is thro a greenstone rock knob almost thirty feet high and it is at this place that the shaft will be sunk.

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p 77 contd. Capt. Barnaby has charge of the work. Up to the present they have been building camps and clearing land but they expect a load of machinery soon. His first orders are to sink a shaft 290 ft and drift 600 ft north. No outcrops of the iron formation can be found in this vicinity. The dip is normal also. The firm's name that is furnishing the capital is The Presque Isle Iron Mining Co., Duluth, Minn.

pp 78-82 Diagrams. Outcrop A, p 82.
Here is an outcrop of green schist having a schistosity of S 68 W, Sp. 769 is a specimen of this chloritic schist found at the east end of the outcrop. The main body of the outcrop is represented by Sp 770. It has a pitted surface where it has weathered. The rock is made up entirely of small crystals about ¼ of an inch in diameter of a black mineral that looks like hornblende. The fibrous cleavage favors that mineral but no hexagonal cleavages could be found. It is possible that this mineral is augite.

pp 83-85 Diagrams. Outcrop A. p 85
Here is an outcrop of rock 55 paces long striking about S 60 W. It gives a magnetic dip of 53°. About 20 paces north the dip falls to 30° which shows that this is the rock that has given the magnetic belt traversed today. The rock is a fine grained rock, dark grey in color. The rock i s apparently schistose with parallel fibers of chlorite showing in the broken pieces. One small piece of quartz was found. See sp 775. The schistosity dips 73°S.

p 86 46-41. The s outcrop was found and tied in while we were returning to camp. No other rocks were seen from the N¼ 25 to cor 13/14/23/24 on the section lines. The surface of this rock was flecked with a white feldspar. See surface side of sp 778. The rock itself is apparently schistose as it possessed a good cleavage. The presence of feldspar phenocrysts may be taken to show that this rock is an extrusive and the good cleavage is due to a subsequent metamorphism.

pp 87-88 46-40 P 88. Outcrop of rock A, p 87.
Three phases of green schist are represented in this outcrop. Sp. 781 is from the center of the body of the outcrop and is highly schistose - strike S 59 W. Sp. 783 is a feldspar rock, non-schistose of apparently diorite composition. Sp. 782 represents an unusual phase of the green schists so far as found in this area. In this outcrop there are several narrow bands of orthoclase rock. No quartz was found with the orthoclase and the only ferric mineral is where the orthoclase has apparently surrounded fragments of the schist. The largest band of this rock is about 4 ft long and 3 inches wide. It follows the line of schistosity.

pp 89-98 46-40 P 90. Outcrop of rock Z, p 90.
Here is an outcrop of rock similar to A, p 85. It gives a magnetic dip of 32-35° and is located on the maximum line that crosses Sec. 19, 46-40. The rock is highly schistose striking about N 80 E. The dip is 68°S. One small piece of quartz was found. Sp. 785, 786.

p 99. Outcrops G.S, p 98. These outcrops were found while returning home after the traverse. Their location is almost correct because the compassman was carrying his count until we got to the section line 31/32. As the specimens indicate they are outcrops of green schist. The strike is N 65 E, Dip S 75°.

pp 100-109 Diagrams of traverses 46-41, 46-40.

On back pages. Expense acct. Indes to specimens RR time tables, C & NW.
Maps of 46-43 and 46-42.

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R. C. Allen No.1, 1912. Friday May 24, 1912. With F. I. Carpenter and J.R. Finlay left Chicago for state line, Wis.

Sat. May 25, 1912. Arrived State Line Wis. 4 P.M. and drove out to Geo. St.Clair's Black Oak Lake Resort.

Sun. May 26, 1912. With Finlay, F.I.Carpenter, Wm Carpenter and H.J.Allen drove to Donaldson to inspect buildings on town site. It was decided to utilize old store and office of Mason-Donaldson Co for office of Syndicates A, B, and C.
Drove out to State Line and spotted drill hole No.1 at Sec. No.11 and verified maximum magnetic line thru hole at Sta. 11 and on Ry, 100 poles east. Returned to Black Oak Lake for dinner.
In P.M. with F.I and Wm. Carpenter, Finlay, Allen and Mr. Hulbert(Halbert) visited Goose Lake. All shores except east side are still(or well) wooded with hardwood. One small island on east side with good stand of pine. Outlet is said to be via springs and creek to Spring lake. No way of getting in or out by canoe but broad can be easily repaired making connection with Berets, Black Oak and State Line. Shores of Goose lake are high and will be valuable for building lots. The land in Sec. 3-42-9 east of Goose lake is of good sandy loam which carried a good stand of pine and hardwood originally but the topography quite rough and rugged.
Mon. May 27,1912. With same party left Black Oak by canoe for Pope's on High lake where we arrived at 6 P.M. Crossed belt on Cochrane lake but took no readings.
Fri.May 28,1912. With Finlay drove to Boulder while rest of party went by canoe down Manitowish River to Oxley. Examined granite outcrops in 43-7. In P.M. drove with Mr. Frissell to Fishtrap dam in 14-42-7 in search of iron formation outcrop reported by Frissell as being south of and near the dam. The locality is one of heavy granite boulder moraine and we found no outcrop nor even a piece of float iron formation.
Wed. May 29,1912 Party went down Manitowish river to Manitowish lake and put up at Deer Park Lodge.

p 6 45-40 Diagram.

p 9 May 3,1912 With F.I.Carpenter, Wm. Carpenter and H.J.Allen went by launch from Engeman's resort to Star Lake, thence by portage and canoe to Dead Pike Lake. Lots 6 and 7 - 20-42-5. Hardwood covered with fine shores. Would be valuable lake frontage on good lake. Dead Pike is isolated and not attractive.

Lots 8 and sev. of sec 21-42-5, Lots 2 & 3 20-42-5 With H.J.Allen ran N on sec. line between Secs. 20 and 21. Took dip readings as shown on p - . Soil is pretty good sandy loam and land lies rich for farming. Pine cut. Hardwood partly killed by fires. Lots 2 and 3 are apparently almost denuded of trees.

SE ¼ Sec. 21,42-5. Crossed there on trip to Dead Pike lake. Soil good sandy loam. Lands are flat lying. Hardwood timber still standing but mostly killed by fire.

SE of SE 26-42-5/ Went by launch from Engemans to Alder Lake and saw lots 2 and 3 from the lake. These lots are bare and denuded but are dry and have a good shore frontage on Alder lake which is a desirable lake. Proceeded by launch to Clear Lake and with H. J. Allen started at N¼ cor. 1-42-5 and made view as shown on opposite page.

