Saturday Aug. 9 20 dollars to Fredrich.

Sunday and Monday. Office work at Ishpeming.

Tuesday Aug. 12

Wednesday 13. Went with Peter Krier on trip to Sec.14, T 48, R. 27.

Thursday to ¼ post of S. line of Sec. 13. 100 steps south to road, from road 200 steps to top of plateau, thence 123 steps to southern edge of plateau. Return to ¼ post. From there north 73 steps to creek. Thence through low pine plains unto 357 steps from ¼ post . This low land is in continuity with the swamp lands westward. Now we are on rising ground. At 220 we have ascended a plateau land. (Specimens).

90 steps further we begin to descend slowly over an inclined plain, also west of our course. Decline of surface for 300 steps then rise over a spur . General inclination towards the west. Specimens at 1140 steps N. of ¼ post.

Rapid descent over several terraces of hardwood land. The second terrace at 1400 steps for ¼ post is arenaceous slaterock. See specimen. 166 steps further, meet a creek running N W. 162 steps further across an undulation we meet a large creek which evidently is the same as the other with some additional branches since entering.

Corner of Sec 13(N E.) From here west 325 steps to creek. All swamp. Accross the creek begins higher land(pine plains). 200 steps from creek the hills begin to ascend. From S.W. corner of Sec. 12, T. 48, R. 27 going south 200 steps ascension, then descent into a little marsh. Ascent again over a ridge, at 430 steps in swamp again. 108 steps across. Then we ascend a high ridge, at 154 steps progress out crop of arenaceous laminated rock. 88 steps further over plateau a small crest of quartzites strikes across from east to west. 254 steps further crossing of small creek flowing east in swamp but no descent actually. 142 steps more we find the ¼ post in swamp. 157 Steps further at foot of hill. 280 steps across is specimen of schist. Then descent into swamp valley in which we find the corner post of the 40 acres on which the shanty is.

Friday Aug. 15 S.E.¼ of S.E.¼ of Sec. 14, T.48, R. 27. To Kerns shanty and to S W. corner of 40 acres lot in the S.E.¼ of Sec.14. Thence north about 150 steps down to swamp. At the distance of 400 steps meet a creek running west and coming from N E. direction. 50 steps more in swamp, then high land rising into ridge 45 steps. There we find the N W. corner of Kerns 40 acres. 84 steps more to summit, thence examining the ridge in east and in west direction. West over the summit about 200 steps, then slow decline unto 440 steps where I meet a large creek with broad slough and deep stagnating water. It runs in northwest direction. The opposite side is slowly rising ground.

The ridge over which I came declines into a swampy depression on the northside and on the south side towards the before mentioned swamp valley. Eastward for 214 steps the ridge somewhat lowering continues, then a ravine and rise again somewhat higher than before which continues with its summit plateaulike for 300 steps more as far as we explored which is as far as the north and south section line. North again 77 steps to swampy depression connecting east and west with different drainage channels.

Thence 320 steps over a fine hardwood plateau extensive in east and west direction. Then descend a slope into a valley running east and west. Outcrop of schistose rocks. See specimen. 90 steps across depression with small creek running east. Then rise again over a shcistose undulation. See specimen. At 225 steps again in a swampy east and west depression. 64 steps across the swamp then bluffs of ferrugineO-arenaceous formation. Short ascent to plateau inclining northward. At 277 steps in a swampy depression again with inclines apparently to the west.

64 steps further on a small cross ridge ending short distance west with a ravine running north. Now descent into that ravine by a steep declivity then swampy valley. To 121 steps further outlet of swamp westward, hill spur again bending north. 147 steps over it to next depression. Since sometimes a north and south valley visible unto our left into which all the depressions open. 138 steps further we meet the east and west line. Going west along line over flats meet a small creek running north at 182 steps distance. Flat land continues to ¼ post. All fine level hardwood land which continues on in that direction.

Now take N.E course. For 800 steps continually on level hardwood lands. Thence we ascend a hill with extremely fine pines. 68 steps to its summit on the left of our course a ravine seems to commence going north. We pass now over various rounded east and west undulations with intermediate depressions all in hardwood lands and strike the line only short distance south of the ¼ post.

Small diagram

We take now a S.E. course, pass over the slope of a high drift covered knob to our left and descend into the swampy valley of the creek crossed by the line near the ¼ post. At 319 steps we are in the swamp. The hill on left has receded and slowly rising level ground is visible to our left. We soon leave the swamp and go on. Swampy pine plains 296 steps further. The pine plains extend in all directions around us for quite a distance. Thence the surface rises, we ascend to hard woodlands which form a barrier of the swamp and creek valley towards the east.

At 413 steps we have crossed this high land and have descended to the level of the lake seen yesterday. We strike near the north end of the lake and from a ravine a fine creek runs there into it. Now we ascend the hills bordering the lake on the east side and cross them diagonally, strike the beaver meadow and leave now the course following the creek to the place where we struck it yesterday which is considerably south of the north line of Sec. 13. From that place we take a S E. course across the first hill marked on the map, descend to the creek and follow its swampy valley diagonally intersecting it for quite a distance. Ascend the second ridge obliquely, descend into a depression between the third ridge and some distance upon its slope, when we turn east and come to the clearing of Murphy northwest of the opposite knob where I found on its north slope a large outcrop of the quartzites dipping north and in close contact with the granites. South of the granites are schistose and dioritic rocks.

Saturday Aug. 16. Go direct over Murphy's land to N.E. corner of Sec. 13. From ¼ post on Murphys to creek 200 steps. Swamp valley. Tolerably wide. 220 steps further over an undulating ridge we are again in swamp with a large creek flowing northwest. The line follows at that spot the creek for 100 steps and in the creek fine outcrops of slate rock form rapids . Part of the ledges dip south, others north.

From corner we go north to creek 160 steps cross it and ascend bluff 200 steps from corner. Then line runs over a hill down into swamp After about 120 steps, thence in swamp 55 steps which is in the direct connection with the slough running east across the creek. We go through swamp Unto about 300 steps from ¼ post where the land rises into an east and west ridge. From ¼ post which is on the lower west part of the ridge we take a due east course along the north slope of the ridge, apparently all land declines from here gradually to dead river. At 600 steps we see a ravine coming from the east short distance north of our course which there bends into a northern direction going straight towards Dead River.

We alter our course now into a southern until we reach the top of the ridge which is a distance of 150 steps and continue eastwards again. From there the ridge has all along slate outcrops standing vertical or nearly so. We come on the south course to a lower portion of the ridge, decline north and southward. The east course is again on the north slope and after 150 steps progress we would again have to descend into and east and west ravine. Therefore we go south again for 204 steps at are(and we) descended to the creek.

50 steps south of the creek we strike on an E. and W. sub-division line. Ascend a hill side. Pass 650 steps over undulating pine lands and have descended now into a large beaver meadow.of The same we visited once before and which is in connection with the slough at the creek. We hunt up east and west line which crosses the meadow and follow it back as far as we suppose to find ¼ post but do not succeed. Thence we strike south in a valley of pine lands and cross a hill range. 476 steps from line we have crossed it and descended into the before mentioned beaver valley further up east.

Ascent of steep hill 98 steps. Descent into an east and west ravine. Ascent unto a plateau and descent to a broad swamp. 194 steps in swamp. 310 steps thence low hardwood land. 152 steps now at foot of high hill range. Ascend it and proceed on its plateau like top to the distance of 350 steps. Now another terrace of rock forms the summit part which consists of granite. The lower terrace consists of ferruginous slate rock, its dip north. The granites continue without interruption to Murphy's hill. On their south side are dioritic schists forming the lower portions of the range.

Sunday Aug. 17. Exploration of Sec.12, T. 48, R. 27. Go from shanty N.W. course, ascend the bluffs of creek and move over flat hardwood lands for a good while, then gradually ascend the higher ridge and on top of it plateau like expanding we go as far as 830 steps from shanty, when we find a depression which one way connects with the southern swamp lands in a west direction, the other descends into a ravine, descending east northeast. A small watercourse in the ravine.

Cross ravine, ascend high lands and proceed 200 steps, where we find a ravine running east into the other first ravine. Outcrops of diorite there. A swamp running west begins right here. It is about 50 feet above the first swamp. We continue our N.W. course through it for 100 steps and are at the base of hills. Take from here a north course. Close by bluffs of dioritic rock of rhomboidal cleavage and fine silky shining fracture. Dip north. Ascend this high knob 174 steps, consisting of the same rock, brings us to the plateau like summit and from there a general decline to the north is perceptible. This is the summit crest of the entire hill chain.

We descend a very uniform slope covered with splendid hardwoods and sandy drift and boulders on the surface and come at 200 steps to the edge of a sort of terrace where outcrops of quartzite and the ferruginous arenaceous beds above it were noticeable.

Thence a lower flat land with the same fine hardwood timber extends northward to the distance of 232 steps where we meet a strong creek running east. North of it again low hills, slates arenaceous outcropping. At 120 steps progress now the land slopes north and eastward. We proceed over almost level ground, slowly descending 390 steps where we are at the margin of the lake in the beaver meadow. Have passed the line perhaps 30 or 40 steps.

We go now east along the meadow to the beaver dam where the line crosses the creek only about 30 steps south from our standpoint on a little hill, and take a northeastern course for 220 steps. The high lands are on our left, swampy creek valley to our right. We take now a north course and ascend on the hill sides which seem to follow the creek on its northside instead of swamps which are represented on the maps.

Ascension of hill and progress on its flat top unto decline northward 300 steps incline of the land towards a depression inclining towards a ravine running N W. 200 steps across this depression which continues also eastward for some distance, then we are at the foot of a high steep hill. Ascend it with 100 steps and have from its crest a splendid view on the Dead river valley. A very deep valley is before us which extends east as far as we can see and west also. All the hills north are at least 100 feet lower or more.

We go now east on top of ridge and find 68 steps further a north and south line and a post on top of ridge marked on 4 sides. I suppose therefore this is the center of the section and on my map the hill has to be placed a little further north. 274 steps further east rapid descent. The hill has no outcrops of anything else but fine sand. We move over a lower plateau and then descend at 200 into lower lands.

We proceed 100 steps and thence begin to ascend a small elevation for short distance and return to the spot from where we take a south course say 600 steps east from the centreline of the section. We proceed over undulating levels and have at 208 steps ascended a somewhat higher terrace of undulating ridges, and arrive after a short previous descent in the swamp valley of the creek 256 steps distance. 32 steps further we are at the creek.

From creek 400 steps north through swamp, thence high land. We pass over its successively rising surface 500 steps when we meet a swamp 120 steps across it. Now ascent of hill. The swamp seems to continue in east and in west direction and to have outlets on both sides. Ascent of steep hill of slate rock. Dip north. See specimen.

Constant ascent higher and higher unto 560 steps where we are on summit which extended into a plateau. From there we begin to descend 30 or 40 steps. The summit part of this ridge seems to consist of schistose rocks connected with the granitic formation but only limited outcrops.

Monday Aug. 18. From camp home. T. 48, R. 27, start from east and west line of Sec. 13 and 24 southward at a place 30 rods west of corner have in general a southwest direction. By following road 200 steps S S.W. and 100 steps west S.W. we have there the hill spur close to the left hand. Road continues S.S W. 50 steps when the creek crosses the road and we continue on the high ground sloping down from the hill complex of our camping ground 50 steps.

Thence over level high ground 200 steps almost south, little to the east and then in swamp 68 steps S.E. where the creek crossed the road again. Creek flows S.W. from there. Road goes S.E. for 100 steps. Thence S W. 204 steps along swamp on the right and low high lands on the left. Now road goes S. 166 steps over a spur of high ground. Then we are in the swamp again which followed us on the right side all along. A little pond there.

South some degrees west the road goes on not far from the course of the creek 28 steps the side creek enters into the mentioned pond. From there we rise on a low plateau of high land and pass on 220 steps in S.S.W. direction . The creek valley always near by to our right. Now the ? bends west(town into swamp lands, high lands close to the left) 125 steps W. thence S.W. in swamp 142 steps. Thence a little more south, 200 steps all in swamp with high land close by on left side. Westward large swamp expansion. A creek probably enters there from the west. Another small creek comes from the east and crosses our road 158 steps ahead.

Road still in swamp 230 steps south now S.E. swamp yet extensive to the west. No highlands visible there. 131 steps S.E. now due east, 66 steps along tolerably high hills on the left. Then E.S.E. 212 right close with the course of the creek high lands on both sides of creek. Now S.E. with the creek 180 steps, then south.

Monday 18. To Fredrich 25 dollars. Paid Krier 6 days work.

Tuesday 19. To Graveyard hill. Diorites and dioritic schists. Both contain chlorite as constituent in place of hornblende and the feldspar is of the ordinary flesh red kind. The rock is in part decomposing and crumbles into gravelly rubbish.

Afternoon visited the knobs north of New York mine over which the section line runs. They consist of massive highly crystalline diorite in which the hornblende is light green fibrous and asbestoslike. Sometimes at the New York mines the hematite ores rest directly on the diorite partly also the higher hard ores.

In the large knob of this group forming its northeastern part on the south side of the bluffs the arenaceo-ferruginous flag stones in an altered condition full of asbestos veins are resting directly on the dioritic rocks in perfect, most intimate but evidently inconformable contact. The masses of well stratified banded rock have the closest similarity with the equivalent rocks at the foot of the diorite hills on Goose Lake and the same beds are well disclosed on the hill east of the Negaunee furnace.

On the other hand the rock resembles the banded strata below the ore beds of the Washington mine and of the Republic mine. They contain like those abundant stelliform groups of actinolite crystals and bands of asbestos like mineral transversally fibrous to the walls of the fissures.

Aug. 22. Up Slate river with Capt. Bayley. Grey comparatively soft slaty rock in immense thickness interlaminated with belts of a well laminated stratified rock of the same material. The stratification lines distinctly indicate a northern dip while the cleavage of the slate cuts it almost in a right angle and dips south but there is no doubt of the actual stratification contrary to the slaty cleavage. Some subordinate more arenaceous ferruginous rock belts are interposed but the great body of the formation is all of the same slaty material.

Saturday Aug. 30. With P. Krier to 3 kilns on Dead River near ¼ post between Sec. 14 and 15, T. 48, R. 26. Railroad expenses .75, victuals 4.50.

Sunday. ToNorth corner of Sec. 14 and 15. Hills of Dead River valley form two distinct drift terraces above which the granitic knobs form a summit ridge. Corner of 11. From there east over a knobby elevation 168 steps to a ravine. At 300 steps on creek flowing from west of north to east of south. 70 steps beyond the creek, outcrop of slaty schist. See specimen. From there over the south slope of hills of schist a high plateau expanding north of the line. Specimen of schist 470 steps from the creek.

Intended to follow the line unto ¼ post but did fail to find it. Went further some distance unto the line descends into a valley and returned from there to the ravine where the ¼ post is supposed to be located. A small creek there. Flows toward the large creek which we struck about 300 steps south of the line. Opposite sides of creek hills of dioritic schists. Went over the creek. Kept south course on which we had to cross two creeks flowing into the large creek. Think we went S.W. and struck the road on which we came, following the line between Sec. 10 and 11.

North of the corner we followed a road which leads west, struck by going a little south the east and west line. Followed it across the creek with very steep bluffs on both sides. Top of the hills plateau like. Followed line through burnt timber but could not find ¼ post. Descended into the next ravine which opens southward into Dead River. East and west line between Sec. 10 and 15 is at the head of the ravine.

Small diagram

Granite outcrops along the line, top of plateau drift covered. The drift terraces at the Dead River are at the base compsed of the feruginous slate rock with dip to the north. Fine outcrops about 400 steps West of the kilns at the river side.

Monday Sept. 1. To north line of Sec. 15. Follow road north 160 steps. Thence NW. 125 steps. Thence west little to the south 100 sreps. Thence S.W. 266 steps, to our right a granite knob. S.W. 30 steps. Thence west 156 steps. Thence S W. in timberland. Roadt to 9 kilns from 3 kilns crosses the East and West section line about ¼ mile west of N.E. corner of Sec. 15. Then again about ¼ of a mile from the N W. corner. Then again 80 steps west of the N.W. corner.

From ¼ post 183 steps south to edge of plateau land and decline to the river slate outcrops here. 400 steps descent of s steep hill side brings us to the river, opposite side of river brisk ascent of hills. A small creek enters there from the south side.

Return to line 80 steps west of corner. Follow road in N.W. direction for about 800 steps. Thence 100 steps west. Are at the foot of high hills consisting of schists. Dip north. From the top a viewon Lake Superior is offered. It is the highest point all around. Descend and take northeast course, then east and strike ¼ post of Sec. 10 and 9. Dioritic rock outcrops in the hill sides there. The quarter post is on a small knoll in a swampy valley which opens east wards into the large creek. The sec. line goes across this valley, ascends a schistose hill and then descends to the large creek which is bordered by a strip of low lands particularly on the north side.

Also on the south side a flat space is seen. On the west side of the line a good road we struck there which we followed eastward. Then it turns southeast for a good while follows the course of the creek. All land as far as we can see from the road is perfectly level hardwood land.

Page of German

Diagram

N.W. corner of Sec. 3, T. 48, R. 26. On slope of a high dioritic ridge. Slope to the north, following that line from the S.W. corner we had a drift covered plateau land with very few outcrops except on a few of the ridges between the arms of the creek and on the last high ridge on whose slope the corner is.

From the corner we go east following line all along slope of the ridge which soon becomes much lower towards the easta and the slope northwards more gradual, often almost level. From the 1/16 post the land is flat, low, hardwood land slightly inclined to the north and on the south side with little higher ground. 340 steps from 1/16 post a small creek running north is crossed by the line. Find ¼ post some distance further in swampy hardwood plains. Low lands all around. We take from ¼ post a southeast course, ascend a hardwood ridge with dioritic outcrops, sloping again south after we have reached top with 223 steps.

76 steps further outcrop of dioritic and granular sub-granitic rock. Descend a very steep rock bluff and are with 134 steps in the swamp valley and at small creek. Direction of valley nearly north and south. Flow of water not seen. 36 steps further meet a large creek flowing northeast which is the same as the two branches which we crossed on the section line from creek. We continue S E. unto the distance of 600 steps from ¼ post. We have ascended from the swamp valley unto high ground rising still further on. We continue to go in the same direction over comparatively flat ground but descended into a swamp after 262 steps. This swamp seems to connect with the swampy creek valley.

Towards the northeast find a creek running that way. Continue in swamp of the worst kind 350 steps further until we strike high ground. Ascending 294 steps we strike the section line 100 steps south of the ¼ post which is on the north slope of the hill. Now take course S.W. on edge of high plateau partly on its northern slope for 368 steps. Rock specimen there. From here we come to a southern slope of the surface but only representing a rolling plateau. 350 steps on it outcrops of conglomerate rock,(See specimen) forms the summit of a knoll.

Wednesday Sept. 3. To north line of Sec. 11 about 400 steps east of the west corner, thence over plateau in N.E. direction after 300 steps descend into a depression at 500 (steps) in depression extending about in N. and S. direction. From there rising unto a knob of diorite. See specimen No.1. at 100 steps progress on top. 168 steps further we begin to descend into a ravine having a N E. direction. Rock outcrops there, the slope of all the hill land directed north. See specimen No.2.