Diagram page 11.

pp 12-19 Diagram of traverse 45-40.

p 20 46-42 July 26,1912. With Geo. Grane and R. Dick walked on road 2½ miles north of Gogebic Station and thence east on old road about 1½ miles to an old clearing the latter being the site of an early exploration for iron ore. We found a number of old pits there, one of which, judging from the dump was perhaps 100' deep.

The iron formation in these pits is moderately magnetic and doubtless future work will reveal its relation to this line of magnetics. The iron formation shows an extreme phase of anomorphism. The iron is mainly in form of crystalline magnetite with some sulphides. Chlorite, garnet, amphibole are also highly developed. Pure chlorite schists(?) are shown on dump. These rocks are all represented in Sp. 400-417 taken from dump of pit.

p 21 46-41 July 27,1912. Outcrop of diabase, massive, coarse to fine grained 500 p plus 3½ rails east of sec. line between 30-46-41 and 25-46-42. Sp. 418. Striae S 12W.

p 22 Locality A p, 23. Outcrop at Gogebic Sta. Green schist intruded by massive diabase. Green schist very schistose with blebs and stringers of quartz showing small drag folds of the drag type. It is possible that the non-schistose phase is of the same as the other but the relations look intrusive.

Diagram.

p 23 46-42 Outcrop B. Outcrop of G S. showing relations similar to those at A - both massive and schistose phases. Schistosity in places wraps around massive blocks which seem to have acted as horsts. In others the relationslook intrusive but in this case I incline to same age for both phases. Quartz veining is prominent.

Diagram.

pp 24-25 Diagrams.

p 26 46-42 A. At A is the pit in lean iron formation described on page 20. At 18 paces S 18°W is an outcrop of rock similar to that on dump of pit. It is a banded silicious dark magnetitic lean iron formation giving a dip of 36° over the outcrop. The banding is well brought out by the white quartz bands. Strike at outcrop is N 15° E and dip 55° S. An old pit is shown on N side of outcrop. It is shallow and not important. Small diagram follows.

p 27 46-41 Outcrop of Rock. Location - Fourteen paces north of the C & NW Ry at a point 27½ rails SE of point G, p 39 - Corless Book 2. Here is an outcrop 64 paces long and half as wide striking S 50 W which is the direction of schistosity and elongation. This rock shows plainly two phases - one showing alternating light and dark bands of thoroly crystalline of basic material but these bands simulate bedding most beautifully. In this rock is an abundance of white milky quartz occurring in blebs and stringers in the strike of schistosity. Some of these stringers are folded into drag folds, some of which are up to a foot in diameter. There are a couple of quartz masses whose dimensions are measured in feet, not in inches - this statement applying to both dimensions. Other quartz stringers cut across the schistosity indifferently apparently filling joints. One can see two sets of these stringers making oblique angles with each other. The weathered surface of the rock is irregular. In fact the whole appearance of this rock reminds me strongly of those that occur in 44-45 mapped in season of 1910. I have described these rocks repeatedly in 1910. Also see notebooks of Clark and Hore for the same season.

p 28-29 It was decided at that time that this type of rock was probably a metamorphosed sediment because of its gradation along its strike into the paint slates of the Iron River district. The recurrence of bedding or that which was believed to be bedding and the predominance of secondary quartz. These rocks have been everywhere associated with greenstone and nothing but greenstone, and the idea has come to me repeatedly that these rocks might be part of the greenstone complex; as a matter of fact they are related to massive non-schistose phases - as for instance - the outcrop in question, as to lead one to believe that originally there was but one phase and that subsequent metamorphism and shearing has been concentrated along certain beds, thus producing a banded schist.

The schistose bands wrap around some of these massive phases - indicating that the latter may have acted as horst or "point de resistance" around which the deforming forces were deflected. These massive phases are invariably, so far as I have observed, massive, crystalline, basic rocks of the diabase family (note the relations at Gogebic Sta).

It should be noted however that quartz of secondary character that occurs in stringers so bountifully in the schistose phases is not found in the massive phase. I have interpreted isolated outcrops of the massive diabase as intrusions into the older schistose rocks. But where the two are found in juxtaposition it is not always possible to affirm with confidence the intrusive character of the massive rocks for reasons above stated. At present however, I incline to this later interpretation.

The weathered surface of the ellipsoidal greenstone north of Thayer aside from its ellipsoidal character is not very much different from the schistose rock here described. It is known that ellipsoids in the Ely greenstone are in some cases not even flattened by deformation and it may be possible that the massive rock associated with the schistose rock here described has merely escaped deformation and is of the same origin and character as its schistose associate. Sp. 419 massive phase Sp 420 schistose phase. Dictated by R.C.Allen to C.B.Corless.

pp 30-31 Diagrams 46-41 - 46-42 with following explanation.

Outcrop of G. Sc. same as above in cut 42 rails E from bridge over Ontonagon River. On the ridge there are three distinct phases of greenstone. (1) Massive coarse diabase. (2) Massive medium grained diabase showing some deformation. (3) Banded schistose white weathering medium basic rock like that described on pages 27-28. No 3 is the oldest and No 1 the youngest - the relations being apparently intrusive. No 3 may be a sediment. Two other exposures nearby of banded G s schist and massive fine grained G s.

p 32 46-42. Geo. Crane found additional pits in iron formation and outcrops of some about ½ to ¾ mile a little N of E of pits located on p 26. He took 3 specimens which are included as Sp. 421-427.

pp 33-34. Readings and diagrams. 46-42

p 35 46-43 Diagram. The postmaster at Marenisco told me that R.B. Whiteside of Duluth has a drilling near the S¼ of 21 of 47-43 near the river 1½ miles off the road to Copes Mine.

46-43

p 35. A. At locality A is an outcrop of banded schist which resembles in many respects the material thrown out on the dump in exploration in 46-42 described on p 26. The most striking character of this outcrop is its banded appearance, bands from a fration of an inch up to an inch and a half of various shades of grey and green with some inclining to brown alternate across the face of the outcrop. The downward schistosity is in the same plane with this banding. Here and there are bands more dense than others that are dull grey to white on the surface. These bands are less persistent than the others and pinch out forming lenticular shaped masses resembling flattened fragments in an exceedingly schistose conglomerate (spec. 728). The characteristic banding described above is well shown in spec. 429, 430 and 431.