From this place proceed in this ravine which expands into a wide valley for 220 steps when we strike on to hill land again in our course. The valley continues to the east. No creek in it yet. 151 steps on hill land, thence decline. Specimen No. 3 from here.

151 steps down we are in a valley running N. and South. No creek. Ascend again 81 steps on dioritic ridge. See specimen No. 4.

135 steps further we are in a ravine running N. and south, declining to the river. Rock specimen No. 5 here. Granite side (or granitic).

Go on comparatively level ground, little inclined in northeast and northern direction 268 steps when we strike a wood road and clearing on the west side of us. All level land 322 steps until we strike the creek at the spot where the line crosses it. From here we follow the line north, cross the Holyoke road and find the corner on entirely level ground. Further north I remember to have gone as far as the ¼ post, if I am right, where the edge of the plateau is. Granitic bluffs there. We go now west and strike the Holyoke road with 170 steps. Road goes north of the line from here.

900 steps from corner all perfectly level land. There we strike a knob of dioritic gneissoid rock. Specimen No. 6.

At a distance near or beyond the ¼ post rock bluffs briskly falling off to the west. Specimen No. 7.

We went about 1200 steps west. Now turn south, are starting on level land at the foot of the high perpendicular bluffs. Soon swamp begins in which we travel 470 steps until we strike high land with outcrops of rock. Specimen No. 8. This swamp is very extensive and forms probably one body with the swamp surrounding the northwest corner of the section. We cross a few other small rock knobs which protrude above the swamp which occupies a very large space. 716 steps we have proceeded in it altogether and are not yet through. This swamp is evidently in connection with the creek running east across the section line. 80 steps more and we struck high lands. The swamp extends east as far as we can see.

We ascend now hard timbered land in mediocre ascent with a plateau-like top for 477 steps when a decline to the south side commences and the ravines run south while before all run north. After passing a depression which opens in a ravine running southeast we ascend a high ridge. At the distance of 245 steps have reached its top and clearing which extends to the S W. corner of the section.

Diagram

We struck the line about ¼ of a mile east of the corner while we supposed to strike it near ¼ post, consequently we had in the first place followed the east and west line of Sec. 2, ¼ mile beyond the ¼ post which we failed to notice. From creek.

Thursday Sept. 4. To N. line of Sec 21. ¼ mile east of west corner. From line north 100 steps to edge of clearing and top of plateau. 100 steps further north from here over the plateau.

Thence 77 steps to descend into a depression which declines in a southeast direction and is the same depression which we entered the day before by cutting our way from the clearing in a N.E. direction. 56 steps further we find small creek running S.E. 100 steps further over a small hillspur we pass the same creek running southeast. A good sized hill is here on the south side of the creek valley over whose S. slope the line must run.

Our course leads us along and up a steep hill side on the north side of the creek 60 steps up fine large outcrops of a conglomerate with granite pebbles. Passing 80 steps further on the edge of this very high knob consisting of this conglomerate all our course leads us down a steep hill side into a ravine. Descending from the north with 200 steps we have crossed it and ascended on the slope of another lower hill south of us, also a ravine. We ascend along the crest of these hills 152 steps, consisting of hard dioritic schist. See specimen No.2 of that spot.

To the south other knobs belonging to the same ridge exist over which the Sec. line passes at a distance of 190 steps as we ascertained. At 240 steps we have passed over the north slope of the hill we are on and descended into a very deep ravine. On our north side a row of other knobs follows us but beyond them a general decline to the north exists. The ravine we are in has a direction from S.S.E. to N.N W. and seems to continue without interruption both ways. Specimen No. 3 is from 70 steps less than the 240, id est, so(to) far west from the ravine.

We ascend now another high knob and up and down several others having the same direction and separated by more or less deep depressions. South another row of knobs goes along with this. The highest one we proceeded this way 410 steps. Find blazed trees and are deceived by them wasting 2 hours with hunting round a trail, then returned to this spot. Went 460 steps east, then south 167 steps when we struck the east and west line 350 steps east of the corner we were hunting for. Finally found it. Now south 460 steps to creek, over steep rocky slope. See specimen No. 5. 82 steps from creek, slate knob. Specimen no. 6.

Descent and ascent of another higher ridge all slate unto the next creek. Slate dips south almost vertical. The creek comes here very close to the line when it descends from the higher knobs but the line goes over high lands and crosses the creek much further south. From the intersection of the line by the creek we went due west with the creek and followed it for 481 steps before our course crossed it. From there it comes of a more northwesterly direction. A tolerably high ridge embanks the creek all the way along on both sides.

Friday along Dead River. Descended to bed on Sec. line between 15 and 16. Very steep drift bluffs close to the river 150 feet high. Opposite banks also high. River runs there from the northwest, then bends into east direction and flows straight for nearly ¼ mile. Then bends north east. There large outcrops of slate ferruginous in river bed. Dip north. Outcrops on the south side.

Friday mittag(mid day or noon) home. From section line at bridge 1100 steps S.E. and 100 steps south making in all a direction of southeast to margin of plateau. From here top of high granite knob opposite the river direct south. The knob east of it much lower and nearer the river. The higher terrace of the plateau west(went) from there about 2 or 300 steps distant to its base.

From there 1000 steps S.E. to granite knob to the left of road. Friday evening in Ishpeming. Railroad fare .75 paid Peter Cier 14 dollars for 7 days. Received check for 100 dollars from Ann Arbor.

Monday Sept.18. To S.E. corner of Sec. 20, T. 47, R. 26. Thence east over an undulating land 267 steps to creek which flows S.E. from there. 316 steps along the slope of hill land running east and west. Strike a quartzite outcrop there. A deep valley to our right, in eastern direction (327 steps). Lost line on high quartzite knob. At the east end of it we descended into a deep hollow and went from there south on which course we had ascended the somewhat lower quartzite range and came to its northern edge with 522 steps. From here the Cribben mines are due south. The high ridge over which the line led to the corner is west S.W. from here.

From creek on ¼ post between 20 and 21, T. 47, R. 26, 132 steps unto foot of high land. Rolling land unto a few hundred steps this side the corner which is in swamp. From corner S W. course 250 (steps) in swamp, thence dry level land. Undulating 400 steps, then swamp land again 90 steps with blocks of ferruginous sandrock. Over rolling hardwood land 300 steps incline of surface southward continues 846 steps to creek.

Thursday to N E. corner of Sec. 20, T. 47, R. 26. Thence east 234 steps in swamp. From there to 500 steps distance from corner, level hardwood land and north and south no higher ground visible. South the surface seems to incline towards the creek andthe swamp land seems to continue in that direction. The level low hardwood land sometimes swampy continues to the ¼ post where a small swell of the surface exists inclining north and southward. We take now S.E. course and soon begin to ascend a quartzite knob isolated from the hills over which the line takes its direction. At 273 steps we have reached its top. See specimen.

We descend now into low lands and proceed 468 steps when we have to cross a small knob of quartzite running east and west. This low land extends westward and seems to sink in that direction. We descend it, go over low land and ascend again a broader elevation with plateau like top 600 steps further.

46 steps further we strike the line about 100 steps north of ¼ post, take south course now. 25 steps south from ¼ post we strike the creek Outcrops of quartzite near ¼ post. 277 steps to top of slate hill and a piece down its south slope 165 steps further meet a small creek which flows S. of west. Comes down from the hills. After crossing the creek and ascending some distance on slope of a hill spur find an east and west subdivision line which goes along the steep hill slope eastward. The N. and S. line descends at the crossing down the slope.

355 steps further we have mounted another slate hill after passing a ravine.Find corner. Slate hill. From corner return N.west course 182 steps down hill we strike the creek which is a large creek much larger than the one into which it is purported to enter and at least at a 100 feet lower level. 208 steps further we have passed along slope of a hill on north side of creek and descended again into a small swampy creek bed coming down from the north.

Pass along slope of slate hills 208 steps. Then leave them to the right and descend into a valley which is probably the same valley as that of the large creek which we left on our south side. Meet the creek right after.

Pass along it 145 steps on its south side. On our south side hills ascend obliquely, their slope gradually rising higher but not quite reaching the top of the very high quartzite ridge. Slope northward 308 steps. At 200 more begin to descend a steep slope. The hills continue westward but lower. Quartzites outcrop. Walk 237 steps on low valley, then begin to ascend a knob of quartzite 106 steps to top. After 250 steps at creek running west pass over undulating hill land. 590 steps come into swamp and creek running southwest. From there I did not keep account of the distances but continuing our northeast course across low undulating ridges we soon struck the north and south line of the sections some distance south of the corner yet in the hardwood land.

Wednesday Sept. 10. ¼ post between Sec. 27 and 28, T. 47, R. 26 to ¼ post on railroad of Cascade, road runs from S.W. Creek short distance along road for 438 steps. Then creek crosses road to the south side, then in an arch 273(steps) direct east when creek comes over to the north side again. Here also it joins the north branch, at 190 steps creek goes over to south side again.

German

Corner of Sec. 22. From road to corner not much over 300 steps. From corner west 100 steps brings us to the base of high quartzose bluffs. See specimen. 273 steps from corner have descended into ravine with creek running south. At 500 steps distance we have ascended the summit of another hill consisting of micaceous sandrock. See specimen.

Now take northern course. 36 steps brings us down the steep bluff, now gentle incline. 34 steps further we come to a creek which is partly the same as we met before runs east. Ascend summit of very high quartzite hill with 248 steps. Some slaty strata in the quartzite near top. See specimens numbered 1.

88 steps down into deep ravine E. and W. The high knob is seen to be isolated to the east and to the west. Pass another small quartzite knob close to our right and proceed in a swampy valley 116 steps. Valley extends east and west for a good distance. We ascend a very steep hill and are with 100 steps on its summit. It consists of a singular granitic rock somewhat brecciated. See specimen No. 2 Hill isolated all around. View on the pine plains. In all 622 steps.

On top(of)breccia of granitic sandrock. Pass over several such granitic knobs separated by ravines and are on top of one which may be quartzite at 300 steps progress. At 44 steps further outcrop of ferruginous quartzite. See specimen 3. We are now on the edge of the hill and see a wide depression extending along this western slope. Due west at about 1/3 mile distance is a very high hill range. With 195 (steps) we have descended on the west slope of those hills into the terrace land of the valley, the high quartzite bluffs are yet visible to our right at a distance of about 100 steps. We strike here a fine road leading to Goose Lake.

We go now S W. about 400 steps through a low north and south valley and ascend a high knob of the granitic breccia rock. The ridge strikes northwest. To the east we are on its terminal point and can see far over the pine plains. We descend again perpendicular rock walls into a deep ravine passing a smaller knob to our left. The incline of the ravine is eastward but it continues also very low westward. Distance made about 120 steps.

250 steps about further we are at the foot of a high slate ridge. Dip north. Specimen 4. We cross the ridge with 451 steps. Are now on the south slope where the granitic breccia rock crops out in large bluffs. See specimen No.5.

Thursday 11. Cascade. S.W corner of Sec. 29 German sentence

140 steps west to edge of declivity of hills. Thence back to corner and south 140 steps to ravine over a spur to creek, 305 steps. 100 steps more at side of granite knob with granite and dioritic-chloritic schist. With the granite I find also a seam of novaculite adjacent to it inclosed by granite from both sides. See specimen No. 1 1 novaculite 1. granitic schist.

146 steps further gneissoid rock Sepcimen No. 2. A knob of granite to the right. 100 steps further white granite with intermingled seams of gneiss. See specimen No.3 Decline to the river. 256 steps to the river. Gneiss with granite seams forming the vertical river bluffs. See specimen No. 4. Return to high granite knob west of the line and count going west from line 675 steps to creek. Upper quartzite southeast of Palmer mine. Specimen No. 5.

Close by east of the sec. corner at Palmer mine about a ¼ mile a large bulky protrusion of augitic rock. Specimen No.6. The augitic dyke near the saw mill at Cascade lies about in the same strike. Augitic dyke, Palmer mine weathered and fresh. Specimen No. 7. Thursday paid 8 dollars for 4 days horse and wagon. Peter Krier 4 days work 8 dollars.

Monday Sept. 15. To Goose Lake. To corner S.W. of Sec. 15, thence 500 steps follow line east. Then south 270 steps to top of quartzite hill. After supper followed road along hill side in S.W. direction gradually ascending the hight. The road as far as we went is yet east of the Sec. line as I suppose on hight as continuation of the higher quartzite knobs. The lower western prolongation consists of a thick outcrop of pure whitish novaculite. The line probably crosses this novaculite knob.

The slaty gray rock likewise of novaculite nature which composes the hills on which the kilns are erected exhibits a slate cleavage which is transverse to the stratification. Some portions of the slate rock is of the nature of a breccia. The dip of the stratified striation inclines northward.

Tuesday to ¼ post between Sec. 22 and 23. Thence ½ mile west. Thence 250 steps north. Thence east 437 steps, thence 320 steps N.E. Now North 312 until we strike road of yesterday. Near Goose Lake waterhouse stratification of slaterock distinctly visible. Dip south. On opposite side of lake. Limestone with northwestern dip. The novaculite is local quartzite breccia with talcose sandstone cemented.

Wednesday to ¼ post of west line of Sec. 23, T. 47, R. 26, from there east. Quartzite range is passed on the south slope. At 216 steps we are about below the summit. 222 steps farther we are near the edge of the declivity on top an undulating rocky plateau land. There the quartzite which before was a pure quartzite is now conglomeratic and talkose granitic, evidently the same complex of strata. See specimen 1.

286 steps further we have crossed a sort of valley with small creek and ascended the top of a knob of talcose conglomeratic quartzite. Specimen No. 2 about 500 steps east of ¼ post west side of little creek. 152 further on sort of plateau. 224 steps more we have descended into ravine through which a trail leads to the Cascade road. Talcose quartzite there forms bluffs. See specimen No.3. This is the centre of the section.

Pass now across the ravine, ascend high knob but not reach the highest part. Pass along precipitous slope 240 steps when we begin to descend into a ravine again at 240. Specimen No. 4. Talcoso-micaceous quartzite well banded and in part granitic conglomerate rock making part of the same complex. 40 steps further on slope, specimen 5. 58 steps further in ravine with small dry creek bed. 314 steps on south slope of high hills. See specimen 6, which represents the general character of all the rocks seen on that distance. 37 steps further seam of specular iron in the granitoid quartzites. See specimen No. 7.

In the next ravine we strike the line. The compass is not working consequently our east course went at least 1/8 of a mile too far south. From the first tree in the ravine to corner 370 steps over granitic and gneissoid outcrops forming small knolls but otherwise over level pine lands. From corner 300 steps to railroad.

60 steps west of crossing of line with railroad on left hand low dome of granitic gneissoid rock, otherwise level sand land with low elevations. At 300 steps further progress on right side low granitic knob close to road . Continues 92 steps then a granite knob comes out on the left side while on the right it retraces from the road further north. 100 steps further the railroad cuts through the granite and gneiss then a swamp valley on the north side. 220 steps further having passed granite knobs on both sides we strike swamp. 150 steps ahead of it the Gilmore mine.

Gilmore mine is opened in a ferruginous and partly chloritic sandrock. The ore is generally disseminated through all the rock but the richer seams form irregular nests. The rock differs considerably from the rocks of Cascade mines. The quartzite formation of the Goose Lake hills is to a great extent a slaty talcose or novaculitic rock. Other large masses are micaceous schists. Much iron disseminated through all the strata. The granitoid conglomeratic masses are most intimately connected with the quartzites and can there not be considered as a separate link of the formation.

Thursday. Quarry of quartzite at Goose lake. Dip N.W. forming a bubble. German

Friday to S.W. corner of Sec. 19, T. 47, R. 27. Thence to ¼ post on west line of Sec. 30. Thence east 500 steps first on high land but soon a large swamp. Strike creek at about 400 steps. At 550 on dry land but shortly swamp again. North all swamp, south high land. Little hill south of swamp not far from quarterpost granite. We proceed 244 steps also in swamp. South at short distance a small granite knob. We proceed in swamp to a total distance from ¼ post of 1000 steps. Swamp continues in east direction. We go now north, reach dry land after 60 steps. With 115 we are on a undulation of granite, the same as the granite knob seen before on our south side. Go over plateau south unto 500 steps from the line we have ascended. Here a granite knob and crossed a small valley in front of it. 160 steps further south we are on the slope of the granite knob and see another one before is separated by a kettle shaped depression. The summit of this knob is about hundred steps west of our course.

We find in ascending that hill the east and west line running over it. Follow east and west line eastward. Find ¼ post on slope of hill. 200 steps down to swamp and a dry creek bed almost with north and south direction inclining north. Further on 164 steps through swamp, then at the 200 steps distance from quarter post on south side of line is a granite knob east side of the creek.

145 steps further through swamp, we are at the creek now. North 124 steps to dry land, an undulating elevation. 100 steps further in swamp again which connects with the other. 130 steps further we see due east of us the swamp continued for not less than a ¼ mile, probably more. 30 steps further strike the creek. Swamp continues 170 steps more to the north. The great rock knob is now due west of us, rising ground. 150 steps on top of granitic knob partly drift covered. We have to descend now into an east and west ravine, cross it and ascend another ridge like elevation and descend slowly into a creek bed running west at 250 steps.

(?)

Peter Krier, 6 days Monday(31)to Saturday Sept. 12 dollars. Boarding 6 dollars Railroad 1.50

Monday Sept. 22. To Greenwood Furnace. Section line crosses road about 200 steps east of the station house. There a post on road says west line of Sec. 14, 1800 feet to northwest corner. Go east on road 500 steps to crossing of creek which flows from N.W. to S.E. 400 steps further over a spur covered by heavy sand strata. At 500 on railroad dam in swamp close to creek on southside. 415 steps to crossing of creek. Creek flowed constantly near the road. Due south from here a hill at a distance of about 300 steps. A little east of south a valley seems to extend between this hill and the next eastern one. From creek to next section line 450 steps. (Gained 50 steps in the mile by stepping).

From section line 100 steps east a small creek comes out of the swamp and crosses the road. 100 steps further the small diorite knoll on road side at the crossing of river with railroad. Calcareo-talcose schists in outcrop on track and in the hills of north side. Dip west southwest. The knob of black ferruginous rock is a part of this series. Stands vertical and on its south side similar calcareous schists are closely adjoining it. The rock is of a breccia nature or conglomeratic.

Tuesday Sept. 23 H(ere- house-hotel-camp) to R.R. west from corner 660 steps. Creek crosses the road. 1000 steps to post on railroad of Sec. 6. 16 miles from Marquette. 100 steps further branching off of Saginaw road. Intersection of section line with road exactly 2000 steps. Saginaw depot 300 steps west of Middle sec. 600 steps west of middle sec. crossing of small creek. At 800 crossing of river. At 1080, intersection of section line. Fredrich land from sub-section corner 200 steps east to test pit on slope. 300 about to crossing of creek.