B p 35 (p 36). An outcrop some 50 p(aces) farther south on the track shows the same general character with the exception that there is abundance of quartz following the bands but pinching out so that it forms stringers and blebs, spec.337, (or 33). On the whole this outcrop is more schistose than the former. Spec. 432 (or 433). Some bands seem to be much more ferruginous and weathers to a rusty red or brown. Spec. 434. A number of these bands were noticed, one being several inches in thickness. Spec. 435 shows both fresh and weathered rock.

A p 35. There is undoubtedly considerable iron content in the form of magnetite. Dip readings of normal 35 and sub-normal of 9 were recorded within a few feet. My impression of this rock is that it was originally a silicious lean iron formation which has been subsequently metamorphosed. Look in Barretts notebook for a description of this outcrop and bear in mind also that this outcrop lies in the path of a magnetic belt that extends twenty to thirty miles to Magnetic Center, Wisconsin, and beyond. The linear character of this magnetic field proves beyond question to me that the rock had originally a bedded structure. Further that it was an igneous flow of large dimensions or a sediment cannot be proved but the presumption is strongly in favor of its sedimentary character. In fact there can be hardly a doubt that this is the correct interpretation when this rock inits relation to the magnetic belt in which it lies and known iron formation in the same belt at Magnetic Center. (Dictated by R.S.Allen to G.B.Corless, 7/29/1912).

pp 38-39 Diagrams and readings. Outcrop of graywacke 100' long 20-40 ft wide which strikes n 19 E and dips about 50° to the SE. This rock is sandy in texture and carries seams and disseminations of magnetite. Above the outcrop the needle dipd 45 to 50° N. The bedding is well developed. Spec. 903, magnetite schist from small pit near road last station. Spec. 904-905 from big outcrop on N of road. Location 550 paces N and 400 east of W¼ 13-46-42

pp 40-42 Diagrams. 45-43, 45-41, 46-41.

p 42. A. An elongated outcrop of green schist. Schistosity N 76 E and dip on average of about 70° S. One set of prominent joints striking N 3°E to N 8 W cross the outcrop. These joints are planes of weakness producing cliffs at SW bed and depressions across outcrops giving this appearance etc.

Rock chiefly grayish green to whitish gray on weathered surface along line indicated is irregular granitic product of differentiation - massive pink orthoclase quarts granite. Sp 437. There are also stringers and dark hornblende schists.

p 43. Locality B, p 42. Here is a large outcrop showing two kinds of rock (1) an older banded grayish-white weathering rock so common in this vicinity. Sp 438. and a massive igneous rock intrusive into the former of medium bascity, showing pink to dark green color on weathered surface. sp 439. This rock varies greatly in composition from probably diabase to a close approach to ahd granite - differentiation products of same mass as the various compositions may be traced into each other.

p 43 Contd. At contact (see K p 42) the banding of the older rock is cut across at about 90° by the intrusive. The intrusive grows dense at the contact and in some places shows well developed schistosity, parallel to contact.

The older rock in its banding, quartz contact, its sandy feel on weathered surface and its very slight to moderate bascity (see p 27-29) suggests very strongly a sedimentary origin .(See microscopic study later). In places there is developed a good E-W schistosity cutting across bedding but usually the banding and the schistosity are in the same plane. The banding strikes from N 3° E.

p 44 diagram

(Contd) to N 20 W in various places indicating a 90° swing to N from last outcrop to south. The banding dips W at 70° on the average. Jointing in two sets. Both rocks affected alike - one almost N-S and a second less permanent set E-W.

Locality A, p 44. Same thing as A p 42. Two rocks, an older banded schistose and a younger fairly massive intrusive like that in A, p 42. Strike of banding in older rock N 25 W, N 25 E, N 18 E, N 12 W.

There is a dominant schistosity showing up best at SW end, striking N 62 E, across prominent banding at N 25 W. This inclines most strongly to theory that older rock is a sediment and banding is original bedding. I do not believe that These bands could be produced by an earlier deformation and still show with such prominence after having been affected by late schistosity in opposite direction. Both banding and schistosity are about vertical. One dominant characteristic of the older rock is the large amount of quartz in blebs and stringers in schistosity direction and also in irregular masses and in joints planes crossing schistosity. This is true of all of these rocks wherever found. Sp 440 banded sediment ?.

pp 46-50 46-41 Diagrams.

p 51. Note. The outcrops platted on pages 47-50 are all in a forest of hardwood and hemlock and for the greater part moss and soil covered. There were very few bare exposures. The outcrops are of two varieties of greenstone (1) an older banded schistose variety full of quartz in stringers and blebs as heretofore described and (2) a younger intrusive, massive and coarse grained. The latter rarely shows schistosity if at all. This is the typical G s complex of the Kewatin.

p 52. Aug. 1, 1912. Banner mine. Sec 1-43-35
In company with Messrs Finley, Dudley and Crane visited the site of the old Banner exploration. Rumor has it that one Fitzgibbons sunk a number of pits here about 25 years ago and about 12 year ago the Oliver Mining Co did further pitting and possibly some diamond drilling tho no evidence of drilling was found. It was evident from the evidence that there has been two periods of activity at the approximate dates above given.

The iron formation comprises a number of different phases. That which is shown in the northernmost phase is a rich ferruginous chert with a good deal of ore. The more cherty phases are represented by sp 443 and 444. This rock shows the typical banding of chert and iron oxide common in Huronian iron formations. In miner's phraseology these rocks would be called "soft ore jasper". Sp 445, 446, 447 are average samples of this ore which occurs in considerable abundance on the dumps of the pits in the ferruginous chert. The ore is of two varieties - a hard laminated variety and a soft red hematite. The entire ferruginous chert formation seems to be considerably brecciated and some folding is shown in larger pieces.

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p 52-53 Contd. The brecciation is dominant over folding and may account for the very considerable concentration that has taken place. The pits in this place do not show how far northward this rock extends but we may figure on a considerable thickness - say 500 (or 200) or more feet.

The ferruginous chert is overlain by an unknown thickness of cherty iron carbonate of which sp 448 is an excellent example. The cherty carbonate is shown in a number of pits extending in a northeast-southwest direction parallel to the magnetic lines,.Southeast of the cherty iron carbonate and paralleling it as shown by a number of pits is a slate formation. This may be called a typical black slate. It has been considerably metamorphosed and is hard and brittle. Associated with it is a very noticeable content of marcasite . sp 449,450,451.

South of the black slate and parallel to it is a bed of hard magnetitic slaty flaggy iron formation lying beneath the maximum magnetic lines as shown on the large pits on this formation where readings up to 77° were noted. This formation is very high in iron as note sp. 452,453. There is no rock or other evidence to show what rock lies above this formation, as the pits do not extend farther in this direction.

The total width exposed in pits across this Banner series is not less than 900 ft and this thickness may be divided as follows:

1 ferruginous chert 500 ft plus
2 Cherty iron carbonate 200 ft
3 Black slate 150 ft
4 Black magnetic iron formation 150 ft

(p 54) The whole series apparently dips toward the south. This is indicated with assumed analogy to the dips of the banded schists to the north and east and also from the fact that cherty iron carbonate which has escaped concentration lies adjacent to black slate. Therefore the black slate must have acted as a protective cover to the carbonate and therefore must lie on its dip side. Compare similar relations on the Gogebic Range.

This formation is exactly similar so far as can be seen to Upper Huronian that can be seen in Michigan and particularly on the Gogebic Range. The occurrence of very considerable quantities of secondary hematite and limonite in the ferruginous chert leads one to expect that the Banner is an ore-bearing formation. This is further strengthened by the occurrence of manganiferous iron formation. See sp 454. Sp. 445 to 454 inc.(Dictated by R.C Allen to E.B.Corless Aug.4,1912).

pp 55-56 46-41 Diagrams
p 57. Locality A, p 55. At this place a large outcrop (largely moss covered) of greenstone ,Sp.456. This greenstone on weathered surface is pitted and in many places showed white porphyritic feldspar (sp 456). The rock is schistose in direction N 60 E and schistosity dips south. This rock is similar toa phase found by Geo. Corless yesterday on N-S line ½ mile east (See notebook No.1,1912 Geo.Corless,p 23). Think it is an effusive greenstone. Note the relation of this particular bed of greenstone to magnetic line, which occurs consistently a few paces north of outcrops of this greenstone on several lines. The rock carries abundant pyrite.(sp.456).

Diagram.

pp 58-59 Diagrams. 46-42. Falls on Scioto River Dense, dark, massive, fine grained G.S. strike N 65 E. Dip 45° S.

p 60. Wauseca. Aug. 27,1912. Operating. Running the formation into SE of NW of 29. Shaft 400' deep. Prospecting with one machine and one shift

p 60 Contd. Run drift on first or second level to shaft about 750' west and 150' N. Ore pockety and bunchy. Small stock pile of about 30,000 tons. Formation over 300' wide. No 2 shaft 180' deep, 150' of drift and 30' ledge.

Republic Iron and Steel.
N½ of SE and NE of SW of 29. Holes reported in ore on NE of SW, also on NE of SE. See Paul Muckle in Commercial Bldg.

Hall
Shaft 450' deep. 3000' drifting on the level. Some ore. Mine drowned out. Water 700 to 900 gal. per minute.

pp 62-63 46-41 Diagram. Sept.4,1912. At a point 800 paces north of ¼ cor 13/14 is a pit in side of hill showing on dump slabs of ripple marked reddish sandstone probably in place and representing top of basal member of Keewenawan that outcrops on River in Sec 13 to SW.

p 64-66 46-41 Sept.4,1912. The following notes refer to pp 70-71 R.A. Smiths book No.1, 1912.
On Sept 3 in company with R.A.Smith and Messrs Fellows and Links traversed from ¼ cor. 11/13 N 450 paces to a couple of pits. On the dumps of these pits there occurred rock of two different kinds; the predominant one being a talcose ferruginous schist - sp 600 - the other is a vitreous quartzite , sp 599. Inasmuch as the pits indicated no magnetism or in themselves bore no reason why they should have been sunk here we started out to investigate and traversed east to a small stream in which were found numerous angular slabs and fragments of the talcose ferruginous schist with other boulders of white quartz and some quartzite. Following up stream we found an outcrop of the ferruginous schist in the bed of the stream. Sp 801,802, 803, striking N 58 E, dipping S 65°. Following down the bed of the stream to locality II, p 70 (R.A.S. I,1912) we found a prominent ledge (strike N 55 E, dip 52 S.) and other similar occurrences at localities III,IV,V.

Measured across the strike in a horizontal line, these schists are some 250 paces wide. At locality V the stream takes a sharp turn around a small bluff, on the east end of which and on the banks some 12 ft high occurs a rotten brick-red sandstone. Sp 806, carrying a number of conglomeratic layers with pebbles up to several inches in long dimensions.

A half hour was spent dragging out an assortment of pebbles, Sp 812. The most dominant pebble is milky quartz, but with the quartz occur pebbles of quartzite and green schist. Possibly other pebbles were present but they were not found. None of the pebbles show extensive attrition and are doubtless near the source where they were derived. At this point we returned to locality V and made careful examination of the schist at this point. We found the source of the milky white boulders in the stream and pebbles of the same in the conglomerate and doubtless also of the quartzite to be in certain beds in the schist. We found one conspicuous instance of the occurrence of a vein of quartz in the schist of character identical to the boulders and pebbles above alluded to. The vein had been broken and shattered and the fragments rolled over one another and worn off to rounded forms by the movements that produced the schist, so that the quartz that was once in the vein assumed the appearance of a conglomerate bed. Sp. 808.

From this point we moved to locality VII and found in the bed of the stream a hard conglomerate with red apparently felsitic matrix, identical with the softer conglomerate of locality VI. Across the stream bed N 50 paces from VI occur beds of red sandstone in horizontal position. Sp 811

p 65 contd. From this point we moved down stream to the Ontonagon River and encountered at the junction of two streams (locality IV) a cliff 30-40' high of well bedded brick-red sandstone and (p 66) fine conglomerate. The dip of this sandstone is 10° N and the strike is N 75 W. Farther down stream at locality X are more beds of this same formation.

The relations between the conglomerate, sandstone and underlying rocks are unconformable, altho the two were not found in actual contact. We were able to locate this contact within a few feet. We have here an unmetamorphosed gently northward dipping sandstone with a conglomeratic base in which is found pebbles of a number of underlying formations reclining across the upturned edges of the highly schistose rocks adjacent.

We infer that the sandstone is of Keweenawan age from its general character and from the fact that it dipd north below the traps ranges to the north at a higher altitude. If that is true it means that the base of the Keweenawan series is in places represented by sedimentary rather than by igneous rocks. In this connection it should be noted that I found on Sept. 4, 800 paces N of ¼ cor 14/13 a pit in sandstone of the same character as the above described. The vertical distance and the base of the conglomerate must be not less than 75 ft. The sandstone shown in the pit is overlain a short distance to the north by traps. Until further evidence it will be well to bear in mind the possibility that the above sandstone may be Jacobsville or eastern sandstone, tho there seems to be little evidence of this interpretation. (Dictated by R.C Allen to G.B.Gorless)

pp 67-68 Diagrams.

p 69 46-41 Outcrops in diagrams on p 68. No.1, p. 68. Trap. Amygdaloid. Sp 458 is taken from top of outcrop. About 8 ft of top of flow exposed. Rock is less amygdaloid below and denser. Strike N 50 W and dip measured on parting planes most certainly - to bedding is 10° N.