Friday Sept. 25. To N.E. corner of Sec. 25, T. 47, R. 28. From road to corner 300 steps west. Thence 558 steps over hill land on plateau-like top. To ¼ post all drift. Large boulders of sandrock and ferruginous-arenaceous rock. Soon descend into large swamp. Northwest across the swamp at about 300 steps distance a granite knob. See specimens. Swamp extends to foot of hill on whose side we find corner.

Thence south over the hill 200 steps. Then to 500 steps distance swamp. Then rising again unto a widely spreading undose plateau on which we are at 750 steps. Drift boulders on all the surface.

At 1000 steps we have descended into a ravine with creek running from N.W. to S.E. Another branch enters it little to the east which runs from N.E. to S.W. Granite outcrops all around. We are probably too far west of the section line. Several 100 feet or perhaps as many steps. Near the creek a coarse grained granite with a seam running east and west of quartzite holding pieces of mica schist and connected with larger bands of mica schists. Quartz seam in all about 2½ feet thick. See speciman No. 2.

(From the German.) Paid Mr. Friedrich Saturday 26, Sept. 20 days board inclusive of Sunday.

C. Rominger 1880

Left Ann Arbor May 17, 1880.

Railroad fare to Menominee	16.90	
Hauling to R R.	.50	
Dinner - Marshal	.75	
Supper - Chicago	.50	
Sleeping car	2.00	
18 Marinette - breakfast	.50	
Dinner at Negaunee	.50	
To Marquette and back	1.10	
3 maps from S.C.Smith	2.25	
Hotel bill at Negaunee	2.50	
29 Trip to Clarksburg mines	7.	or 1.
30 Sunday return to Menominee at Vulcan Mine Hotel	.75	
June 1. Dinner at Brion mine	.75	
2 Dinner at Quinnesec	.75	
Hotel bill at Vulcan Mines 6 days	16.00	
7 Horse and wagon	1.50	
13 Quinnesec Falls	3.00	
14 Little Quinnesec Falls	3.00	
16 Bought for St(ephen) Nickels wool blankets	3.75	
Coffee	.80	
Milk, condensed	.25	
Axe	1.00	

Notes from front fly leaf Stephen Nickels. Dike Mine N.W. of N.W. Sec. 7
Chapman mine. S.E. of S.W. and S.W. of S.E.
5136 plus 83 100 ft. end station.

Outcrops of the great quartzite formation mentioned by Brooks.
Sturgeon river Sec. 8, T. 39, R. 28
Sec.1. T. 39, R. 29
Sec. 28,T.40, R. 29
S.W.¼ of Sec.23, T. 40, R. 30
Mentioned by Cridner Sec. 17 and 18, T. 41, R. 30. Dip S.E.

S. half of S.W. ¼ of S. 32, T. 48, R. 28. Location of the hill with the upper quartzite and iron formation. Granite hills rise to the north of it across a swamp about 1600 feet wide. The iron formation itself forms a ridge surrounded on both sides by swamp in eastern continuation of this low ridge. The upper quartzite is said to appear at the surface in the north half of the N.W.¼ of Sec. 5, T. 47,R.28 Also near the quarter post on the line between Sec. 5 and 4 and a half mile east of there. No more outcrops eastward unto the Jasper Hills in Sec. 6, T 47, R.27. The other mining pits south of Clarksburg are in the S.W.¼ of S.W.¼ of Sec.7, T.47,R.28.

North of Clarksburg the first range of hills is composed of a very thick series of the arenaceous slate group dipping north. The lowest beds are a very massive but distinctly laminated hard rock containing in a micaceo hornblendic and quartzose ground mass a considerable proportion of ferruginous calkspar. The rock is often conglomeratic and shows in this locality its intimate connection with the much twisted and contorted banded arenaceo-ferruginous rocks of the 4th group.

These massive rock beds identical with the rock bluffs north of Saginaw Station are the lowest in the series. The banded rocks are above and north of these a second undulation is composed of the black slate. North of these a drift covered interval [illegible] and then further north the hill range with the iron bearing rocks dipping southwards follow.

In the locality south of Clarksburg the highest part of the hill range is composed of the banded rocks of the 4th group. They dip south on their north side. On a lower level we find in anticlinal position to them ; first a micaceous silky shining argillitic schist with some martite granules inclosed; in it is a belt of rich partly chloritic iron ore (specular) and on the ore the upper quartzites dark grey colored by magnetite rest upon it, all with northern dip. This ore belt is a direct continuation of the Washington mine ore belt.

(This paragraph had lines drawn through it. In this vicinity and along the R.R. east of Clarksburg the black coarsely crystalline dioritic rock found in the Washington mines next and apparently above the ore is seen in frequent outcrops and from them I come to the conclusion of its being a lower rock than the ore beds and not a higher as I at first was inclined to suppose. Written in red ink across it the following , "It is an eruptive rock belt".)

Monday May 31. At Vulcan mine which is situated in the N.W.¼ of Sec.10, T.39, R.2) On the south slope of a range which extends diagonally from the south part of Sec.15 northwestward to the N.W. corner of Sec.10 of this town and further on. The Norway mines are in a continuation of the same ridge which is cut off from it by the swampy valley of a creek.

The south slope of the iron bearing hill range and the valley through which the railroad winds is covered with considerable partly sandy, partly gravelly drift masses well stratified. The ore formation is in a remarkably contorted condition and consists mainly of fine grained argillaceo- silicious schists and slaty rocks which partly take the nature of a banded jaspery iron ore of a blackish color. The schist contains a large but very variable proportion of dark lead colored granular magnetite and martite and within it are seams of pure ore in a soft friable condition of dark graphitelike color.

Such ore seams are quite frequently found in repeated alternation with the leaner schistose rock. Some ore seams are only a foot or 2 wide. Others are over 30 feet wide and still larger. The upheaved Huronian beds are very often overlaid with Silurian sandstones.

The ore belts of the Norway mine are very large and of harder consistency than the ore of the Vulcan mine but it is of the same character essentially. At the Norway mines the silurian sandrock is found locally to be very calcareous and contains frequently the perforations called Scolithus but other fossil remains I could not notice. The base of the Silurian rock reposes often on a coarse breccia of the schistose iron bearing rock which are evidently debris re-cemented by Silurian sedimentary material as they fill out the clefts and erosions of the surface of the Huronian beds. The breccia is hard and forms a favorable hanging wall of the orebeds which is in many of the other mines very brittle and makes the mining very dangerous.

Monday afternoon. Went across swamp at the east end of lake to south side of Lake. Bluffs along the south shore consist of slaty or schistose beds, somewhat micaceous.

Dip south. Further south the crest part of hills is formed by a more compact hard rock of laminated structure which appears to be identical with the lower micaceo-calcareous beds of subdivision 4 which form the bluffs north of Saginaw mine Station. Further south again silky shining slate rocks crop out in almost vertical position and near the south slope of the ridge hard siliceo-calcareous seamy beds form the steep escarpments towards the low bottom lands surrounding the creek which is the outlet of the lake near Vulcan Station. The whole thickness of the series amounts to about 2000 feet.

Diagram.

Tuesday June 1. To Brien mines situated in the north half of N.E.¼ of Sec.22, T. 39, R. 28. Formation dips south. Consists of highly ferruginous schists of a reddish color which include seams of a dark grey rather soft iron ore of non- magnetic properties. The schists are very thick and contain several valuable seams of ore besides smaller ones. The footwall of the lower ore seam is a dark grey ferruineous and micaceous shale. Under it are silicious and argillaceous iron bearing schists continuing in great thickness which contain other ore seams; and the Emmet Mines east of the Brien mines mine an ore belt which is above the ore belt of the Brien mines and is of a much larger thickness.

The ore of all these mines is partially very high graded but much mixed with silicious jaspery fragments from the hanging wall and footwall. These jaspery, but contain abundant druses of calc-spar and iron pyrites. The thickness of the ore bearing strata cannot be much under 2000 feet. Silurian sandstones. everywhere are found capping the ore bearing hills and the base of the sandrock is generally a conglomerate of ore and schist fragments with the sandy material as a cement. The sandrock fills out all the clefts and inequalities of the surface of the iron formation, which on the slope of the hills is often hidden by deep drift deposits, sandy or boulder drifts, mostly composed of calciferous limestone and sandstone with Scolithus, only fewer granitic or Huronian boulders.

Wednesday June 2. To Quinnesec Mines in S.W.¼ of S.W.¼ of Sec. 34, T. 40, R. 30 W The railway from Vulcan mine to Quinnesec cuts all the distance no rock beds but deep cuts through the drift frequently occur about near the west line of Sec.2, T.39, R. 30 where the road runs over plains unto Quinnesec Creek. I notice on the north side at 1/8 mile distance a rock crest striking northwestward which consists of marble strata dipping south. These marbles come near the creek close up to the wagon road and the creek falls in a cascade over the ledges.

The northwest corner of Section 2, T. 39, R.30 is situated on top of a small knob of this marble. A second higher range north of this first one is likewise composed of marble which must be here about 500 feet thick. At the mentioned corner of Sec.2 the marble outcrops suddenly disappear westward under drift deposits and not over 200 steps further on in the direction of the range another hill body rises which is composed of the iron formation.. The strata dip northward in nearly vertical position and the adjoining undulation north of it is composed of the marble with a southern dip.

The iron formation of this hill amounts to not less than one thousand feet of strata and perhaps much over. The lowest seen beds which however were not observed by me are said to be micaceous soft schists.

Above are hard silicious schists of grey metallic color containing large proportions of martite and partly magnetite. They are distinctly banded and laminated but other cleavage planes intersect them obliquely to the stratification. Higher up are harder silicious schists also very rich in iron oxyd, often constituting a fine grained hard ore with metallic lustre.

Still higher strata of the same nature but in the form of very even bedded silicious flag ores follow. Then comes a rather soft argillaceous shaly seam, partly chloritic and not so much charged with iron, of a greenish grey color which forms the footwall of the productive ore belt. The ore is dark colored martite in well laminated rather softer layers, partly disintegrating into a crumbly mass. Above the ore are again silicious well laminated beds containing much iron similar to the lower ferruginous jaspery beds. And inconformably spread over the heads of all these beds follows the Potsdam sandstones, either in solid homogeneous beds, or the lower portion of it are a coarse breccia of fragments of the silicio-ferruginous beds of the ore formation cemented by sandrock mass. This breccia is very hard and forms a good roof in the mines whenever it happens to cover the ore seam.

South of this ore hill which is the location of the Quinnesec mine flats covered with drift extend unto the Menominee river, in whose bed the rock appears again, as I am told.

Thursday, June 3. To Pine Creek in Sec. 11, S. half. Silicio-ferruginous schists like in the other mines with intermediate ore seams smaller and larger mostly soft friable and of blackish color. In the shists are also narrow seams of hard finely granular specular ore. The strata are vertical. Some lean over to the south and seem to dip north, other times a slight inclination northward and a southern dip is perceptible. The ore hills are forming a low ridge with plateau-like top which is partly covered with Potsdam sandstone and all over with a thick stratum of clayey boulder drift. The north slope of the plateau is all drift covered with exception of the basal portion near the creek bottom, which consists of marble beds with southern dip. The outcrops are however not very extensive.

Northward across the creek a broad spur of hill land rises which is at the surface all drift, with no outcrops of solid rock ere reaching the quarterpost. On the line between Sec. 1 and 2 a swamp valley is to be crossed and beyond it a high ridge of white quartzites with ripple marks rises. The trend of the quartzite ridge is from S.E. to N.W. The ripple marks on the beds are so formed that I consider the north side of the layers the upper face, consequently their position would be an overtilted one towards the north as they dip south.

Afternoon went on the road to Felch Mountain passing by the Vulcan mines. The hill top of this range is overlaid by a thick series of Silurian sandrock beds. The base of the ridge which expands into undulating highlands is all deeply drift-covered unto Paint Creek. The road crosses the creek near the section line between Sec. 3 and 4 and passes the north corners of these sections but the corner and witness trees are burnt. I went more than ¼ of a mile north beyond the corner all over undulating drift covered lands without any outcrop.

Friday June 4. Went to Stephensons mine in the S.E.¼ of the N.W.¼ of Sec. 9, T. 39, R. 29. Ore belts dips south close to the shaft. On its north side rises a knob consisting of marble with southern dip.

At the western base of the marble bluffs a creek comes down over ledges of marble and on the west side of the creek a min r row of marble knobs trends in a northwest direction. All strata dip south. Some are conglomeratic, some consist almost entirely of a jasp ery quartzite of a reddish color. North and south of this row of marble hills is a swamp valley which on the government map is incorrectly laid down. The chain of marble hills connects directly with the hills of the Norway mine in Sec. 5, S.E.¼ of S.E.¼. But the west end of the chain is for some distance covered by drift.

The marble however soon appears again further northward in the south part of the N.W.¼ of the S.W.¼ of Sec. 4, which is the location of another mine belonging to Stephenson. The marble dips under the ore belt being only about 30 feet distant from it. And in the interval chloritic ferruginous schists of a rather soft nature are found. See specimens.

Some of the rock of a sub-porous easy weathering nature contains evidently a large proportion of fibrous half decayed hornblende crystals. This marble continues westward and likewise underlies the Norway mines. It is there of a more quartzose nature and is partially overlaid by horizontal silurian sandstones like the ore formation. South of Stephensons mine are the so-called Saginaw mines in the S.W.¼ of the S.W.¼ of Sec. 4. Their ore belt is the same as in Stephensons mine.

Diagram

The Conry mine is situated short distance S.W. of the Vulcan mines. It is situated in the S.W.¼ of the N.E.¼ of Sec. 9. The Vulcan mines occupy the north half of the N.E.¼ of Sec. 9 and the N.W.¼ of Sec. 10.

In the afternoon went from the S.E. corner of Sec. 10 to the S.E corner of Sec. 15 over drift covered undulating plains. No there any outcrop. From there over drift covered pine plains diagonally through the section 14 until I struck the railroad. Return from there without seeing any outcrop.

Saturday June 5. Rainy. Went to hills on southside of Lake Wanbury to re-examine the strata specially described in Brooks report. Ascended the hills about in the centre of Sec. 15. The strata on the north side decidedly dip south. Those in the crest of the range are nearly vertical and of those forming the south slope some seem to incline north but the generality of rock beds is either vertical or dips south. I do not see an indication of a folding of the series and a repetition in a regular corresponding order but the whole ridge consists of slaty rock beds in alternation with harder calcareous-arenaceous and ferruginous massive seams of greater or lesser thickness.

The slaty strata have a cleavage intersecting the lines of stratification obliquely and the strata are also more or less corrugated. It is therefore not clearly determinable which way the strata exactly dip. I have collected 12 specimens. No. 1 is farthest south from a bluff situated above a little lake or swampy hole. 2, 3, ectr. are the next following strata northward. 12 is from the bluffs on the north side of the ridge.

In the afternoon I went along the railroad to the R.R. bridge across Sturgeon River, crossed it and found a short ways below it on the east bank of the river the slate outcrops mentioned by Brooks. They dip south and are evidently the same as those on the south side of Wanbury Lake.

From there I went to the mines of Dibbles which are a ¼ of a mile northwest from the river bridge. The iron formation is in exploring pits uncovered only a very short distance north of the railroad. The uppermost first encountered strata are soft argillaceous schist partly red colored by hematite, partly greenish colored. The Dibbles mines are on the slope of a drift covered hill in the N W ¼ of the N E ¼ of Sec. 13. The drift is there about 30 feet deep. The strata struck in the shaft are hard jaspery iron schists with some thin seams of hard sub-specular iron ore.

North of the shaft they struck thin seams of the soft blackish ore like that of Vulcan mines. The east Vulcan mines are in the east part of the mining locality right on the south line of Sec. 11, not far from the west line. Close by is the mine of another company on the north line of Sec. 14. Took specimens of ore from both adjoining shafts. Some distance north of the Dibbles mines the marble crops out but on account of heavy rain I did not visit the locality.

Sunday June 6. All day rain. Sent letter with 30 dollars to Stafford which pays for 6 more maps to be drawn for me.

(This paragraph has been crossed out). To be remembered of the relationship of group 4 to the Ogden and Tilden mine ore deposits I make this note. Have to examine the slaterocks seen on the north side of lake in Sec.14, whether they are incumbent or succumbent to the Ogden ores. In the first case the Tilden ores would be an equivalent of the Menominee ores and the slates represent the slates south of Hambury Lake.)

Monday June 7. Went to Sturgeon Falls of Menominee. The falls are a little over a half a mile below the bridge across Sturgeon River. The hills near the river are composed of drift. ¼ of a mile below the mouth of Sturgeon serpentine appears in the bed of Menominee. It strikes from S E. to northwest. Seems to dip south but stratification is scarcely perceptible. If one goes south at the first little creek which enters the river he comes on the right of the hill soon to knobs consisting of a white speckled diorite of massive character which is intersected by a large belt of serpentine of a broken up fissured and corrugated nature. The diorite incloses if from both sides. The outcrop strikes from N W. to S.E.

Like the belt of diabase which forms the falls, the diabase belt is about 2 or 300 steps south of it. The diabase incloses a belt of a peculiar silky shining schist. It incloses also veins of dolomite spar of granular structure. No stratification perceptible so as to make the dip recognizable but the schistose band dips south and probably likewise the diabase.

I followed also the road from the bridge towards Menominee. All the elevations south and north are for the first half a mile drift covered but when proceeded ½ mile I saw directly south of the road at a distance of about 400 steps the knobs of diorite and serpentine before mentioned. At ¾ of a mile, small dioritic outcrops are seen about 100 steps from the road at the south side, which continue further on until the road descends into the valley of a creek.

At the New York farm (formation) all the surrounding elevation to the north and west are drift and have no rock outcrops. The Wisconsin side is all formed of high precipitous hills but I could not cross the river to see what nature the rock had. The before described serpentine belt of about 30 or 40 feet wide. The diabase belt may be 6 or 900 feet.

Tuesday June 8. Moved down to Wauceda. Rented room for 4 dollars per month. Expenses for transportation of baggage .50 cents.

The clay slates crop out on the side of the railroad track about ¼ of a mile west of bridge across Sturgeon river and again at the S.E. corner of Sec.13 opposite the small lake on the north side of road. In the afternoon followed road towards Menominee which leads south of west over drift covered rolling lands. The map is altogether incorrect. I went on the road as far as 140 steps south of the quarterpost between Sec. 20 and 29.

Near that place Indians have made a clearing for a potato field. They live on the shore of the lake which is much further off from the quarterpost than indicated on the map. The distance is about 600 steps from the ¼ post to the lake.

To the left of the road to Menominee about near the centre of the southeast ¼ of Sec. 21, T. 39, R. 28(or 18) are some testpits in which red clay shales and white and red mottled shales of the same nature are uncovered. They belong doubtless to the iron bearing formation. The drift is all well stratified and consists principally of sand mixed with boulders of calciferous and Trenton limestone but with scarcely any fossils. Also Silurian sandrock fragments are abundant.

Wednesday June 9. Rainy. Intended to go to the falls of Sturgeon river but struck the wrong road and came on an abandoned road as far as to the line between Sec. 10 and 15, 6 rods east of the quarterpost. Then I returned without having seen an outcrop on the way. As I was told afterward, the road on which I was soon turns west and would finally have led me to the falls.