Small diagram

Shows character of outcrop . Sp 458 taken from B which is amygdaloidal. Top of A.
No.2, p 68. Small ledge of trap amyg. Same dip and strike as No.1.
No.3. p 68. A ledge of trap. Exposure about 8 to 10 ft. Faintly amygdaloidal at top grading down into dense variety not very coarse grained. This represents top of a flow. It gives a beautiful dip slope to NE and a straight SW facing cliff for 50 paces which on east end faces SE. Shape of face > apparently controlled by jointing-one set parallel to strike and the other parallel to dip.

pp 70-72 Diagrams. 46-41

p 73 46 - 41. Sept.7,1912. With Messrs Youngs and Fellows started at NW cor 13, went east ½ mile and then north two miles and 1400 paces. Set east ½ mile and run south on range line to Ont. River 103 paces S of E¼ cor. Sec. 12. Going north from the N½ Sec.13, we made a gentle ascent of a ridge which is here swinging NE. In the vicinity of Center of section (see plat) we found a number of outcrops of trap. These outcrops form low ledges facing SW. The southward faces are formed by joints about parallel to the strike of the beds (N 50-60 W). Jointing practically parallel to the dip produced a second low cliff on each of the outcrops facing the SE. This SE face results from the position on the east slope of the ridge and the SW facing ridges result from a northward dip of the beds.

p 73 contd. Parting planes parallel to the bedding dip NW at angles from 8-12°. In crossing these outcrops from SW to NE one ascends as in a series of steps giving a typical saw tooth structure on a small scale. I was not able to measure the thickness of the beds inasmuch as the bases seem not to be exposed, the tops forming dip slopes on amygdaloids. In one case however, the outcrops 300 paces N of the center of the section, we were able to measure one bed of 8-10 ft in thickness, this being the distance between the tops of superjacent amygdaloids. This outcrop forms the extreme crest of the ridge which is not sharp but rather flat at the top. North ward on this line is a gentle slope for a distance of almost exactly one mile. The total descent being not more than 100 ft and possibly less.

p 74 Northward from a brook 500 paces N ofcenter of Sec.1 another ascent is made for a distance of about ¾ of a mile to the crest of another flat topped ridge which has a morainal expression. The drift however appears to be thin although no outcrops were found and I am not able to say with certainty whether this ridge is caused by morainal deposition. It is the N extention of a ridge which further to the west bears on its crest outcrops of SW dipping traps. It is not therefore that the elevation of this ridge is partly due to a rock core of trap - presumably dipping southward.

N of this ridge begins a gentle slope to the south which according to Young's traverse extends for several miles. No outcrops have ever been found on the North slope for(or far) beyond the crest of the ridge and whether this long slope is caused by N dipping traps or N dipping SS (Jacobsville) is not deffinitely known. In this connection however recall again that all trap found in the N ridge dip south. This observation being established by Youngs and Smith, by the fact that all ledges are N facing. N facing ledges would not occur on a gentle slope of this kind unless the underlying rocks were flat or N dipping.

Returning S on a line ½ mile E both the N and S ridge above described become very flat and the valley between is merely a low depression in which a stream drops off to the Ontonagon. No outcrops were found on S run.

p 75

It seems from data that in this township that the socalled S trap Range begins to the west in the vicinity of Gogebic Lake in a single high ridge of trap beds, practically flat lying. East from Sec 6 and 7 this ridge extends NE to near the west line of 3-10-15 where it flares out abruptly producing a distinct N ridge with beds dipping south and a S ridge with beds dipping N. These ridges separated by a broad valley falling NE to the valley of the Ontonagon. As before said both the N & S trap ridges flatten out and disappear toward the valley of the Ont. This valley is without doubt of synclinal structure, the drift being thin and the configuration controlled by the structure of the underlying trap.

To the East in 46-40 according to runs by Smith, the country is flat and doubtless underlain by SS as Smith finds the soil red and sandy and great quantities of angular blocks and slabs of SS along stream beds. The question is; Is this SS Eastern (Jacobsville) or is it Keewenawan ? possibly basal and equivalent to that in Sec. 12,13,and 14, 46-41 which is possibly 100 feet thick and dipping 10° N under the S trap ridge.

On Sept.5 with Smith and Young made examination of exposures in Sec.14,13, 46-41. Going N thru center of 14 we rise from the valley of the Ont. to the crest of a ridge of Kewatin G S., strike N 55 E. Northward the crest of this ridge is marked by a cap pf massive diabase which extends from near the middle of 14 N for 650 paces, where it drops suddenly down 80-100 ft into the valley of a brook.

p 76 Contd. The brook is flowing on a soft ferruginous talcose rotten schist which outcrops on the N face of the diabase cliff dipping under the diabase at angle of about 55°. Northward as the creek is crossed there begins a sharp ascent which continues upward for 100 ft and then breaks off into an ascent of very greatly lessened angle which is followed upward by a second rise steeper than the first and capped by great cliffs of massive traps. From the bottom of the creek to the top of the first step rise is a distance of approximately 100 ft and the talus is predominantly red SS with considerable trap. Above the bench marking the top of the rise the SS talus disappears entirely and thence upward to the crest is trap.

From these observations the impression is that the 100 feet of trap forming the top of the high range is underlain by an equal thickness of SS (See section on field plat of 46-41). Both trap and SS must from the topography be in flat or north dipping position. From this vicinity we proceeded to brook and old camp about 500 paces N and 100 paces E of west ¼ cor of 13 and followed this stream down to the Ont. re-viewing again the phenomina described Sept.4 pp 64-66.

Mr. Smith, in digging at base of outcrop 6 (Smith Book I, p 70,1912) succeeded in uncovering beneath the creek the ferruginous talcose schist shown in pits and outcrops and found the contact between the schist and overlying conglomerate is marked by 12-18 inches of rubble consisting of angular fragments of the schist and boulders of vein quartz which occur so abundantly in the schist. This observation of Smith's adds certainty to the conclusion drawn on pp 64-66. From this point we proceeded down the Ontonagon and took three views of sandstone cliff, outcrop 9 (Corless Kodak).

We then crossed the river and proceeding SW upstream found for a distance of nearly half a mile almost continuously exposed in a gorge (75-80 ft deep) diabase varying from massive fresh unaltered rock thru various weathered rotten phases into the ferruginous talcose schist exactly similar and the fact the same as that occur at the unconformity above mentioned pits and exposure along the brook (outcrops 1-6 Smith Bk I p 70,1912) and 650 paces N of center of 14 dipping SE under the outcrop DD Smith 61). Sp 820-3 represent a gradational series from massive fresh disbase 823 to schist 822.

It is plain as shown in some places along the gorge that great shearing and faulting has occurred in the diabase subsequent to the main deformation of the Keewatin and prior to the formation of the basal Keweenawan conglomerate which lies unconformable on the schist as shown above. Thus our observation heretofore made and written that the ferruginous schist in which so many pits have been sunk is merely a schistose altered diabase or G S. This conclusion is absolutely confirmed.

p 78 Lane mentions (pub.7, pp - -) the occurrence of Keweenawan feeder plug on Sec.13 and prior to our discovery of the relation of the ferruginous schist and the diabase was that the diabase was the plug alluded to by Lane. Indded this is not the plug and such plug does not occur as said by Lane. It now appears that the basal Keweenawan is unconformable on the schist and diabase and cannot therefore be Ke-weenawan. Providing of course that the sandstone ie Keweenawan which I hold to be a practical certainty. Furthermore it might be argued and doubtless would be in absence of these facts in view of the great heaving that has taken place for ¼ mile that the south edge of the trap range is a fault scarp. It is however shown beyond doubt that the shearing of faulting is pre-Keweenawan. While some of these massive plugs found elsewhere in this township may represent Keweenawan vents there is nothing to prove this assumption; while it is certain that the particular plug referred to by Lane is pre-Keweenawan and entirely unrelated to Keweenawan phenomena.

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p 29 It might be added further that the shearing planes in the diabase strike N 55 E (dipi S 52-60°) thus being oriented in strike and dip parallel to the secondary structures in the Keewatin of this region. If then the diabase is Keweenawan why should it be so intensely sheared in places exactly parallel to structures which were certainly produced in Keewatin time. In other words, the deformation is not related to the shape of the mass as it doubtless would be were the shearing due to the mass movements in a plug.

Sept. 6,1912. Cassius McDonald says that the drilling and pitting done on 13 and 14, 46-41 was done in 1884. He found core of drill and says it is slate meaning the fine grained schist mentioned above.

p 80. Sept. 7, 1912 Interview with Cassius McDonald, Watersmeet. Reports occurrences of mica schist in Sec 30-44-39. Diagram. (pencil note added says "All bogus,R.C.A.) Also reports slate?(second hand information) on Wis. river one mile South of State line near Smith's siding. Also pits, one 189' deep and others in ledge on old tote road 21 miles south of Smoky Lake in Wis. Sec. 1-41-12. Reached by launch from Haven's Resort on Long Lake via Hackley. Small diagram.

pp 82-85 46-39 Diagrams.

p 86 Trap in Sec 9-46-39. Sept 12, 1912

Ran on Military road north to town line and set W¼ mile, thence S. to C.NW as platted. Went in to Paulding and got a man to escort us to the "only rock outcrop" in NW quarter of 46-39 according to natives of Paulding. These outcrops are on a hill crossed by the E-W between Sec. 9 and 16, 46-39 between the S½ cor of 9 and the SW cor of 9 (see plat book).

Traps. This ridge is formed by traps showing massive and amygdaloidal phases in flows about 8' to 10' thick in one case. The beds dip N about 15° and strike about E-W. The outcrops are on the south side and on the top of the hill. Surrounding the hill is a swamp. Some places show quartz veining and accompanying the veining are aphanitic cherty looking thin layers. Sp 460,461,462, amygdaloids, traps from above locality.

p 87 Sept.13,1912. Traps at Big Falls. Middle Branch Ontonagon. Sec.1 & 12,46-39.
With G.P.Links visited above locality. Rained all day and could make no notes on the ground. The river falls about 100 feet in a distance of about 250 paces over trap, making a final and greatest sheer plunge of about 30 feet. The traps seem to strike about N 80 E and dip about 25°? N. The dip observation was not satisfactory. Could not divide section into constituent beds. All or nearly all is amygdaloid of massive structure. The ridge on which the river falls extends E-W for some considerable distance. Sp 463-7 are from this exposure. This locality should be visited again and carefully mapped.

pp 88-90 Diagrams of traverses.

p 91 46-40. Locality A p 80. Outcrop of green schist- strike of schistosity S 39 W, Dip 80°S. Rock is exceedingly schistose, of light yellowish green color and full of blebs of quartz of oval elongated shape, long in plane of schistosity. Typical Kewatin green schist. Some quartz veins are up to 3' thick.
Moraine. This outcrop appears to be on the very crest of a very high moraine ridge. The ridge doubtless is caused by core of greenstone which is itself the cause of ice recession and morainic deposition.

B
Locality A p 90 At locality A and B p 90, the schists are exposed in hog back parallel to the strike of schistosity. We have mentioned in locality A the prominence of quartz blebs and stringers. These are also very prominent in the outcrop at B. These rocks do not look to be very basic. The outcrops are gray white (B) green white and light yellowish green. Here and there are cleavage faces glimmering white in the sun due to a mica probably sericite. The sericite schist is developed in the quartzose portions, along quartz veins and also irregularly in the rock.
on(?)
Here and there are the surface are elongated oval shapes of rock which are harder than the schist and also of somewhat different composition. The planes of schistosity wrap about these as they do the quartz blebs and one gains the impression that these forms are original structures. In some of them a zonal arrangement of minerals is noticed. Very commonly the outsides show well developed dark hornblende showing no orientation and embedded in feldspathic and silicious base. These may give place to an inner core of dark fine grained material showing secondary mica (biotite) and probably hornblende. This band may enclose an inner core like the outside rim. These forms are a very prominent feature of exposed surfaces. Garnets are developed profusely in the most highly krinkled phases. Sp. 459

It occurs to mee that these rocks are exactly similar except for their higher metamorphism to those that occur on the Paint River. North of Elmwood and northeast from these. By reference to my notes of 1910 it will be found that I describe these rocks very carefully and came to the conclusion that they are metamorphosed tuffs- that is, they are sediments composed of volcanic ejectamenta and the elongated fragments being bcrules (?) - the matrix being tuff. This rock is most certainly different in origin from the ellipsoidal basalts and surface effusives of the Keewatin. The fact that this series contained so much quartz, is not very basic and that it shows evidence of bedding forms the basis of, putting it in a class as a type of the Keewatin.