Thursday June 10. Went to the falls of Sturgeon river a little north of the center of Sec. 8, T. 39, R. 28 by the road leading to some newly opened mines in the S.W.¼ of the S.W.¼ of Sec. 7 close to the Sturgeon river. The road led from Wauceda over the rolling south slope of the Wauceda iron range which towards the west is capped with considerable masses of Silurian sandstones. On the road however the surface is all covered by drift.

The road leads diagonally across Sec. 17 in the north part of which low ridges of marble trending from S.E. to N.W. or something near it form undulations on the pine plains of the section. The marble forms two or 3 parallel ridges and is apparently of immense thickness. North of the marble ridges the land is again a deeply drift covered rolling plain bordering the meandering Sturgeon river.

In the S.W.¼ of the S.W.¼ of Sec. 27 a number of exploring pits are opened. The drift is about 25 or 30 feet deep. Under it are flaggy silicious iron ores of a specular granular or of slate-ore character which are comparatively very rich in iron, perhaps 40 per cent of iron oxyd, taking all the rock as it is. The strata strike approximately east and west and dip south or are vertical. Thickness as far as seen from the extent of test pits very large.

From these mines I went on a trail up the river to a lumber camp about ¼ of a mile below the falls but first I misunderstood the directions given to me and followed a road leading to the right for about 3 miles over drift covered hills, quartzite and granite ridges in a northeast direction. Then I returned to the lumber camp in a constant rain, soaking me all through. Then went to Falls.

At the entrance of the chasm on both sides high walls of quartzose inclose the river bed.

The quartzite distinctly strikes from S.E. to N.W. and dips under an angle of about 70 degrees to northeast. The lines of stratification of the quartzite are in part very distinct, in part quite obscure and the beds are almost as compact and white as vein quartz. The surfaces of the bedding are frequently covered with micaceous scales and exhibit very fine ripple marks. Coming up to the falls a sort of amphitheater opens, the quartzite recedes and the central part of the space is first seen to be formed of well stratified partly ripple marked schistose or slaty rocks in alternation with various thick beds of a granite conglomerate which itself often is interlaminated with a harder siliceous rock but well laminated and ripple marked.

These beds which may amount to about 100 feet strike from N.E. to S.W. and dip northwest in conformity with all the other beds composing the falls. The strike and dip however locally changes quite considerably.

Under the lowest conglomerate bed immediately the granite appears in apparent conformity with it and sometimes with obscurely laminar striation below. The granite is a dark hard blackish green rock with much iron pyrites forming a belt about 40 or 50 feet wide and so connected with the granite, which also forms its footwall, as to evince its intrusive character. The dark rock incloses fragments of granite and is surely a dyke parallel with the formation. The underlying lowest bed is already mentioned to be granite.

In the direction of the dip of the strata closely adjoining and highly surmounting these outcrops is a direct continuation of the before mentioned quartzite belt which in this place seems to dip in conformity with the other strata and consequently directly overlies them. This irregularity in the position of the strata indicates that we have here before us a bubble like protrusion in which the granite is the lowest, the schists above it, and highest the quartzites which are by the protruding masses pushed aside in all directions. This granite however is not a Laurentian granite and also just as little a representative of Brooks subdivision 20.

The quartzites form precipitous cliffs all along the west side of the river unto the S.E.¼ of the N.E.¼ of Sec. 7. But from recollection of my first visit to Sturgeon river falls, I have the impression that a part of those cliffs believed to be quartz belongs to the higher calcareous series, to the marble group.

Another idea awakened in my mind by seeing the structure of the Menominee region is the possibility of the so-called 4th group in the Marquette district being misapprehended in its actual position in the series. It may be above the ore formation instead of below as I believed. This question is to be altogether reconsidered by me. A good many facts in the Marquette district hard to be reconciled with the presumed older age of this group could be more satisfactorily explained, by taking the 4th group as a younger formation than the ore formation. Returned to Menominee.

Friday noon. Went in the evening with train to Quinnesec.

Saturday June 12. Attempted to walk to Quinnesec falls but found the road and adjoining marsh country so flooded over that after persevering efforts to get through proved in vain I returned and hired a boatman for the next day to bring me down.

In the afternoon walked to Lake Antoine over drift covered hills. The lake is beautifully situated surrounded by high ridges from the north and south side.

The ridge on the north side is clear of timber by a former destruction by fire. On its slope towards the lake a number of test pits have been sunk through the drift which is very thick. Under the drift a conglomerate of Silurian sandstone with an abundance of fragments of iron ore of good quality, specular in its character and blotched with jasper seams and concretionary spots is found in all the test pits which have not yet reached the stratified iron formation which in all probability underlies them. The hills on the north side of Lake Lure are a direct continuation of those on Lake Antoine and so far as I am told, perfectly analogous in structure with those of Lake Antoine.

Sunday June 13. By boat to Quinnesec Falls in company with Engineer Rumperford whom I invited. Hired a man and boat for 3 dollars.

Quinnesec falls break through a rock barrier about 400 feet. The strata as far as can be ascertained dip south. Strike E N E. first and lowest is a thick belt of massive dioritic rock. Then schists of various modifications containing an abundance of ferruginous carbonate of lime and quartzose seams follow alternating with a narrower belt of dioritic rock. Furthest south is again massive dioritic rock in a belt of great thickness. The strata follow the direction of the river for over ½ a mile below the falls and project in high vertical cliffs. The dip of the strata is generally almost vertical. Many specimes collected there make description of rock character here superfluous. The massive rock belts appear as altered members of the sedimentary series and not as intrusive masses.

Afternoon visited the mines. In the oldest pit the superposition of the Potsdam sandstone on the ore beds in a trough is well exposed.

Diagram

North of the pit they sunk a diamond drill hole under the sandstone and struck besides lean ferruginous schists the siliceous beds of the marble formation. Further north a drill hole went after penetrating the Silurian sandrock altogether through siliceous marble. The marble crops out with a southern dip north of the mines where the laborers houses stand.

South of the ore hills and west of the village a basal undulation of the ore ridge is composed of micaceous clay slates in vertical position or slightly dipping north. Further south no more outcrops unto the Menominee river.

The borders of the Menominee are so low that by high water on the northside of the river a belt a half a mile in width is perfectly inundated and at such times the road which passes over these low grounds is perfectly impassable.

Monday June 14. To Little Quinnesec Falls. Railroad Station of Quinnesec is 460 ft. above Lake Michigan. Falls of Little Quinnesec strata strike E.S.E. to W.N.W. Dip almost vertical. Falls across a very thick belt of massive diabase 150 feet or over in thickness. Dip and strike not accurately ascertainable. Then a belt of very tough sub-conglomeratic rock with a sub-schistose corrugated structure. Next light reddish colored silky shining slates in vertical position. Strike east southeast. Next to them similar whitish grey schists somewhat corrugated. The two laminated slaty beds amounting to near 150 feet then exposed. First in a bay below the falls, dark green dioritic rocks with much iron pyrites partly massive, partly somewhat schistose and of very great thickness.

Further down the river more perfectly schistose strata are seen to follow this belt, but soon outcrops disappear from the banks of the river which are at present deeply inundated by the river. Paid Bertram 5 dollars.

Afternoon with Mr. Buel west(went) to some exploring pits in Sec. 33. Leaving the main road and going north the south half of sec. 33 is found to be occupied by silicious limestone forming several belts with intermediate swampy interrals. The general direction is east and west and the position vertical or nearly so. Ascending further north drift deposits compose the summit of a high ridge but in numerous test pits at various depth from a few feet to 80 feet below the surface, a thick series of horizontal Silurian sandstones is struck, partly a pure homogeneous light colored sandstone, partly a dark ferruginous breccia full of iron ore fragments of a very good quality.

The breccia is generally at the base of the sandrock deposits and is in some instances found to rest on the silicious limestone or on a breccia of the limestone. The ore belt of which the abundant fragments of ore originate has in none of the test pits been found yet. But these **rich** Silurian ore breccias are topographically north of the limestone belt and seem to indicate in this position the existence of the ore in situ . North of the high ridge on which the exploring pits are,no outcrops of rock can be found unto in Lake Antoine an island is seen to consist of a limestone cliff.

Tuesday June 15. Returned to Wauceda. Wrote home. Received mags from Stafford. Engaged a man at 35 dollars per month and all his board and traveling expenses free. His name is Steph. Nichols. Went in the afternoon on a road southward to the south line of Sec. 27 . Not far west of the ¼ post crossing 3 or 4 parallel undulating ridges which were all composed at the surface of drift, but Mr. Saxton asserts to have found on the north side of the second or third undulation outcrops of a dark trappoid rock which were distinctly in place andnot boulders.

Wednesday June 16. Went on road to Sturgeon Falls again. Rock outcrops in S.E.¼ of N.E.¼ of Sec.35, T. 39, R. 29. Outcrops trending from S.E. to N.W. Beginning on Menominee road southward. First a rock ridge about 300 feet wide consisting of massive diabase, then a drift covered depression 200 ft. wide. Then another parallel rock ridge about 150 ft. wide consisting on north side of a sub-schistose rock. See specimen 4. The body and south part is again massive diabase mottled. See specimen No.5.

Now crossing of valley of a little creek and ascent of another parallel rock ridge which is occupying the north part of the S.E.¼ of the section. We cross two other ridges of massive diabase. One is marked Specimen 6, two others 7. Still another rock ridge is between us and the river to which we now go across the depression. The rock composing it is the same as before, massive diorite or diabase with occasional stratified schistose seams mixed into it in irregular twisted manner. Specimens 8, 9 and 10 are from this knob but do not characterize the generality of the rock but only peculiar portions of it. The great bulk of dioritic rock resembles the previously collected specimens.

Returned to Wauceda the same road we came on. All is drift covered land as soon as we leave the before described rock belt and come to the road, which leads from the outcrops for more than a mile due east through the centre of the north half of Section 35 and 36. Thence turns **northeast**, crosses the outlet of a lake near the N E. corner of Sec. 31 and swings from there in an east of north course to near the ¼ post on the N. line of Sec. 29,which locality has been described on former occasion.

Thursday June 17. Went with canoeing equipments to the lumber camp in the N.W.¼ of the N.W.¼ of Sec. 6, T. 39, R. 25. Went to Dilse miner and struck from there across the woods towards the road from East Vulcan mine to Pine River. Waded across the river and went to farm in the east half of the southeast quarter of Sec.7,T.39 R. 25. From there by a road to N.W.¼ of N.W.¼ of Sec. 6, T. 39, R. 25. We camped in a loghut in this place which is about 400 steps east of the N.W. corner of the Sec. and 800 steps south.

All round granitic outcrops on the hill sides. In coming to this place from Sec.1 we passed first a high quartzite ridge with vertical strata striking from S.E. to N.W. Then all the other undulations with a similar strike consisted of granite but much of it is covered by drift.

Friday June 18. Went S.E. course from camp over granite hills. Intersected Black Creek at 1427 steps. From here we continue S.E. and strike for the S.E. corner of Sec. which we did not ascertain exactly but we found the line and went on it southward to Sturgeon River first, still across granite hills which have here a laminated gneissoid structure with a direction from southeast to northwest.

Then the undulations next to river are white quartzites with very distinct stratification, dip North of northeast, strike almost S.E. One seam of the quartzite is bright green. The section line after its intersection of the river passes right thro the camp from which I went at the first visit down to the Falls which are not quite a half a mile from the line.

The strata on the west side of Sturgeon river right under the falls strike N.E. to S.W. Dip N.W. There is an anticlinal position of the strata visible. The ones next to the base of falls dip N.W. and consist of granite and next on it the dioritic rock belt. Then upwards the falls again granite. Downstream next to the granite are stratified beds of a reddish granite-like rock 8 or 11 feet wide which contains a large proportion of magnetite and iron pyrites seemingly dipping under it. Then come arenaceo schistose beds, some 10 feet wide. Then a flesh red fine grained Feldspathic rock about 20 feet, then silky shining grey schists and under it arenaceous micaceous harder layers evidently schisty part of the silky shining schistose beds which seem to be a direct continuation of the silky schistose beds on the other side of the river.

All the named beds seem to dip under the granite on the west side of the river but there is an evident breach of the exact conformity near its junction with them. Going on farther down the stream the silky shining schists and arenaceous beds are seen to dip in opposite direction. The arenaceous rock gradually assumes upward the character of the ordinary quartzite which a few steps further is seen to overlie it regularly. Specimens collected on this trip are numbered; 7 is the magnetic ore bed, 6 is the Feldspathic rock under it, 5 are the silky shining schists beneath it and the arenaceous rock, 4 is the dioritic rock cropping out higher up on the slope of the hill next to granite, 3 is a green quartzite, 2 is white quartzite, 1 is gneissoid granite collected on our way to the falls. 8 is dioritic rock cropping out in the granite region near the bed of Black Creek in the S.W.¼ of the S.E.¼ of Sec.26, T. 39, R. 28.

The course of Black creek is very incorrectly marked on the Governments map. The conglomerate seen on the other side of the river in alternation with the silky schists is not noticeable on the west side of the river. The singular position of the stratified beds beneath the quartzite to the granite I am inclined to explain by a folding of the strata during the eruption of the granite about in the manner as delineated below.

Diagram

Saturday June 19. Went on west line of Sec. 6 to S.W. corner of it over granite hills for ¼ of a mile on the other side of the 16 post in a creek. The hills on its south side are quartzite. The corner is on the top of the south slope of the quartzite ridge. Below the precipitous side is a creek, a side tributary of Black Creek. Trend of quartzite S.E. to N.W. Dip vertical.

We followed the line southward, across the creek all undulating plateau without any outcrops. Struck Black Creek, crossed it near its south end followed the river up stream. The high hills in the north half of the south half of Sec. 7 are all quartzite, also the hills close to the river in S.E.¼ of the N.E.¼ of Sec. 7, but not the next hill row north of it which is granite. We followed a wood road with many flexions but pursuing a northern course on the east side of a small creek all over granite. Changing our course into a northwesterly near the south line of Sec. 6 we struck within the granite a large belt of dark hornblendic rock. See specimens. Soon after we crossed Black Creek and came home over the same road as yesterday. All granite of a gneissoid character.

Sunday June 20. Return to Wawcedah. Following the road to Vulcan mines. Train had left 10 minutes before our arrival. Had to wait for the evening train at 4 o'clock. Saw Mr. Saxtons testpits in N.W.¼ of N.W.¼ of Sec. 23, red and white mottled soapstone in pit near swamp. Ore belt must be further north under drift and Silurian sandrock.

Monday June 21. Started at noon with camping equipments for Felch Mount in. Wrote to Dr. Jones. Arrived in the evening at Holms Farm in the centre of Sec. 19, T. 40, R. 28. 9 miles distant from Waucedah. Found good quarters there. On the whole distance with excention of a few small granite outcrops no other rocks can be seen. it is a rounded drift covered hill country covered with heavy timber of hardwood mingled with pine. The road follows in its upper part the course of Sturgeon river.

Tuesday June 22. Left Holms camp at 7 in the morning. Followed a lumbering road winding along the south side of Sturgeon river. This road ends in the centre of Sec. 20, T. 41, R. 28 but by following the river a short distance further we met the iron road which comes from the Vulcan mines. We cross now the river and go due north with the road on the Sec. line between 17 and 18. Then intersect Sec. 6 diagonally and pass through the east part of Sec. 5 northward to Felch Mountain.

From Holms farm to crossing of the river we saw only in a few places granite, outcrops of small extent. All the remainder of the surface is formed by drift deposits and also across the river below Sec 19 and 20 no outcrops except large boulders of granite could be noticed. Descending from the drift covered high ridge on the east line of Sec. 18, I found testpits opened by Mr. Wolf of Chicago where ferruginous sandrock beds with intensely red color were uncovered in connection with a quartzite like rock. Dip of the uplifted but indistinctly observable ledges in the pits seems to be to the north.

We go further on through Sec. 8 and find all the surface covered with testpits most of which have uncovered beneath drift the horizontal ledges of Silurian sandstone. Descending the north slope of this undulating plateau land near the road and on its west side the testpits of Mr. Jacobs have struck the iron formation direct under a thin crust of Silurian sandrock ledges .

The ore bearing series dips under high angle to the north. The gradrock on top of it forms with the ore debris a conglomerate or breccia in which high graded darkish grey coloured ore fragments are very abundant. The ore resembles the harder portion of the Vulcan or any other mines of the south belt. Part of the ore is also softer, easily fusible. The associated leaner strata do not seem to differ much from the south iron belt. At the foot of the hill is a narrow swampy valley with a creek and across it granite knobs in dispersed isolated distribution rise directly from the edge of the swamp and continue to form the surface up northwards to near the Felch Mountain which is not a high mountain but a gently rounded drift ridge underlaid by the conformation.

The granite outcrops on the interval from Jacobs testpits to Felch mountain are frequent and large as the fire has destroyed all the forest on this part. The granite is mostly fine grained and of gneissoid well laminated often banded structure alternating with belts of gneissoid hornblende rock. Arrived at Coreys camp at ¼ of 4 o'clock and put up our camp, much fatigued from the journey.

Wednesday June 23. Inspected in the forenoon the different testpits on the location. Camp is very close to the N.E. corner post of Sec. 32. The principal testpits are west of the camp. The crest part of the hill is formed by a belt of blackish ferruginous quartzite laminated with seams of purer iron ore. It has a great thickness(150 to 200 feet thick) and dips in one place very distinctly to the north but in other places it is vertical or dips southward also.

Next north of this belt are the testpits with rich ore seams penetrated by brown or Siderite spar in great abundance, sometimes with fine crystals druses. The miners think this ore belt dips under the quartzite and believe the general dip of the strata to be south. On the south side of the black ferruginous quartzite is a large series of other schistose ferruginous rocks which contain some seams of good iron ore.

In the afternoon the foreman of the exploring party took me to the testpits south of the camp, led over the belt of quartzite which commences to rise above the ground a very few feet south of the testpits. The strata also here are dipping north or else are vertical and repose in apparent conformity directly on a large parallel mass of gneissoid hornblende rock which in other places is seen in alternation with granite belts. The contact of the two formations is fairly exposed on the south slope of the hill and no other rock beds are seen there intervening.

The outcrops of quartzite further east described this morning I thought were underlaid by ferruginous quartz schist but the exposures were not so plain and I may have been in error about that. The strata in the latter locality are much more disturbed and partially dip southwest, or possibly the strata are tilted over. See specimen of the gneissoid hornblende rock marked N E ¼ of Sec. 32.

Evening went to S.E.¼ of S.W.¼ of Sec. 20, T. 42, R. 28. Saw large granite outcrops of gneissoid structure alternating several times with large belts of gneissoid hornblende rock. Strike east and west. Seams of quartzite and seams of coarsely crystalline granite composed of large Feldspar crystals whitish mica blades and quarts run irregularly across the granite.

Thursday June 24. Started in the morning on a trail westward along the north line of Sec. 32 across 31. From there lost trail. Followed by compass the west direction. Struck another new trail leading to Flodens camp in the S.W. corner of Sec. 26 near S.W. corner of Sec. 31 large outcrops of Silurian sandstone on very high hill range,

On the way to Wheelers camp no more outcrops until we cross the river on the south section line about ¼ mile west of ¼ post. Quartzite outcrops at Wheelers camp. Many testpits, strata almost vertical but seemingly dip north. Lowest according this theory a compact whitish somewhat micaceous quartzite. On them to the north mica schists partly light colored, partly dark red colored by hematite. Further north a ferruginous argillaceous schist (soapstone) dark red and whitish mottled.

Friday June 25. Started from Wheelers camp. Struck bad water road ¼ of a mile from camp. Traveled over drift covered plateauland with here and there an outcrop of Silurian sandstone until we came near the west line of Sec. 36, T. 42, R. 29 to Woods exploring camp in pits south of road. Rich seams of iron ore are found imbedded within a massive compact quartzite strata. Dip north. The ore has quartzite for foot and hanging wall. North of quartzite are mica schists(quartzose) with large leaves of white mica. Connected with them are minutely scaly ferruginous mica schists in a number of various modifications uncovered.

By going further west on the road other testpits are found in Sec. 31, at the foot of a high ridge trending westward on north side of road which consists of quartzose-ferruginous schists inclosing narrow seams of ore in great abundance and are themselves very highly charged with martite and magnetite. The thickness of these ferruginous quartz schists is very considerable and their position seems to be above the micaceo-ferruginous beds.

The road enters Sec. 36 of the next township close to the ¼ post between Sec. 31 and 36. We took our dinner there at a clear creek with cool water. Met at Woods Camp with Mr. Duel and Mr. Wheeler. Went about 2 miles on road. Found large granite outcrops on road side about the places where the road crosses across Sec. 2 and 3 of T. 42, R. 30. In alternation with the granites are large belts of gneissoid hornblende rocks See specimen. Further on no more outcrops are seen on the roadside.

Arrive after tedious travel at Red Water village and camp on roadside. Much troubled with mosquitos so as to make my face swell.

Saturday June 26. Went from camp to outlet of creek. Found large outcrops of massive diorite on the Menominee river instead of chloritic schists as represented by Brooks. After breakfast went down to Quinnesec road to meet the stage. No outcrops seen on the way but near the Quinnesec road at Twin Falls schistose rocks in large rather massive exposures which might be termed chloritic but are very similar to the dioritic schistose rocks of Negaunee district.

Stage expenses to Quinnesec for two, 2 dollars. Dinner for 2, 1 dollar. Passed on the way to Quinnesec the different mines, Chapin mines and Keelridge mines but paid no further attention to them. Arrived at Quinnesec at noon. Rented a room for the 6th of July at 8 dollars per month. Went to Neucedah with the 3:40 train. Met with Armstrong, Duel and others. Paid Steph. Nickels 10 dollars. 5 days board to be calculated up to Monday June 28. 50 cts R.R. fare for man.

Sunday June 27. Remained at Neucedah.

Monday June 28. Moved to Quinnesec. Paid O'Connel 3 dollars room rent. Steph. Nickels pay suspended until he enters my service again. Went afternoon to Keelridge mine. 75 cts fare.

Next to the roadside in a well and in the excavations of the railroad soft fissile silky shining schists of light color are denuded and surface indications of similar schists on the south side of the ore belt could be perceived. On the whole interval from Quinnesec to the Keelridge mine their thickness is very considerable. Further northward on the hill their nature gradually changes, becomes more ferruginous and silicious unto we have entered the regular ore bearing rock belt of silicious schists of well laminated form.

These strata have in the mine a vertical position but the superficial portions are in places tilted over to the north or to the south side, and the miners say the vertical position of the layers changes in the bottom of their openings into a southern dip. The color of the ferruginous silicious schists in the mine is red, the alternating ore seams dark metallic grey. The continuation of the schistose beds north of the openings exposed in testpits is lead colored. Their nature is more argillaceo-micaceous than jaspery as the former were, but they are still richly impregnated with martite granules and often alternate with narrower rich seams of ore. The exposed thickness of the whole complex of described beds from the road to the top of the hill is not less than a thousand feet.

Near the top however Silurian sandrock covers the ore formation and between it and the top of the ore belt is a brecciated rock composed almost exclusively of rich ore fragments, part of them of the nature of specular slate ore. The cement of this breccia is evidently of Silurian origin and of arenaceous nature besides abundant seams of brown spar which fills also numerous druse cavities in the rock with fine well-formed crystals. Short distance northeast of this locality are the exposures of marble shown to me previously by Mr. Buel when we went over his exploring pits but no denudations of marble can be seen on the north side of the Keelridge hill, but the surface is full of large calcareous drift boulders belonging to the marble series of the Huronian formation. See specimens collected on this trip.

Tuesday June 29. Went along county road to Norway across Sec. 2 and 1 in T.39, R.30. Passed along a limestone ridge on the left and found near base of the rock bluffs some testpits with high-colored argillites calcareous argillites and cellulose quartzose rocks thrown out from them. See specimens.

On down line we turned north. Found ¼ post 900 steps north from county road. Passed over rolling hills covered by drift and found following a straight north course with the road no outcrop until we came into the south half of the S.E.¼ of Sec. 25 where a ridge of massive quartzite conglomerate strikes east and west. Little further we are at the exploring camp of Price (Pierce or Piece) of the Cambria Iron Co. The testpits after penetrating a number of feet of horizontal Silurian sandrock strike on a rich silurian ore breccia, but the Huronian ledges have not been found yet in the pits.

After dinner Mr. Piece ? led me in a southeasterly direction from his camp over the top of a high plateau whose southern rim is formed by precipitous cliffs of the Silurian sandrock which is there visibly not less than 700 feet in thickness. We descended over these cliffs to a valley which in one direction has its drainage to Pine Creek, in the other with the creek draining Lake Fumee. We found and followed a wood road leading to Pine Creek and passing near the N.E. corner of Sec. 30. Found light colored silky shining slates in loose fragments on the road which indicate the rock in situ below the soil crust of the surface. From section corner returned to camp and went home by the same road we came.

ednesday June 30. Went to Lake Dumee in N.E.¼ of Sec. 27 and in the north half of Sec. 26. A high drift covered ridge forms the north shore of the lake. The base of this ridge is all composed of ferruginous quartz schists with interbedded seams of high graded iron ore approaching specular ore in a very fine grained condition, sometimes also having the structure of a specular slate ore. The strata dip under a not very high angle from 45 degrees to 25 southwestward and disappear under the swamp.

The uppermost beds near the swamp are micaceo argillaceous more or less rich in ore. Some of them are on the cleavage planes covered with fine dendroid ramifications of infiltrated ferruginous matter. The lower beds are well laminated flaggy strata of quartzose character, richly impregnated with ore granules of metallic lustre. Some are thicker quartzite beds, dark colored by ore granules and argillaceous slaty beds of red color alternate with the harder flaggy and jasmery seams.

Higher up on the slope of the hill horizontal sandrock and Silurian ore breccias cap the Huronian strata. In one of the pits a calcareous red rock partly arenaceous and likewise of Silurian age is found capping the ore belt. Still higher up on the slope of the hill the drift deposits are very thick, and from 60 to 70 feet of them have to be dug out in the pits before the Huronian beds are reached.

No outcrops of any kind north or south of this ore belt. All is covered by drift. But this ore formation seems to continue in a northwesterly direction to the north side of Lake Antoine. In one place of the hypothetical western continuation of this ore belt very strong magnetic attractions are observable. A spot of this kind has been pointed out to me by Mr. Fitzgerald, an untiring explorer. The locality is 130 steps north of the fork of the road to Lake Antoine on the branch road leading to the head waters of Pine Creek. The needle on this spot points with its north end southward, and 10 or 15 steps further it returns again to its normal position. No outcrops there, all the surrounding surface deeply drift covered.

We went on this road northeastward to the centre of Sec. 15 without seeing any rock outcrops but found many large boulders of granite quartzite marble and iron ore on the surface. But in the northeast ¼ of the S.W.¼ of Sec. 15 by several exploring pits ferruginous argillaceo-micaceous slates and ferruginous quartz schists have been uncovered by removing a few feet of drift material. The quartz schists contain thin seams of specular ore. Similar strata I am informed by Mr. Fitzgerald which opened these pits are also found in the north part of Sec. 14. The dip is said to be north.

Thursday July 1. Went with construction train to switch leading to Woods mine on Lake Antoine. Followed the track laid out over rolling drift covered land with large boulders of granite, gneiss, quartzite, marble, Silurian sandstone and limestone. Woods mine is in the N.W.¼ of Sec. 21 on the slope of a very high drift covered ridge, touching with its base the Lake Antoine.

The strata dip in a southwesterly direction under a high angle away from the crest of the ridge. In the mine are about one hundred feet of strata exposed. Lowest are hard siliceo-ferruginous somewhat flaggy rocks which are more or less banded and on the one hand gradually become by preponderance of granular iron oxyd a siliceous iron ore, on the other hand by scarcity of the iron particles are more a quartzite rock. On this ore south of it as the strata are almost vertical is a belt of dark bluish black rather soft iron ore of not less than 20 or 30 feet in thickness, partly well laminated or more a friable mass or harder and approaching specular slate ore.

South of this are argillaceous and quartzose schists all impregnated with hematitic iron ore particles. Some are of slaty structure, others cleaving in very irregular angular lumps. Further south the mining captain tells me he found in exploring pits soft ferruginous slates and next on them a belt of dark sub-micaceous glassy quartzite, but these beds are covered with from 50 to 70 feet of drift.

About ¼ of a mile south from there is a low island in the lake which consists of a white silicious marble. All strata have a conformable dip southwards. On the higher part of the hill north of the mine red slates are said to be found, and further upward the horizontal Silurian sandstone forms the top part of the hill. Returned on the railroad track to Chapin mine which is on the south slope of a high ridge bordering the south side of Lake Antoine.

The mining is all underground and the strata can not be seen at the surface. A blackish blue soft ore of great purity occurs there in a large seam. Connected with it are arenaceo-argillaceous slates carrying a large proportion of iron. See specimens.

From here I went to Iron Mountain City. Took dinner. Afternoon went to Ludington mine in the S.E.¼ of Sec.25. Near the switch of railroad to it is a bulky mass of marble protruding from the swamp. I do not know whether it is loose or in place. The strata in Ludington mine are nearly vertical, strike about east and west with southern dip. Only about 75 or 100 feet are exposed. Silicio-ferruginous schists of variable red or greenish color and most all of the strata so rich in iron as to deserve the name of lean ores. The productive ore belt is about 5 or 10 feet thick. Consists of a soft bluish black glistening mass which is sometimes harder approaching to a specular slate ore, but most of it is a pulverulent or easily crushed mass. See specimens. The surface all around it and the mining location itself is deeply covered with boulder drift.

Afternoon went on railroad track east to creek which crosses railroad in Sec.33, T. 40, R. 30. Found outcrops of mica schists vertical. Strike east and west. The drift all along the railroad contains in the cuts a large quantity of such silky shining schists which evidently have their position above the ore belt of Quinnesec. Their thickness must be very great. Limestone outcrops north of Chapin mine. N.half of S.W.¼ of Sec. 30, T. 40, R.30. One large outcrop a little south and east of ¼ post on west line. Chapin ore belt is said to dip north.

Friday July 9. Went on a road leading by Dikys farm to Lake Antoine. Found on the right of range beyond Dikys several testpits all penetrating the Silurian sandrock and not yet through it, thence to shore of Lake Antoine which the road strikes not far south of the centre of Sec. 29. West from there close to Lake several testpits are opened in which beneath a stratified series of horizontal sandrock and ore conglomerate the red marble is struck with bed dipping north. On the brow of hill everywhere the Silurian sandrock ledges crop out.

At the west end of lake I took a road leading in S.E. direction to top of ridge. Passed ¼ post on south line of Sec. 29. Went from there leaving the road in S.E. direction looking out for limestone outcrops without success. Thence took a S.W. course and finally came out on the south slope of hill to a mining camp in Sec. 32, N.W.¼. From there by a road west passing over a hill spur to the left of the road called Iron Mountain.

The whole Hill is composed of a series of about 300 feet thickness of almost vertical beds of banded silicious iron ore. See specimens. Dip northward if deviating from the vertical. These beds appear to be a direct continuation of the ore belt of Ludington mine but the latter dips south.

The banded hem ores of Iron Mountain are also parallel with the ore belt of Chapin mine which is close west of it occupying a lower level and separated by a narrow depression from the Iron Mountain beds which however are according to the dip of the strata the next lower series of the formation. And further north in the testpits opened by Friedrich near the roadside red argillaceous schists are uncovered which must be the next lower bed to the Iron Mountain strata.

And south of all this series are the limestone outcrops in the swamp near the railroad track of which I made notice yesterday. The Captain of the mine informs me that further east from the limestone outcrop on(of) the railroad north of the Chapin mine another large outcrop of limestone forms quite prominent bluffs, but I could not find them in the timbered land with thick underbrush. The limestone at the railroad dips north.

The Chapin mine is described to me as consisting of a broad seam of soft bluish grey ore known to be over 30 feet wide without any intermixture of worthless material. The foot wall is formed bi silicious ferruginous schists which rest on the silicious mixed ore of Iron Mountain. North of the productuve seam of Chapin mine no explorations have been made. They found in drifting this way soft schists usually termed soapstone by the miner and went no further.

From Chapin mine revisited Keelridge mine. At the base of hill on northside of road the silky shining mica schists are well exposed in a testpit and on the railroad track. Their dip is vertical or north. Next above on hillside are red sub-micaceous argillites followed northward by a large succession of mixed silicious jaspery ores which contain the productive ore belt. But this belt is not only narrow but much intermingled with worthless silicious seams and the ore shipped is almost 1/3 worthless rock.

North of the ore belt similar silicio-ferruginous strata, some of grey instead of red color continue for several hundred feet to be exposed in testpits. Heavy drift masses cover the ore belt on the slope of the hill. On top the Silurian sandstone and its conglomerate layers cap it. The rich ore seams corresponding to the Chapin mine ore belt must be considerably further north of the presently mined seam in the Keelridge. The strike of the ore series is from E S.E. to W.N W. The dip of the surface portions of the ledges is decidedly northward evidently yielding to the pressure of their own weight. The deeper portions of the strata stand vertical and in the bottom of the mine indications of a gradual change into a northern dip seem to be perceptible.

Saturday July 3. Went to Hucodah and Vulcan mines. As informed by the man which dug the testpits on south shore of Lake Antoine that about 200 yards south of test pits with limestone in bottom he opened a pit in which he found under a cover of 35 feet of Silurian rock a 20 feet vein of ore dipping north.

Met with the Captain of the Quinnesec mine and was informed by him of the results of a diamond drill hole sunk north of the mines.

The drill went after going through some strata of Silurian sandrock into a quartzitic limerock for over 500 feet. Below it they found light colored soft so-called soapstone of not a very great thickness and then struck the regular red colored schsist of the ore bearing series. The entire depth of the boring in an oblique direction southward amounts to 750 feet.

At Naucedah visited Saxton's testpits with red and white mottled argillites having their position south of the ferruginous quartz schist of the ore belt. The strata of Emmet mine in their southern dip being in the deeper part almost vertical, favor the hypothesis of their being in an overturned position.

Went from Naucedah to Vulcan mines. Found in front of the quartzose schists of the ore belt again the red and white mottled argillites as in Saxtons testpits. The ore is taken from the quartz schists, forms a seam not over 10 feet wide and is interstratified with quartzose seams of lean ore. The superficial parts of the ore seam are purer and softer and are evidently a decomposed schist from which the silicious parts have been lixiviated.

In the west part of the mine a larger belt of soft very pure ore is mined which is at least 50 feet north of the other ore belt and is covered by well laminated slaty argillaceous rock beds of great thickness which underlie the first ore seam having only silicious strata for a hanging wall. The strata in the west part of the mine have a less inclined position and bend so as to be nearly horizontal in places or dip to the south under an angle from 20 to 30 degrees.

The Cary (Cory) mines are a continuation of this ore belt but the strata of its hanging wall are less argillaceous, more quartzose.

The abandoned shaft of Stephensons mine in the N.W.¼ of Sec. 9 is sunk into the ore belt close to a large ridge of marble and in the bottom of some pits after sinking through the ore bearing series the marble is struck. In this place no intermediate slaty beds are noticeable between the silicious schists of the ore series and the marble. Their contact is immediate. Still the dividing line is rather abrupt and no transitory rocks are observable.

These marble outcrop continue northwestward and directly join with the marble underlying the ore beds of Stephensons pits in Sec. 4 and those of the Norway mine. The dip of all the strata in these locations is conformably to the south, sometimes nearly vertical. In the Norway and Stephenson mines 3 or 4 different seams of ore are mined. I suppose also the Vulcan and Norway ore belt with the underlying marble must be in an over-tilted position.

At Norway met Mr. Wendel the proprietor of the land on which Norway village is built. He took me in his carriage on the Quinnesec road as far as the powderhouse of Mr. Armstrong near the testpits at the foot of the marble ridge. On the righthand side(north side) of the road are numerous testpits all along the high ridge trending eastward, in all the silicious lean ore belt is uncovered.

From the powderhouse we rode southward for about a mile over level sand plains until we reached the south edge of the plateau towards Menominee River directly north of Quinnesec Falls.

The slope of the plateau is formed by undulating lower east and west ridges generally covered by sand but in many places slaty schistose argillites with mica and arenaceous constituents, alternating with quartzose beds partly strongly tinged by iron crop out occupying a belt ¼ or ½ feet wide and frequently changing in litholo ical character by prevalence of argillaceous or quartzose constituents in one or the other of the beds although the general character of the whole complex is uniformly the same.

The strata are nearly vertical. The northern portion seems to have rather a southern dip. The southern rather a northern. From these outcrops the surface slants to the river bed which is not a great distance off and no outcrops are visible on this space until the dioritic rocks of the Falls come up to the surface. These arenaceous slates are undoubtedly the analogon(analogue) of the formation south of Lake Kaubury. Collected specimens from all these outcrops which are in Sec. 11, T. 3?, R. 30.

Sunday July 4. Went to the limestone bluffs west of outlet of Lake Puneo. The southern part of bluffs dips south.

Diagram

The thickness of this well laminated series is at least 500 feet. Then rises a higher rock ridge with an opposite dip. The limestone of this mass is not distinctly laminated in bulky blocks. Further north again the well laminated strata like the first occur with a vertical position and finally again with distinct southern dip. The swamp valley of Lake Puneo cuts the outcrops off which altogether are ½ mile in width but on the opposite side of swamp other limestone outcrops are visible. The trend of the formation is from S.E. to N.W. This is evidently a repetition of strata by folding.

Monday July 5. Walked to lower Quinnesec Falls. Strata nearly vertical with southern dip. Strike N.W. and S.E. At foot of falls a thick belt of very even bedded micaceous schists. No.1. Next to them on north side a belt around 90 or 100 feet in width of similar schists but in a highly corrugated condition and abounding in calcareous and partly silicious linear veins. A part of the schists is silky shining and delicately laminated. Other portions are more a compact mass. Next to it is a belt of crystalline diabase or diorite likewise full of spar veins and quartz veins with nests of chlorite. A part of the quarry rather by its rosy color seems to be dungun spar. The diabase is pretty sharply defined from the schists and connecting in a sort of tortuous course which causes me to suspect its intrusive nature. Diorite or diabase is numbered 5.