In 1900 I described these rocks on the Paint River on the supposition that they are there Huronian. If now I can trace the series in 46-42, 41, 40, 39 east to connect with those on Paint River, we will have to put all in the Keewatin where I am of the opinion they belong. To the above should be added the fact that these banded schists carrying quartz and the peculiar fragments above mentioned, are nowhere magnetic which fact gives another reason for believing they are quite apart in origin, from the ancient basalts and green schists of the Keewatin.

pp 94-98 Diagrams.

p 99 Locality A p 97. Green schist, Strike S 84 W, dip 60°S. Greenish gray color. Schistose stringers and blebs of quartz. Typical of the oldest Keewatin of this area described on p ( ) of this book.

Sp 468 shows a dark grey phase which looks like altered graywacke or tuff and was so considered in rocks north of Elmwood on Paint River in 1910. Sp 469 shows quarts with schistosity wrapping about it - characteristic of this rock wherever found.

Locality B p 98. In a distance of about 250 paces the middle Branch of the Ontonagon falls in a series of rapids and cascades 50 to 60 ft. over the green schists. Schistosity strikes S 88W and dips 57 to 69°S. The rocks show all gradations from a dark grey rock resembling altered graywacke. Graywacke under - .

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p 99. Contd. (Sp 470) to a perfect schist (sp 471). Quartz in blebs and stringers is very conspicuous as usual drown out in planes of schistosity. I am now convinced that this series is identical with rocks north of Elmwood on Paint River which are identical but less highly metamorphosed, the whole series being without much doubt Keewatin. I think too as in 1910 that the series is sedimentary as I did in 1910. Same arguments then advanced still holds good.

Expense account in back of book.

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pp 1-25 Diagrams of traverses

p 26 T 45-41 Description of outcrop A.

Outcrop A consists of two exposures of rock separated by a light cover of soil a few feet in width. The two parts are essentially a single outcrop 25 paces long and 16 paces wide. The rock is apparently a fine green schist, cleavage planes being very pronounced in much of the rock. The direction of schistosity varied somewhat in the two parts, - the strike in the east half being N 62 E and N 70 E in the west half. The dip also varied from 70 to 45°.

The rock showed three distinct systems of joint planes with two or more minor systems intersecting at more or less oblique angles. The fracturing in folding was very minute judging from the innumerable fine intersecting cracks filled with vein material. The joint planes were so close together that the rock broke up into very small angular fragments an inch or less in diameter. Very few fragments were more than a few inches in diameters. The fine cracks were especially pronounced on slightly weathered surfaces.

Large cracks filled with quartz often ran parallel with the schistosity. The lentil shape of quartz filling suggests that open fissures developed along the schistosity planes. Other seams were composed of feldspar and quartz. These ran parallel to the schistosity or the joint planes. No positive evidence baking was discovered along the margins of lentils of granitic material although ridges were possibly noticed along weathered surfaces.

There was an apparent difference in the rock material as noticed through a difference in weathering. Contorted stringers and bands of this rock material were arranged as though there might be interbedding which was at an oblique angle to the schistosity. The strike of the layers was approximately N 70 E.

p 28. Spec. No 501 was taken from the east half and 502 and 3 from the west. No. 503 was taken from the vein or seam quartz and quartz-feldspar material. One of the fragments of this specimen shows the fine fracture lines or seams.

p 29-32 Diagrams of traverses.

p 33 T 46 - 41 W. July 13, 1912 Sec. 32.

Description of series of outcrops location of which is outlined in note book of L.J. Youngs No.1, p 26.

We have here a rather subdued but prominent ridge striking about N 58 E. The southwest end of this ridge drops off gently into lower ground where no outcrops are seen, while in the opposite direction the ridge is covered by a growth of hardwood where there are no exposures as far as they have been searched for. The area of outcrops is outlined to scale by L.J.Youngs Bk, p 26. In this area the exposures are so numerous as to prove beyond doubt the absence of rocks of a variety different from those exposed. The following is a description or assemblage of features noted in the group of outcrops as a whole without reference to anyone exposure. A typical outcrop is a low smooth rounded knoll. Declivities of a few feet are noted only on the southwest side of the ridge. These declivities are an unimportant feature but the relation of these to the direction of ice movement suggests that they may have been caused by the plucking action of the ice.

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Contd. p 34

The rounding or oval character of the exposures is doubtless due to ice abrasion. The direction of ice movement is denoted by gentle flutings running between S 8 W and S 4 W. The rock itself is not favorable for the retention of the glacial scratches but the few observed have the same direction as the flutings heretofore mentioned.

The general color of the exposures is a grayish green. The rock has none of the characters of a sediment inasmuch as no plainly sedimentary characters and structures can be discerned. The texture of the rock is exceedingly dense and fine grained, and as far as observed no original mineral can be discerned by the naked eye.

The most conspicuous structural feature is the occurrence of numerous ellipsoidal forms, the outlines of which are in some cases plainly discernible, but in the majority of instances, are imperfect and in some cases only faintly suggested. A close examination however shows that at least some parts of the rock are made up almost entirely of these forms separated by a matrix consisting of the same material as the ellipsoids.

The ellipsoids vary in size from an inch to four feet in long dimension. The longer axes lie in the general direction of the axes of the ridges and in one case was found where this direction was cut at more than an acute angle by the long axes of the ellipsoids. The outline of the ellipsoids are made plain by the deflection of the lines of schistosity about them. The matrix between the ellipsoids was more schistose than the rock within the boundaries of the ellipsoids. The latter in most cases are different in color being lighter or darker than the material on either side. The ellipsoids themselves show an abundance of pistachio green epidote doubtless due to the development of secondary epidote. In one instance there was found a layer of extremely amygdaloidal rock two feet in thickness in sharp contact with another rock of dense non-amygdaloidal character. The line separating these two varieties was made more distinct by the fact that certain alternating bands in the amygdaloidal variety did not cross the plane of contact.

The entire rock has been intensely metamorphosed with the development of schistosity striking about N 70 E thus making an acute angle with the direction of the ridge. The dip is at varying angles to the southeast. The schistosity is not marked by apparent development of secondary minerals but by numerous finely spaced lines of fracture which are distinctly brought out by weathering. The schistosity is crossed by a series of fractures in several different directions.