On the north side of the diabase are again schists identical with the corrugated schists on its south side. They form the top rock of the falls and seem to be continued in a broad belt in the river bed to the shore on the Wisconsin side where large exposures of similar schists are seen. The diorite belt is about 40 feet wide. According to the strike of the strata the high ridge striking the river below the falls must represent more southerly strata which are partly massive diabases, partly again schistose rocks similar to the former. The thickness of all the exposed series is very great but I have no idea to give its thickness in numbers of feet.

Returned to Quinnesec in the afternoon and saw the peculiar July 4th exhibitions of the villagers and hikers of the surrounding country which assembled in large crowds and gave me an idea of the number of people even spread over the woods in all directions. 3000 people present is not overestimated.

Tuesday July 6. Went with Mr. McMahon to Red Lake and Balch mountains. Followed road through east part of Sec. 19. Struck S.W. corner of Sec. 17, proceeded to the middle and went west to ¼ post on line between 17 and 16 first crossing the woods to 300 stens south of N.E. corner of 17. Granite outcrops there. Followed line south to ¼ post, all over granite from ¼ post eastward through middle of Sec. 16. In west part of 16 first descent into a swamp. Then ascent unto rolling land with granite knobs which continue to the creek near ¼ post between 15 and 16. We take dinner there.

Then travel in N.E. course across Sec. 15, 11, 12, over an endless repetition of chains of granite knobs higher and lower, all of a gneissoid character, well laminated and dipping northward. In most instances with the granite are belts of true gneiss, a large belt of a gneissoid puddingstone and gneissoid hornblende rocks in constant alternation. In one of the hills I notice a transverse augitic dyke cutting the granite. It divides in branches some of which are not wider than two inches.

Reach after great exertion through swamp and windfalls the camp in S.W.¼ of Sec. 31, T. 42, R. 29 where we are on the iron formation but the granite comes close up to the southern township line which runs parallel with a high drift covered ridge and occupies about its crest part. Brooks indicates at the swampy creek valley running through centre of Sec. 31 a limestone belt but I cannot discover a trace of it.

Wednesday July 7. Went per wagon eastward along road across Section 31, 32, 33, 34, 35, and 36. About ¼ of Sec. 36 we had to walk. West from there to the centre of the S.W.¼ of Sec. 31 in the next town. On all the way made by the wagon we saw no outcrops except a few testpits opened on Sec. 32 and small outcrops of Silurian sandrock in the south half of Sec. 36. The high plateau on which we are falls off at once 200 or 300 feet to the Sturgeon River.

The bluffs are vertical, consist of Silurian sandrock which amounts to over 100 feet in thickness. At the slope of the hill range particularly in the southwest ¼ of section 31 of Range 28 under the sandstones a large series of silicious lean ore beds of jasvery nature and with some seams of good ore besides layers of red micaceous argillite are exposed in testpits dipping regularly northward under high angle. The series uncovered amounts to 150 or 200 feet. No valuable ore seam has been struck.

A separate lower hill bordering Sturgeon river with a high vertical bluff of Silurian sandrock consists on its north side all of the silicious lean ores directly opposite the sandrock bluff. I subsequently ascended on the return trip this high ridge capped with Silurian rocks and found the slope of the hill for its whole length westward composed of the silicious ore formation with some rich but narrow seams of ore which is overlaid by a rather soft white or red Potsdam sandrock and the higher portions standing out in vertical bluffs I found to be composed of a dolomite with traces of fossils. The dolomite is from 60 to 80 feet thick in well stratified somewhat weathered horizontal layers. The top of this ridge is a plateau which with few interruptions by ravines and by the channel of Sturgeon river extends far westward.

To the north of the road going through the centre of Sec. 31 where Mr. McMahons camp is, a high ridge covered on the summit with sandrock consists on the south slope of the silicious formation(iron). strata dip north. The beds highest up on the hill are a thick bedded ferruginous quartzite forming a large belt.

These strata as far as I could notice seem to dip southward contrary to the thinner bedded layer down the hill. With the hard silicious iron rocks occur on the basal part of hill also micaceous argillites red colored by hematites in the N W ¼ of the S.E.¼ of Sec. 31, T. 41, R. 30 at the close of the mentioned ridge of iron bearing rocks.

A separate small knob projects which I found composed of a white crystalline limestone in well stratified vertically standing layers running parallel with the other formation. The outcrop is about 100 feet long and a series of about 30 feet of rock beds exposed. Merely separated by the narrow creek bed is a gneissoid hornblende rock and further south large granite outcrops.

Diagram.

Thursday July 8. Went from camp north over the iron bearing quartz schists and heavier quartzite beds which as I recognize now plainly all have a northern dip and extend from the bottom of the valley to the top of the ridge. The top is a plateau sloping northward which is covered with a thick series of Silurian fossiliferous limestones or dolomites resting on horizontal sandstone layers. This Silurian series covers all the surface for ½ mile north of the section line of Sec. 31 and no gneiss outcrops as indicated by Brooks can be seen.

In testpits running northward over the hill the Silurian rocks are well denuded. Return to road . Several testpits in S.W.¼ of Sec. 31 have struck promising seams of ore in the pits near the creek running west passing the ¼ post on west line of Sec. 31 at which place also the road intersects the line.

In testpits situated in the N.E. corner of the S.E.¼ of Sec. 36, T. 42, R. 30 Huronian limestone in a vertical position is laid open in test pits very few feet below the surface. See specimens. North of the testpits on the other side of the road are others in which the silicious beds of the ore formation were found partly next to the surface, partly covered by horizontal sandstone.

Returned to Quinnesec in the afternoon without seeing any outcrops on the road while it passes through the west part of 36 and Sec. 1 of the next southern township. In 2 and 3 are large granite outcrops. Further on no more rocks can be seen until we reach the Menominee at Red water.

Friday July 9. Went with Buel to Sec. 33, T. 40, R. 30, S.E ¼ of S.E.¼. On Dikeys place good exposures of Huron limestone with alternating slate seams of silky lustre. Strike north of west to south of east, southward dip. The limestone is found in many testpits west of this locality usually covered by horizontal sandstone layers and silurian ore conglomerates. But north of the limestone and in close proximity to it rich conglomeratic ore deposits are found at the base of horizontal sandrock ledges penetrated in pits and seen in natural outcrops. In a few of the pits under this ore conglomerate the ore formation with very rich seams of ore is uncovered. The strata dip to the north as far as can be seen and north of these testpits the Silurian sandstone overlying the ore belt becomes very thick, over 40 feet in some places explored.

In the afternoon went again to Sec. 33 and 28. Found the limestones noticed in the morning at Dikeys place to continue in a W.N.W. direction forming a row of outcrops with steep bluffs through the south half of Sec. 33.

The limestone is either vertical or else dips south. Most southerly is a belt 200 feet thick which deserves rather the name of a quartzite and contains scarcely any lime. Next north of it is an equally thick or thicker belt of well stratified silicious limestones. The quartzose and limey substratsions are usually separated by a small depression. This lime formation strikes after intersection of 33 through the north part of Sec. 32 in a direction that would cross the north side of Keelridge mine and the south side of Chapin mine.

Going southward from this limestone ridge about 300 steps west of the east section line of Sec. 32 a row of lower hills runs parallel with the limestone ridge which is composed of the Iron formation dipping north. Most northerly are silicious lean ores. Furthest south are ferruginous argillites mottled with white blotches of argillite, all dipping north and making transition to the micaceous slates cropping out in the plains toward the Menominee river. This ore belt is about 600 to 800 feet wide and its direct continuation are the Keelridge mines.

Going northward from the described limestone bluffs we find on a sort of terrace land a narrow seam of outcrops of the Iron formation which is laid open by Duel's exploring pits. These strata dip also north but seem to form the crest elevation of the iron bearing rocks as right above them to the north are heavy deposits of Silurian sandrock which by boring experiments are proved to become thicker and thicker the further you go north in the ridge which ascends still higher and higher.

This ore belt is as it seems the direct continuation of the Quinnesec mines and of the Chapin mines ore belt, while the southern ore belt belongs to the Keelridge deposits. An ideal cross section through this mountain body would be about so.From outcrops and testpits of iron formation to the county road 200 steps south.

Diagram

Saturday July 10. Went with Mr. Prey to testpits in Sec. 17, T. 40, R. 30.Passed on road to Lake Antoine near the creek crossing it ¼ of a mile north of Quinnesec a limited outcrop of limestone and micaceo-calcareous schists dipping north. Saw test pits in Sec. 21 close to west line which go through 30 feet of sandrock and through a rich silurian or breccia beneath. Still lower a limestone breccia occurs and as it is believed the solid limestone formation is struck.

Woods mine adjoining is in Sec 20 and not as I formerly believed in 21. A test pit on Woods mine not over 20 feet north of the productive ore belt and about 150 feet west of the mining pit is sunk in a silicious specular slate ore, the same which I afterwards found in Duels test pits in Sec. 17.

Kimberlin's exploring pits are inthe S W ¼ of Sec. 17, T. 40, R. 30. Those worked at present are the most northerly and are situated in the south half of the S.W.¼. Horizontal Silurian sandstone from 20 to 30 feet thickness is first penetrated.The lower portion is a rich ore breccia. Under this is a thick stratum of a soft hematite ore partially of grape ore structure and mingled with a small proportion of streaks of sandrock.Under it is a ferruginous argillite in horizontal beds. As it appears all these strata have therefore to be considered as Silurian. Regular Huronian strata are not reached by these testpits.

South of these ponds as down to the south line of the section is a row of testpits opened by Ingol. In the most northerly ones specular siliceous slate ore is found which forms a very thick belt but contains as far as exploring pits show no pure seams of the specular ore, but the mixed siliceous ore carries a high percentage of iron. The strata dip south.

Further south the mixed ore belt gradually changes into an arenaceous banded argillite tinged with hematite or by a specular iron ore of a bluish grey color, and forming a transitory form between flagstones and slate. Die south. Beyond the Sec. line[2] no[3] more testpits are seen but in Sec. 12 and 13 several have been opened by Frederik north of Loon Lake in which the same or similar slaty and flaggy argillites are found as in the southern pits of Ingol. These are beyond doubt the upper beds of the Iron formation.

A broad depression extends from Lake Antoine northwestward directed towards the Twin Falls of Menominee River. But the iron formation composing the north side of this depression is not visible in the hills near the river which are deeply drift covered or are composed of dioritic rocks. Diorite is also reported to be as occurring in the bottom of testpits sunk a mile north of Kimberlins testpits in Sec.6.

Sunday July 11. Remained at Quinnesec writing letters. Paid hotel bill.

Monday July 12. Went with Mr. Fitzgerald on road to Merriman's camp No. 6 in the N.E. corner of Sec. 14, T. 40, R. 30 close to the entrance of a creek into Pine Creek. On the south side of this tributary flowing eastward a quartzite crest striking in the usual N.W. and S.E. direction and having an almost vertical position is noticeable between the creek bed and the road. The quartzite disappears eastward under the drift and also on the hills on west side of the creek no more outcrops can be seen.

This quartzite identical in appearance with the Sturgeon River quartzites incloses a seam of sparry carbonate of iron but of no practical value. Short distance southwest from the outcrop the road crosses over a belt of hard dark grey mica schist but there are no good outcrops. It is only indicated by angular slabs abundantly mingled with the drift.

In the hill slope at Merriman's camp the drift incloses a very large number of big angular blocks of a micaceous sparry limestone evidently belonging to the Huronian limestone series and as it appears very near to the formation in a solid belt.

The valley of Pine Creek is a bottom land about ½ a mile wide. Lumbermen have built a substantial dam across the creek. The section corner is on north side of creek not far from the dam. From said N.E. corner of Sec. 14 a road leads to the quarter post between 12 and 13 at which place I struck hi h quartzite bluffs of a massive character and of which the dip id not well to be determined, but it seems to be to the south. This quartzite ridge has the usual northwest strike and continues as a high hill chain to the north corners of Sec. 2 and 3 of the same town where it intersects Pine Creek. A high hill visible in the northeast corner of Sec. 11 is described to me as consisting of granite rock.

I returned the way I came on and Mr. Fitzgerald pointed out to me a diorite ridge striking westward through the north line of Sec. 14 in part and from there thro the north part of 15,16,and 17 connecting with the diorite outcrops at Twin Falls. See specimens.

The foreman of the camp informs me that the quartzite outcrops crossing Pine Creek going east at the north corner of Sec. 2 and 3 inclose seams of red ferruginous slate.

Tuesday July 13. Went with canoe to Upper Quinnesec Falls. Landed about 200 ft. below the falls on Wisconsin side. Strike of formations N.W. to S.E. Dip apparently south but almost vertical at the landing and for some distance below. Outcrops of a large series of schists with interpolated massive belts of diabase not strictly defined from the schistose rocks, partly in a corrugated condition and full of narrow seams of calcspar and quartz. Thickness several hundred feet next upwards the river but below the falls is a 50 feet wide belt of even bedded so-called sericite schists (Wisconsin survey) which are seen to be continued on the Michigan side. Then comes a very wide belt of diabase which forms the falls. Above are many seams of micaceous schists interstratified with the diabase, the whole belt amounts to about 700 feet.

Further up the outcrops are for awhile interrupted but here and there schistose strata come to the surface which compose some small islands and form rapids a half mile above the falls are other more considerable rapids formed by large outcrops of mica schists with interlaminated lenticular masses of quartz and also sparry veins. These mica schist are very well stratified. Dip south and amount to about 300 or 400 feet in thickness. They rest immediately on a coarsely crystalline white and green specked massive diabase which composes a high ridge south of the Menominee River and north of a creek which enters it close below the said rapids running over the mica schists. In this diabase belt are also seams of granitic characters. See specimens. Further south on the south side of creek the hills are drift covered but may be composed beneath the drift of the granite described by Brooks as sub-div.20. Returned to Quinnesec.

Wednesday July 14. Settled up with Nickels and dismissed him. Paid him 15 dollars on balance due him. Afternoon went to testpits on Sec. 27 and the south part of Sec. 22 near Lake Fumee. Searched for outcrops on the hight and slope of the sand hills without success. Came down through a ravine northeast of the camp directly north of the long testpits opened at the base of the hills near swamp.

First I met with a limited natural outcrop of a reddish flinty quartzite which I suppose represents the upper horizon of the limestone formation. Short distance below are testpits in which a light colored micaceous quartzite cleaving with irregular rhomboidal fracture but I could not ascertain its dip. With it are nodular seams of granular spar mixed with quartzite crystals and with much sparry carbonate of iron of a brown color and partially transformed into hydrated oxyd. Other pits close by have in their bottom the same rock.

Pits little lower down on the same line expose well stratified argillaceo-ferruginous quartz schist variegated by lighter and darker colored lineations. They contain an abundance of octahedric iron oxyd. Still lower down are softer slaty rocks of micaceo-arenaceous character and tinged red by iron oxyd. Still lower are the mixed quartzose lean ore strata formerly described dipping clearly south as the before mentioned slates do. Other slaty beds with dendritic efflorescences on their plains of stratification are connected with the siliceous lean ore belt. In this case the limestone formation appears to be plainly at the base of the ore formation and the transitory gradual change of the rock in the different succeeding pits seems to be confirmatory of this fact.

Thursday July 15. Went with construction train to switch for Woods mine. Followed the main track northwest into Sec. 24, T. 40, R. 31 where are reaching Bass Lake the road bed cuts through a belt of slate and quartz schists 200 feet wide. Strike of strata N.W. to S.E. Dip vertical or very little to the south. The silky shining dark lead-colored slate here is interlaminated with narrow quartzose seams and thicker seams of quartzite are particularly noticed in frequent repetition in the south part of the cut. The northern portion is more exclusively slaty but the last beds seen at north end of cut are chloritic and ferruginous-arenaceous slates. See specimens from this place.

Went from here on railroad track up to Bass Lake. All surface covered with well stratified drift sand. No outcrops. Returned to the limestone outcrop on the east side of railroad close to the branch road for Ludington mine. Following this road the limestone is well denuded in the ditches of the road in a belt about 60 feet wide, dipping north as it appears and striking in the usual N.W. and S.E. direction. Going higher up on the road the limestone is hidden by boulder drift.

At the Ludington mine in the most northerly testpits a quartzite which is probably a subordinate member of the limestone formation is uncovered. Its dip cannot be seen. Higher up the hill in the same line of strike variegated slate is thrown out of a pit. South about 50 steps is the ore belt of Ludington mine, a quartz schist with ore seams. Part of the strata is also more argillaceous than quartzose and carries much granular specular ore.

The strata in the mine are vertical and if a dip to any side exists it is to the south. The limestone formation and variegated argillites resemble those seen yesterday. At Lake Fumee testpits are identical and are no doubt underlying the ore belt.

After dinner went again to Ludington mine. The Captain of the mine tells me the dip of the ore belt is rather to the north than to the south. Went west on top of hill but found no outcrop. The different testpits found there generally have not penetrated the Silurian sandstone which covers the top. From there went down to limestone outcrop on railroad and followed the strike of the outcropping ledges. They disappear first in a swamp but ascending the slope of the high hills in the north half of Sec. 30, I found large limestone outcrops and some testpits on their north side, but they did not uncover any rock ledges.

The limestone outcrops are best found by starting north from the middle shaft of the Chapin mine following a trail cut out for indication of a subdivision line until we come to a small clearing opening in the beginning of the side trail for the ore cars. The red colored water from the mining pumps here there its efflux to the creek. From there 200 steps due north on the continuation of the trail and then on another trail 340 steps northeast when the limestone bluffs are found on the righthand side and the testpits on the left hand on low ground. The marble bluffs are in fine hardwood land and 50 feet higher the horizontal Silurian sandstones cover them. The limestones stands vertical.

The strata of mixed ore belt at Iron Mountain are so nearly vertical that little importance can be placed in the observation of their northern dip.
Expenses 75 cts. Specimens 1 dollar.

Friday July 16. Went with railroad to Dillons Camp. From there followed trail winding along the hill side bordering Sturgeon river valley.

As stated before in the testpits close to [illegible] soft red slates of considerable thickness are exposed further north. The jaspery [illegible] belt follows in which Mr Dibbs [illegible] a good belt of soft blue ore is found. Further north for ¼ of a mile the ore belt of jaspery beds continues and is exposed in many testpits until we come close to the limestone. The strata are vertical. The limestone is also nearly vertical and dips south, forms a belt about 100 feet thick, strikes in east direction across the river south of the mouth of the creek. The interval to the creek is all deeply drift covered. Briens testpits are sunk in this area and north side of Paint Creek, little distance from Sturgeon and in sight of the mines on other side of the river, not far east of section line.

Follow river upward for not quite ¼ mile from camp when high quartzite bluffs rise to the left side which I mount and find composed of the typical rock of the great quartzite formation. After crossing this ridge by going north meet with another ridge of quartzite, well stratified, striking north of west and dipping northward. Follow a lumbering road in northern direction, crossing this quartzite belt after which the next ridge is granite.

The granite continues from here for a long distance northward, thence take an eastern course never leaving the quartzite formation. Finally come out on Sturgeon River near a bridge which is destroyed and near an old camp. Here large belts of diorite are found interstratified with the granite, also gneissoid seams occur.

Follow river downwards. Find a large augitic dyke in granite differing from the dioritic rock. Lower down the diorite forms again a broad belt which at the surface is in decomposed condition, easily crushed with the hand into a sand mass. Collected specimens of this diorite. Then waded across river and walked down to the falls. The granite has here a decidedly northern dip (where I crossed above the falls.)

At the falls everything is so irregularly dislocated that it is difficult to see the true order of things. There are still frequent alternations of diorite with the granite at the falls. I collected various rocks numbering those next to the granite 1. A black micaceous schist forms a belt in close contiguity with the granite. Next to it are schists micaceo-feldspathic gradating changing into true granitic rock of red color. Next to it is a black hard rock weathering with very ragged cavernous surface. Then come silicious schists of grey color containing an abundance of calc-spar seams. Then a compact granular rock with much pyrites and crystalline fracture. Lower down at the end of the falls are large belts of schists with several conglomerate seams and an even bedded silicious rock of which I did this time not collect any specimens as I had done so before.

The strata on the other side do not correspond with those on this side and as granite forms there also large walls the sedimentary beds appear wedged in between the granite of the schistose beds. As I recollect this moment I collected one specimen with very distinct ripple marks.

The large quartzite formation lower down the river forming a range of [illegible] north towards the granite as previously stated. I never saw one instance in which the quartzite laid conformably on the granite. From the end of the quartzite range no more rock outcrops can be seen on the south side of Sturgeon River. The hills are all deeply covered with drift.

At the mining camp on north side of river in Sec. 7 since my last visit explorations have been continued but without success. The exploration has been restricted altogether to a very rich silicious specular ore belt and the mining company made the erroneous impression as if the strata would become wider the further they go, pertinaciously sinks in the same pits instead of cross cutting the formation and sinking pits north and south from the other testpits and shafts. The strata of the ore formation correspond fully with the silicious or jaspery lean ores of the Vulcan and other mines. Their position is nearly vertical with slight southward dip.

Brien's testpits on other side of river have not yet gone through the drift which may be very deep as in the river bed. In the strike of the ore belt no trace of rock comes to an outcrop.

Saturday July 17. Returned to Quinnesec about the same way I came. Examined some dioritic schists and slate outcrops near railroad on centre of Sec. 14. See specimens, and went at Vulcan mines to the drill hole with diamond drill. The boring commences in a light colored arenaceous rock next the footwall of the old mining pits and is sunk in oblique direction about 350 feet. Cores show all that thickness a silicious iron bearing banded schist. About 300 steps north of the diamond drill is a deep exploring shaft sunk through horizontal sandstones and under it light white and red variegated argillites of great thickness are struck in connection with quartzose seams and dark greenish colored easy weathering silicious argillites. Dip of strata south.

Sunday July 18. With train to Norway and Cyclops. Cyclops dip south. Uppermost red argillites seen about 100 feet. Under it a belt of soft grey ore about from 25 to 35 feet wide evidently much twisted by the uplift. The strata are partly vertical in the bottom of the mine. The footwall of ore are a few feet of arenaceous schist very rich in ore granules and a greenish argillite very brittle and easily decomposing into small angular fragments. At the east end of the pit the Silurian sandrock overlies the ore belt.

Diagram

Further east hard jaspery beds mixed with fine grained hard ore seem to form the next underlying belt but further on apparently north of this jaspery seam is a belt of very fine soft ore mined which has a brecciated fragmentary structure and may be a seam of Silurian age deposited in the clefts of the surface by washing over the then exposed ore seams. This ore is dark lead colored , perfectly soft and at all events a product of decomposition of the original ore bearing strata.

Coming to the Norway mines. I see no interruption of the beds between Cyclops and Norway only the Norway beds are a lower series more composed of jaspery beds than of argillaceous. The formation is very much crushed and a part of the ore and jaspery schists are cemented into a hard breccia of great thickness filling out all the fissures and inequalities of the Huronian surface, and overlaid by the horizontal sandstone which here on top of the hill is much over 100 feet thick.

The ore formation all along the Norway, Stephenson and Saginaw mines rests directly on the silicious beds of the limestone formation which next under the ore are in a clearly and brecciated condition..

Further north purer limestone beds occur. All dip south like the ore from the Norway mine. Northward after crossing the limestone belt and going down towards the swamp one descends over the sandrock and soon is on Huronian slates of silky lustre partly deep red colored by iron oxid, partly mixed with more or less arenaceous material. These slates are at the surface crushed into a disorderly rubbish. But in a trench dug for an acqueduct and in a deep shaft in the swamp, the strata are well exposed and form a series of at least 400 to 500 feet. From the limestone belt to the shaft these slates underlie evidently the limestones and resemble much the variegated and red slate next on top of the ore formation.

East of Stephensons another company is sinking at present a shaft right through the silicious beds of the limestone formation, while any ore beds to be sought for are at least 100 or 200 feet south of that place. The limestone belt extending from Cory's mines forms an angle with the limestone of Saginaw and Norway mine but is seemingly in direct continuity with it.

Diagram

Afternoon went with Mr. Roos to Corey's testpits in Sec. 6. The ore formation occupies the south slope of the range almost close down to the sand cut of the railroad. Its ledges are found denuded in testpits in Sec. 6. The lowest testpits near the road to Quinnesec are in jaspery lean ore belt. Higher up the hillside a light colored sandy argillite containing scarcely any iron forms the base of the ore formation and still further north all the testpits on the summit of the ridge strike the cherty portion of the limestone formation beneath a heavy deposit of Silurian sandrock which is partly in its lowest beds a rich ore breccia.

On the north slope of the ridge under the sandrock in the testpits soft light colored slates are brought up which are identical with those uncovered north of the limestone belt at the Norway mines. Paid hotel bill Monday morning in full.

Monday July 19. Went with train to Norway accompanied by Mr. Elsworth and Capt. Pray. Went to see the section across the limestone formation north of the Norway mines. Followed down to shaft in which the underlying slates become very well exposed. Thence followed the road to the slaughter house which is situated on the creek in the N.E.¼ of the N.E.¼ of Sec. 5, T. 39, R. 29. Testpits close to the slaughter house expose the same slates and after crossing creek in the south part of the S.E.¼ of Sec. 32, T. 40, R. 29 similar exposures can be found.

Going north from there a succession of exploring pits has uncovered silicious iron ore belts in alternation with arenaceous slates of various modifications and of dark iron colored quartzite ledges. Further north again ferruginous slates and dark black colored graphitic slates follow in regular succession, this whole conformable series of rock beds, which all dip regularly south under high angle. In the north part of the south half of Sec. 32 the outcrops are interrupted by a creek and swamp valley running across the section.

North of this creek the surface rises again abruptly and we find ourselves in front of limestone bluffs extending as a ridge east and west as far as we can see. The limestone is partly of a breccia character, partly also highly quartzose with inclosed quartzite fragments resembling the quartzite of the great quartzite formation.

This limestone forms in different rows of cliffs a belt almost ¼ of a mile wide thence nearthe north line of Sec. 30 the swampy valley of Pine Creek he ins in which we went for a good distance northeastward before we struck high lands a mile in the S.W. part of Sec. 29, but no outcrops . We followed through Sec. 30 the north shore of a hill range which probably is composed of the continuation of the last named limestone ridge but we see only boulder drift on the surface.

We keep the N.W. course until we strike the road which crosses Sec. 30 diagonally from near the S.W. corner to its N.E. corner. Thence we followed road southwestwards to old camp of Coreys. Left my cadi there and went to Mr. Piece's camp for dinner. From there returned to witnessed by the road, passing by several testpits which only went deep enough to strike the Silurian sandstone.

Also in the testpits in Sec. 25 of Pieces superintendence only the sandrock and underlying ore conglomerates was struck. The limestone outcrops however all around the pits so nearly that every one of the pits would strike limestone if sunk to a greater depth.

Tuesday July 20. Went to Lake Wabbery outcrops on south shore. Slate about 60 ft. with interstratified seams of quartzite. Specimen No..1. Above rather massive schistose rock about 200 feet. Specimens No. 2. Next above Lard slaty ledges No. 3 and 4, about 100 feet. Next above hard silky shining slate rock No. 5 and 6. This series forms the first hill elevation . South of it is a broad depression and other slaty and quartzose rock beds amounting to great thickness are exposed of which I did on this occasion collect no specimens. See specimens collected on my first visit of(to) this locality. The dip of the previously described beds is southward, a part of the rock is in vertical position.

From here I went with Mr. Elsworth on road from Vulcan mines to the bridge crossing Pine Creek and thence took a northeasterly course over drift covered hills. Came to a large lumber camp on Pine Creek at the entrance of a small creek from the east which extends with its mouth into a small lake. Passed this creek and followed the Pine Creek upwards.

The hills on right side of us are granites with a large diorite outcrop in connection . The granite bluffs follow the creek upwards the river unto a large creek enters it from the N.E. Further on granites continue in high bluffs on east side of creek unto about the ¼ post of the north line of Sec. 34, or some distance south of it Thence a high crest of vertical ledges of quartzite sets in between the creek and the quartzite and follows the creek for quite a long distance and the rock indicates to the north ¼ post of Sec. 28.

I left the quartzite ridge about ½ of a mile west of the N.E. corner of Sec. 33 and took a south course. first across swampy valley, then over undulating ridges but without seeing any rock outcrops at all. I changed my course after 2 miles walk into a southeast course and finally came out on the Vulcan road near an old lumber camp in S.E.¼ of Sec. 4. From there to Norway station and home by railroad.

Wednesday July 21. Went with construction train to Menominee river. A belt of schistose diorites striking N.N.W. crosses the river at the bridge. Follow the river upwards. The schists and diorites dipping south are exposed all along the river unto the first small creek enters it from the south side. See specimens.

From the creek upwards to another larger creek the high bluffs bordering the river are entirely composed of drift deposits. Also above the creek to the base of the lower twin falls all is covered by drift. Then schistose rocks interstratified with massive dioritic seams which are not clearly defined from the schistose rock come to the surface and form a belt of 6 or 700 feet thickness which the river breaks through and forms the falls. The strata still have a southern dip.

Above the falls the rock disappears again for almost ½ mile when below the bridge crossing the river and below the upper Twin Falls schistose and dioritic rocks of the same character as the former come out in a very broad belt which ends above the upper falls. The strike of the formation is here more east and west and the dip north as far as the nearly vertical position of the strata allows a determination. The massive rock prevails at the upper falls over the schistose but is not defined from it and constitutes only a further advanced metamorphosis. See specimens

From the bridge I returned. Took the old road to Quinnesec which passes between Moon Lake and another small lake. On the way about half a mile east of Moon Lake I crossed a ridge situated in the centre or in the north half of Sec. 18 composed of diorite(schistose also previously near the north section line of Sec.12).

I crossed a dioritic belt striking E.S.E. Further on no more outcrops can be seen excepting some testoits on the north side of Moon Lake in which the slates of the iron formation are struck. The slate belt exposed in the railroad cut described previously strikes a good distance southward of Moon Lake but nothing of it can be seen there.

Thursday July 2d. Went with Mr. Brotherton to Pine Creek. Camped on the north side of creek in the N E ¼ of the N W.¼ of Sec. 11, T. 40, R. 30, a short distance from the south quarterpost of Sec. 2.

After dinner went on road north to foot of diorite and granite bluffs which are 100 steps north of ¼ post of Sec. 2 and 200 steps east of it. See specimens. From here took a northwesterly direction. The bluffs continue to our right but recede northward from our course. Found a very high bluff of gneissoid hornblende rock in the centre of N E ¼ of the S.W.¼ of Sec. 2. The granite outcrops continue from there in a N.W. direction. On our course we passed in the S.W.¼ of the N.W.¼ over a hill with large bluffs of quartzite apparently with northwestern dip. North of this hill the granite range continues in a higher ridge than the quartzite hills.

We cross the swampy valley of the creek and ascend another high ridge which is most composed of Silurian sandrock of a quartzite-like hardness but porous and under it the quartzites seem to come to the surface. But I am not quite certain about the nature of the rock, it is too porous for the quartzite formation. The location of these hills is about on the south line of Sec. 36. T. 41, R. 30. The corner is not to be found.

From here we follow the east and west line of the Township 41 eastward, cross the creek and ascend a high granite hill. We follow the line until the south ¼ post of Sec. 31, T. 41, R. 29 and return to camp in a south direction first, thence winding eastward. We strike in this course the before mentioned quartzite ridge again at the same spot where we had passed it. From these outcrops to camp we followed the top of the bluffs on north side of creek downwards but all of them are composed of drift and no outcrops whatever seen.

Friday July 23. Went from camp to West line of Sec. 2 at ¼ post followed line north for 700 steps when we came on the quartzite bluffs which we had seen the day before. At location into the S.W. ¼ of N.W.¼. From here we crossed the creek striking N.E. for the N.W. corner of Sec. 3 which is on the northern decline of a high hill with broad glaciated summit, all from base to top deeply drift covered. From here we strike southwest for a lake intersected by the west line of Sec. 3 over a broken country with no outcrops, all being covered with drift and sometimes with large granite and quartzite boulders.

At lake took dinner and went from there for the S.E. corner of Sec.7 over a similar drift covered hill country as before. Near the southeast corner of 7 the diorite forms low outcrops north of the head of the creek. See specimens. We go ¼ of a mile north of the south line of Sec. 7 and west in this direction eastwards to the west line of Sec. 18. No further outcrops seen. From here we take a northeast course and strike for our camp without seeing any more rock.

Saturday July 24. Went from camp east 700 steps and found a hill of quartzite with vertical dip. Strike southeast. Crossed swampy valley of a creek found on the other side, the quartzite again forming a very high ridge with vertical ledges amounting to not less than 800 feet in thickness. Strike the same as before. This ridge continues and passes near the ¼ post between Sec. 17 and 13 southward along the creek. Between the ridge and the creek are lower drift covered hill lands and behind the quartzite ridge the granitic outcrops seen at the northeast corner of Sec. 11 appear to continue southeastward parallel with the quartzite ridge.

At Herrimans camp examined again the limestone blocks in a drift pit southeast of the camp and found the actual ledges in the bottom of the pit. Then went west of the camp along the creek following the section line between 11 and 14 and found 400 steps north of the quarter post a large outcrop of this micaceous crystalline limestone.

The formerly examined quartzite belt striking this same creek from the east side is only a short interval apart from the limestones, further upwards the stream but I have not measured the distance. I am now inclined to consider this quartzite belt about 60 or 80 feet wide as belonging to the limestone as a subordinate limit and not to represent the large quartzite formation north of Pine Creek.

After leaving the quartzite outcrops and following the road towards Quinnesec, we soon find in the roadbed and in the soil of the hill side an abundance of a hard fine grained silky shining grey slate rock wringing under the hammer and splitting into rhomboidal columnar fragments which seems to compose a broad belt next to the quartzite. Further on softer ferruginous slates and porous cellulose quartzites are found in test pits situated in the N.W.¼ of the S.W.¼ of Sec. 15.

Sunday July 25. Went to Sturgeon Falls of the Menominee in company of Mr. Alward, not Elsworth. Examined the outcrops of ferruginous-silicious slate mentioned by Brooks in the Wisconsin reports in centre of Sec. 26, T. 39, R. 29. From there returned to the Menominee road and followed it for short distance when I noticed on the west side of it a small knob of a dioritic rock, partly coarsely crystalline, partly fine grained and evidently corrugated and contorted like a semi-fluid mass of eruptive origin. Its position is in E. part of the S.W.¼ of Sec. 26, T. 39, R. 29.

From here I went along a logging road in a swampy depression, west northwest. Struck in the south part of S.W.¼ of the N.W.¼ on a row of rock knobs, striking N.E.-S.W. which consist of a mottled massive diorite formed by dots of white feldspar secreted in the green ground mass.

And of a large belt of serpentine which intimately connects with the dioritic rock and is on both sides inclosed by it in such mode as to make the intrusion of the serpentine into the dioritic mass probable or more likely assumes the contemporaneous eruption of both rocks between which they become partially interlaminated. The diorite and serpentine belt disappears from the surface in the place where it strikes the bed of Menominee River and only drift bluffs are seen on the Michigan side, but further up the river in the N.E.¼ of Sec. 27 not far from the mouth of Sturgeon river the embankment of the river bed is formed by serpentine outcrops. The hills further away from the channel only drift masses form the surface. Returned in the evening to Quinnesec.

Monday July 26. Went with share to Florence. Had a letter of introduction to Capt. Morrison of Florence mine. The mine is in S.W.¼ of Sec. 21, T. 40, R. 19 on the north slope of a ridge which is generally covered by drift.

Tuesday July 27. Went to the Florence mine. Met Capt. Morrison which kindly went with me through the mine and exploring pits west of the mine. The formation has the usual strike, west northwest. Dips north. A dark, very pyritous schist forms the crest part of the ridge with a brisk slope towards the south side . On these slates are ferruginous slaty argillites and on those.A belt of serpentine ore not much less than 50 or 100 feet wide follows as hanging wall of the ore belt. We find ferruginous clay slates with seams of quartz and intensely impregnated with graphite.

Above these are red and lighter colored whitish argillites more or less impregnated with ore particles and the uppermost strata are composed of soft silky shining hydro-mica schists of whitish color and dotted with granules of iron oxyd. This series of rock beds is much better exposed to view in the testpits of Mr. Harvey west of Florence mine in Sec. 20.

Generally the surface of the country is drift covered with softly rounded undulating hills. The only outcrop of rocks besides the ore bearing rocks artificially denuded is at Florence on the shore of Fisher Lake close to Jack Armstrongs dwelling where a schistose diorite is denuded in a limited spot. See specimens.

The strata of Florence mine are near the surface very much shattered and a fault seems to exist on the east side of the mine considerably disturbing the strata in their relative position and changing the northern dip of the formation locally into a southern.

Went in the afternoon with landlord per buggy to the Commonwealth mine. Captain Tobin led me through the mine and the surrounding testpits. Under a drift cover of 5 or 6 feet thickness on the plateau-like top of a hill an iron ore belt of 162 feet pure iron ore is uncovered. The dip of the ore is to the south, north of it consequently. Beneath are ferruginous schists of reddish and of blue color which inclose another narrower belt of good ore. Further north are the pyritous dark schists which form the footwall of the Florence mine ore belt. All these beds are in different testpits and in a railroad cut well exposed.

From there we went south of the ore belt to see the overlying beds which next to the ore belt are dark clay and black schists with quartzose seams. And above these are softer graphite schist and pure masses of graphite which might be of commercial value. The total of beds seen crossed including foot and hanging wall of ore belt is not less than one thousand feet.