It is apparent from the above that the rock here exposed has the characteristic (p 36) of an effusive basic lava as shown by the development of the ellipsoidal structure and amygdaloidal texture and dense fine grained general texture. It was not possible to ascertain the number of flows exposed in the area of the outcrops but the occurrence of the two foot layer of amygdaloidal rock between two adjacent flows.

The general state of extreme metamorphism suggests extreme age although this metamorphism is not nearly so extreme as in many of the Keweatin green schists of this character. Or in other words there is nothing to indicate the horizon in the Algonkian at which this rock occurs.

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p 36 It should have been noted that tortion cracks from a fraction of an inch to two inches occurred and they cut the plane of schistosity at a different angle. Quartz occurs in some cracks but on the whole, the cracks are open. Blebs and stringers of quartz and quartz -feldspar in the schist are a common character.

pp 38-45 Diagram of traverse.

p 45 T 46-41 Aug. 22, 1912 Outcrop X p 41

Outcrop X consisted of a group of three ridges extending respectively N 65 E, N 70 E, N 60 E. The first bluff faced north and the second and third south. The first was composed of a massive coarse grained greenstone apparently of the hornblende gabbro type. There were two sets of fractures, one, approximately east and west, a second north and south. Both were about at right angles to each other and nearly vertical. See sp 570. The second ridge was composed of massive greenstone and green schist, the schist being in minor amounts. Some bands or lenses were exceedingly schistose, being a fine green schist. Parts of the rocks however, showed little or no schistosity, and this had a strike of N 30 E and a west dip. Some phases of schistosity were scaly gneissoid and resembled augen gneiss, the bands of schistose material running around lenticular masses, of a different material. And the length of the outcrops were respectively 75', 250' and 150'. They were oriented in the general direction of other glacial ridges showing no outcrops.

The third ridge was wholly a massive greenstone, apparently without schistose phases as in ridge No. 2. See spec. No. 571 and 572. The apparent freshness of the rock in No. 1 suggests its later age and possibly the cause of part of the cause of schistosity in No. 2 ridge. Its coarse grains would signify an intrusion. It also might be only a dyke.

Outcrop Y. This outcrop consisted of a ledge 40 ft high facing west and north. The bluff which was practically vertical made almost a right angle. The rock material was identical with the types common in Sec. 5 and 6. Bands and masses of amygdules filled the rock in many places but showed no special orientation. A band of schistose material 2-4 in. wide and a few feet long showed a slight dip to the south, but I could make nothing out of it. The rock as (a) whole was massive. The fracture gave the general direction to the west and north bluffs. The longer or north bluff had a general course of N 55 E in correspondence with the fracture which was near the vertical.

Outcrop Z. This outcrop was one of the largest and highest observed, being nearly 100 feet sheer, with a steep slope upwards to the height of 150-200 ft. The length was continuous for 600' or more paces. Further conditions suggesting the occurrence of exposures were seen to the west but it was too late for further work. The bluff was composed of a massive rather fine grained rock, often filled with amygdules locally and now and then a schistose lens occurred. The dip of one of these schistose phases or lenses showed a dip from 10-15° to the S. The general course of the bluff was approx. E 60 W. I could not discern any difference in texture, structures, minerals, etc, between the rock of this outcrop and the traps in 5 and 6. See description p 139 Note book 2. Specimen was not taken or was lost, at least none was found when specimen bag was examined later in camp.

Outcrop AA

This exposure was found when beating our way along a section line to camp on our way home. It consisted of a south bluff of rock 30 or 40 feet high which turned almost due north until it disappeared along the top of a ridge.

Outcrop AA Contd.
The rock was a dense greenstone without amygdules or shcistosity. A north-south and east-west system of practically vertical(joint or fracture) systems gave the course to the two bluffs. See sp 573. It did not resemble the traps in Sec. 5 & 6 as far as I could see.

p 48. Four days of rain. Moved from one camp to another.

p 49 Diagram Traverse Aug. 27, T. 46-41 N.
p 49. Outcrop BB, consisted of an 8-10 ft ridge with ledges exposed at edges. The direction of extent was N 55 E. The rock was a banded schist full of blebs of quartz, also stringers. The schistosity bent around the blebs and lenticular masses which were often connected like beads. The average strike of schistosity was N 25 E, dip 55° at east end, 60° at west. The schistosity was very pronounced especially next to the blebs and stringers. Farther away the rock was more massive, betraying(?) its schistose character only through weathering. Sp. 574 shows occurrence of the quartz in the schist.

The west end of the outcrop showed the same phases, massive and schistose. The strike of the schistosity though strikes N 60 E and dips at 60°. Parallel to the schistosity but dipping at a higher angle (80° S) are bands of material of different nature and composition, as shown by differential weathering. Some of the laminae are lighter in color but this was hard to see in a hard specimen, the difference being so slight. See sp 575 from one of the darker and more schistose bands. The massive rock was very dense and fine grained, felsitic in appearance, as shown by Sp. 576. The rock as a whole was much fractured, a major joint plane extending N 25 W and dipping at 60° toward the southwest. The other systems did not seem to have any special orientation or relation.

p 50. Diagram. Outcrop EE
Outcrop consisted of north facing low bluffs running mainly E - W. Rock is identical with that on the south. The amygdaloids in one band dipped at an angle of 35° to the north. Exposures was small, hence may be only a local variation in the contact plane, if contact plane it was, and thus be no true indication of the bedding plane of the flows. Most of the zones of amygdules thus far observed appears to have a pronounced dip to the north. Found exceptions. Do not believe any one zone has been traced for a sufficient distance to warrant any decided opinion concerning the exact position of the flows.

Outcrop DD. This outcrop located as on pp 49-50 consisted of a long ridge extending N 60 E for 250' paces or more. The south bluff was only about 40 ft high and showed a low ledge of rock here and there, a few feet high. The north bluffs descend in two separate declivities - the first at the top shows little or no rock but it was but a few inches under cover. A sloping terrace 50 ft wide descends until the larger and almost vertical bluff is reached. Here the declivity is fully 25-30 ft down to the creek bottoms.

The rock on the south bluff appears to be a massive diabase(trap) of medium grain and good crystallization. See sp. 579. The rock at the top of the north slope as of the same type but just below it, there is a zone of dark aphanitic or felsitic rock, showing but little or no traces of crystallization. The rock breaks like hornstone and is somewhat similar. Under a hard lens traces of crystallization seem to be present and indicate perhaps that the rock is merely a felsitic phase of the diabase (581).