No other rock outcrops are seen in the vicinity. The abundant drift boulders partly of angular form principally consist of granite and basic rocks and diorite of a rather light color. [illegible] the boulders of the [illegible] quartzite [illegible] Commonwealth [illegible] Sec. [illegible] hill.

Wednesday July 27. Went in company of Mr. F.H. Albert, Mr. F. A. Ames and of Capt. Morrison to Jack Armstrong' so-called Thompson Mine, T. 41, R. 33, Sec.13, east half. A tolerably good wagon road leads to the place. North of Florence ere coming to the bridge across the Brule River we have to cross a high ridge of diorite but most of the rock is hidden by drift deposits. On the Michigan side of the river we drove for a long distance over drift covered woodlands partly burnt, partly covered with hardwood timber.

In the north part of Sec. 31, T. 42, R. 32, for the first time outcrops of the ferruginous and [illegible] quartz schists underlying the ore belt of the Florence and Commonwealth mines are seen on top of the hill over which the road leads. High crests on both sides of the road are composed of this rock which seems to have an immense thickness. From here to Browns place on the Brule River the schists form all the surrounding lands, being more or less covered with drift. Brown's land, a trading post, is in the N.E.¼ of Sec. 36, T. 42, R. 33.

We follow now one of the many roads radiating over the country which has a direct northern course and brings us to Armstrong's camp in the east half of Sec.13 T.41, R. 33. All the surface we passed over seems to be underlaid by the ferruginous-silicious schists and slaterocks previously mentioned and are in many places close to the surface. But it is impossible to ascertain in any place the exact dip and strike of the beds as the surface portions are generally shattered and the denudations small.

Close to Armstrong's camp, north of it a large mass of pure iron ore with some seams of jaspery mixed ore projects about 15 or 20 feet above a swampy depression. On both sides the silicious ferruginous schists form the main portion of the surface and rise in the adjoining hills high above the ore outcrops. The surface material covering the base of the ore mass is a red drift sandstone inclosing pebbles of ore and schist and one seam of this sandrock is colored dark black. A similar black drift sandrock is also seen in the surface material of the Commonwealth and of the Florence mines. In the swamp inclosing the ore mass also masses of black bog iron ore are dug out.

A trail leads from Armstrong's camp along the town line northward to Sec. 1 where Capt. McPherson is engaged in opening testpits. All the rock seen there is the ferruginous quartz schist and slaterock besides [illegible] schists and some streaks of a lean iron ore. The strata strike from east to west or nearly so and are almost vertical so that in the shattered condition of the surface portions no accurate determination of the direction can be made.

The [illegible] schists are seen in the southern pits, the silicious schists in the northern so that the ore belt seems to occupy an intermediate position between the two as the [illegible] is in other mines [illegible] the [illegible].

[illegible] traveling [illegible] west from McPhersons camp to the [illegible] pits in Sec. [illegible] of T. 42, R. [illegible] [illegible] feet [illegible]. The ore is [illegible] to the Commonwealth [illegible] portions of it are mixed with jasper. [illegible] schists. [illegible]

[illegible] July [illegible] accepted the invitation. [illegible] C. [illegible]

In [illegible] location in the N E ¼ of the S.W. ¼ of Sec. [illegible] T. [illegible] R. [illegible] Wisconsin survey. I found most all the testpits opened in various ferruginous [illegible] which seem to overlie the ore belt. The testpits are consequently all too far north while a broad belt of argillaceous [illegible] the [illegible] the [illegible] which form the crest part of the hill and are supposed to underlie the ore belt remained unexplored.

I [illegible] Mr. [illegible] my opinion [illegible] Collected a complete series of all the [illegible] denuded in the pits together with the [illegible] Packed a box with the collected [illegible] Rev. Mr. George S. [illegible] presented to me [illegible]

Friday July [illegible] returned [illegible] After [illegible] the [illegible] until [illegible] the Twin Falls bridge [illegible] dioritic rocks project above the undulating drift covered high plateau lands from which [illegible] all the timber is cleared off by former destructive fires. Arrived at noon at Quinnesec. Received letters from [illegible] and from Dr. Jones. Answered them.

Saturday July [illegible] All day long rain. Went to the mines [illegible] the [illegible] of the [illegible] which are exclusively limestone and [illegible] At the base of the hill in [illegible] ravine [illegible] the ore [illegible] calcareous schists in vertical position have become denuded which lie directly under the [illegible] jaspery ore belt, cropping out at the blacksmith shop a few steps from the ravine. These schists evidently form the uppermost layers of the limestone formation largely denuded in the hill side. [illegible] steps further north the same time it is observable that the limestone cliffs appearing to be south of the ore belt east of the mine are here bending northward and are in continuity with the limestone belt north of the mine. And the overtilted position of the ore formation where it dips to the north is not to be doubted the jaspery beds seen resting on the limestone at the blacksmith shop, have [illegible] position towards the limestone and dip southeast.

Sunday Aug. 1. Went with Mr. Dilley to Pine River in Wisconsin. After crossing the Menominee bridge below the upper Twin Falls the road leads across sections 11, 10 and 9 of T. [illegible], R. [illegible] East of Wisconsin survey most of which space comprises a drift covered high plateau with undulating surface on which in many places outcrops of schistose diorites are noticeable.

On a branch road we went down to the north end of a large lake in Sec. 17. where a lumbering camp is located. From here we went over drift covered lands to the N E. ¼ of Sec. 20 where on the north side of Pine River the micaceo-ferruginous argillite schists and plumbagineous schists are uncovered by testpits, lying near the surface. The almost vertical strata dip north. The plumbaginous schists are found in the northerly pits. The ore seams, if there are any, I suppose to be further to the north. The argillites of this place resemble very much those to be described in Sec. 8.

The South side of Pine River is formed by high drift hills which are Brooks and Pumelli's property. We returned to camp and from there went north ascending high drift covered hills but on the top part of these is only a thin crust of drift material above the ledges of hornblende rocks striking in the usual N.E. direction and apparently also dipping north or in vertical position.

Furthest north on the north half of Sec. 8 are large outcrops of schistose diorites. See specimens. Next south of them are laid greenish schists in close contact with them which I am inclined to consider as belonging to the iron formation, their thickness is not great. Next south of them and also in close contact are dark purplish colored laminated micaceous argillites impregnated more or less with hematite.

South of them is a large succession of greenish colored partly ferruginous argillites inclosing an abundance of thin scales and as it seems dolomite spar crystals. Also quartzose seams are found interlaminated. Further south the same rock material is in streaks deeply red colored by hematite. Next south to those beds are again coarsely grained micaceo-argillitic rocks of light color. Then follow argillites and quartzose rocks of a laminated structure so rich in iron as to constitute lean ores and with them are beds of a rich hematite ore of an aphanitic dull fracture and very compact but brittle, breaking in very irregular fragments .

With these are porous ore seams of partly hydrated composition under the form of grape ore. The thickness of the productive ore series is not yet ascertained. Interlaminated with them are greenish banded and somewhat brecciated and corrugated seams of a hard silicio-argillitic material also slaty argillites of red color are alternating with the ore seams, and south of the ore in all testpits are again red slaty argillites found. The strata are so near to vertical that their dip is not exactly to be ascertained . In several instances it seems to be decidedly to the north and between the diorite and the ore bearing belt an inconformity seems to exist although they are in a general way parallel. Returned to Quinnesec in a streaming thunderstorm and arrived there at 6 in the evening. Paid board to Sunday evening.

Monday Aug. 2. Packed and labeled specimens and recorded observations of the day previous. In the afternoon went with Mr. Alsworth and Ames to Chapin mine. Collected specimens of rock from the testpits on south side of Chapin mine in Sec. 31, where a peculiar arenaceous iron stone is found in connection with argillites which I at first thought to be Silurian but which evidently belong part of the ore formation.

From here we visited the limestone outcrops N.E. of the Chapin mine in Sec. 33 and returned, stopping to see the testpits on the line between Sec. 32 and 33, T.40, R.30. The ore deposit in loose masses is right below the horizontal sandstone, almost free of rock and of a rich quality. There are also banded jaspery ores ledges dug out which dip north and seem to constitute the actual formation.

South of the pits, only few steps from it are the limestones seen in a large belt dipping south and the most southerly portions of the belt are a red somewhat brecciated quartz rock. South of this quartzite again the ore formation is seen in a large belt forming a low ridge and partly the bottom of a swamp. The strata dip northerly. The most northerly are banded jaspery ores partly rich in narrow bands of excellent hard ore of sub-metallic lustre. Their thickness amounts to not less than 400 feet, perhaps much more.

South and seemingly under them are red soft sub-micaceous slate rock with various shades of color partly mottled and partly almost white so-called sandstones which in all other outcrops of the vicinity are above the jasper banded ore belt and must be here in an overtilted position. Further south the light colored so-called talcose slates follow the red slates but there are no good formations of them while the strata in the pits are very regularly dipping to the north.

Tuesday Aug. 3. Went with Mr. Kemp to his camp in Sec. 24, T. 42, R. 33 and noticed there the silicious slate formation connected with the Commonwealth ore belt outcropping in many places of the road leading to the camp.

At the camp some deep testpits are sunk in a grey banded quartzrock with graphitic slaty seams and with much pyrites. Their dip is apparently north. South for several hundred steps are many other testpits opened which all have mainly dark blackish quartzose slaterocks or sometimes graphitic slates with pyrites as the bottom rock. Still further south red slates with higher percentage of iron oxyd are found together with a dusky pronaceous slaterock.

And in the most southerly testpit so far as it is opened a mass of broken partly brecciated material is existed which principally consists of a high graded hard ore similar to the Commonwealth ore and probably the undisturbed ore belt is very few feet beneath the loose masses. Many other testpits are dug in the quartzose and graphitic schists which often resemble the schists seen in the Florence mine beneath the ore belt but evidently belonging to the series above the ore. So far for this day.

Wednesday Aug. 4. Went to Armstrong's Hastdon outcrop. Found in the swamp 1 mile north of Porters camp a hummock of diorite. See specimens. Armstrong's ore exposure strikes almost north and south. From there by trail to S E. corner of Sec. 11 where Mr. Pondy sunk a series of testpits along the east section line of 11 on the south slope of a high ridge with plateau-like top.

In the testpits near the corner be uncovered jaspery ores. Further north the ore becomes purer of jaspery and quartzose parts, and some of it is of very rich quality. Further on by almost reaching the plateau we find the dark black quartz schists with iron pyrites which are seen as the surface rock of a great part of this country. These quartz schists are in some of the pits almost horizontal but in others have the nearly vertical position of all the other Kurunian beds, a variety of argillaceous more slaty beds or of black graphite colored sericeous argillites alternates with the flinty quartz beds.

On the whole surface to the northeast corner of Sec. 11, these rocks are found in outcrops and can be seen well disclosed in the creek bed little distance east of the corner with the usual strike W N W. and with a high dip south, or in nearly vertical position. Across Sec. 1 to Hefferson's camp the same silicious and slaty rocks cover the surface and are met with in all testpits. In one of them an unusually low belt of chlorite schist is found but no signs of ore yet encountering loose masses in the superficial deposits.

Went in the afternoon by trail to the N W ¼ of Sec. 31 where on Sheldons and Schaefers testpits a large body of ore is uncovered nearly as large as the Commonwealth belt, partly in very pure quality, partly mixed more with jaspery seams. Slate slate beds follow, then the ore belt are seen in contact with it. They contain enough iron to make a merchantable ore. In other rock is denuded there in connection with the ore belt.

Proceeding to the locality we had to pass over a hill just before crossing a good sized creek. Quartz and disturbed rock in the south part of Sec. 31 or of Sec. 36 of the eastern township. This hill is drift covered on the surface but in some places large angular blocks of diorite are abundant and in the creek bed below angular blocks of diorite are the inclusive rock in the bed although no actual outcrop is seen. See specimens collected there. On the north part of Sec. 1 the black ferruginous silicious schists of the iron formation are on the side of the trail frequently exposed. Went back from there to Porter's camp.

Thursday Aug. 5. Returned to Florence. On the road to Browns trading post the dark iron colored quartz schists in layers of various hardness come to the surface in numerous places. Also beyond trading post the road leads over large hills composed of the same rock. Further on to Brule farm. Even this is deeply drift covered.

From the Brule farm I walked down to the Falls which are not quite a mile below the bridge where mica schists and gneissoid rocks well stratified and alternating with hard feldspathic rock and with belts of quartz are barely exposed on both sides of the river. The strata have the usual strike from east southeast to west northwest and a southern dip. Some of the schists are finely corrugated like curly maple. All the surface of the surrounding country is full of boulders of this rock.

From here we crossed the bridge and went on to Florence. In the south part of Sec. 16 are several knobs of diorite. See one specimen. Took dinner at Florence and went to Commonwealth. The Captain, Tobin, showed me quartz schists dug out of a well at his new built house of a black graphitic color which resemble much the worst schists of Kemp's pits, and somewhat south of them are ferruginous seams almost rich enough for ore.

From here we went along the road to the east section line of Sec. 24 and followed it north to the quarterpost, about 200 steps north of the road. In Sec. 25, close to the quarterpost are several testpits in which under a cover of Silurian sandstone and an ore breccia the soft red and variegated slates called soapstone are uncovered. Also in Sec. 24 short distance west of the quarterpost are other similar pits with red slate and a caving of Silurian sandstone which is rarely seen in this region.

From the quarterpost we went south for a ¼ of a mile and saw in numerous testpits the red slates which compose here a belt of over ¼ of a mile wide. Their dip is south consequently they seem to lie here beneath the ore belt. Between these and the ore belt is in several pits graphitic slate exposed which according to the testpits must be over 100 feet thick. Next north of the graphite is a greenish arenaceous and argillaceous schist separating the graphite belt from the red slates.

On the road side in Sec. 24 I found a large boulder of the chloritic hieroc identical with the boulders found in connection with the limestone formation on Merriman's camp in the N E ¼ of Sec. 14, T. 40, R. 30. See specimen. There is also a specimen collected of the Silurian sandstone infiltrated with iron ore in a mottled manner.

Friday Aug. 6. Left with Mr. Tobin to Sec. 33, 28, and 21 to Lake Elise. Followed a road to exploring pits in the S W ¼ of the N W ¼ of Sec. 27. On the way from Lake Elise we went over numerous outcrops of ferruginous quartz schists and passed near the ¼ post between 27 and 22. Large flat like outcrops on south side of road which follows the section line.

Further on near the N.E. corner of Sec. 34 are the graphite slates well exposed and little further on the ferruginous quartz schists. A short little distance beyond corner of 34 the road and followed a trail to the camp in S W.¼ of N W ¼ of Sec.27. First the ferruginous quartz schist carrying a good deal of iron ore seen close under the soil. Then the trail leads to a sort of low land. Extensive outcrops of dioritic rock partly of rather coarse crystalline grain. See specimens. Thence we came unto rising ground and find it underlaid by the ferruginous quartz schists of the ore formation.

Visited the testpits which appear to be dug in the ferruginous quartz schists overlying the ore belt of Commonwealth. They contain here a large amount of magnetic ore but the ore is interstratified with cherty quartz seams and never amounts to seams more than 5 or 6 feet wide. Some of the ore is porous or cellulose shining in indigo purplish colors and is intermingled with well formed translucid quartz crystals. The entire ore bearing rock belt is in almost vertical position, strikes from E S.E. to W N.W. and is not wider than about 150 feet and inclosed from both sides by diorite which is clearly seen in the testpits adjoining the ore. A part of the diorite next to the ore is considerably weathered and soft fragile.

In the southeast ¼ of the N.E.¼ of Sec. 28 are other testpits in a similar rock which are south of the pits in Sec. 27 and separated from them by a thick belt of diorite in Sec. 28 are graphite schists in close connection with the ore bearing schists.

Returned to S E. corner of Sec. 27 where we left our wagon. About 100 steps south of this place in the N E.¼ of the N E.¼ of Sec. 34 is an outcrop of the same ore bearing quartz schists which we saw in the testpits of Sec. 27, T. 40, R. 17. The outcrop of plumbago schist near the road is already mentioned. We returned now homeward. Passed the diorite outcrops before mentioned and little further the ferruginous quartz schists crop out in the road bed. Our wagon broke here and we had to walk.

Near Lake Key or Lake Elisa we struck a trail northward. Passed on it over outcrops of ferruginous quartz schists, some of a finer grained shining character of steel-blue color and quite hard. In the swampy land surrounding a creek we found large bog iron deposits and further on north on the hills large outcrops of schistose quartzites of a laminated character by intimate intermixture with the loose sheets. The quartzites have a great thickness, vertical position and a strike W.N.W. The adjoining rocks are not seen here but it is said that in numerous testpits along the south side of the quartzite range the ferruginous quartz schists with ore seams are uncovered.

From here we returned to Lake Elisa and took the trail to Florence which leads all the way through low lands with little swamp or on higher ground at the base of the hills. Saw no outcrops. When we started in the morning we followed a road leading from Commonwealth mine to Lake Elisa.

Diagram

Went in Sec. 33 over a hill of the ferruginous quartz schists down its south slope where graphite schists are denuded. Below the slope is a low protrusion formed by a large mass of ore identical with the ore in Sec. 34. From there we strike again towards the road in N.W. direction and found in the ravine of the creek flowing S.E. large outcrops of the graphite schists.

Thence we go along road to S W.¼ of Sec. 30 where not far south of the road a large body of ore of a magnetic granular character is found. The ore is partly mixed with jasmery or quartzose seams and with siliceous clay slate rocks and larger quartz seams. The clay slates are partly light colored, partly quite rich in hematitic iron which beds are principally seen in the west portion of the underlying pits. The belt with productive ore seams is very large.

From here went south. Found the plumbago schist and then returned northward to the road where soft somewhat sandy red slates are seen in the testpits on both sides of the road. Further on in the S W.¼ of Sec. 31 at the north slope of a high hill close to the wagon road are rock bluffs consisting of a light colored quartzite in thick masses. The surface of the rock is red stained by iron oxyd but it contains scarcely any iron. See specimen. Not far from there we struck Lake Elisa.

Saturday Aug. 7. Returned to Winnesec. Found letters from home with check for 200 dollars. Deposited it in the Winnesec bank.

Sunday Aug. 8. Made a day of rest. Prepared for trip to Felch Mountain.

Monday Aug. 9. With Mr. Alsworth Ames and editor of Winnesec paper to Felch Mountain. Not to pass the outcrop of quartz in the N E. corner of Sec. 17, T. 43, R. 30 or near to it, not far from a lake.

(N B. Sec. 14 T. 42, R. 30 S.E.¼ west half, exploring pits Clarks recommendation. Sec. 33, Piece's exploration. Sec. 34, limestone outcrop, Nelsons camp. From there trail).

Arrived at 4 o'clock at the exploring camp in the S. half of Sec. 31 short distance east of centre of Section. The explorations have been very extensive since my last visit of the place. Most of the camp we examined in the evening. Found south of the jaspery ore belt which is in trenches uncovered all the way up to the hill top and has a thickness of more than 600 or 700 feet, soft micaceous slate rock likewise of great thickness and variable in different layers. With the slate are quartzose strata and harder argillaceous strata found in alternation but not in regular seams as in one pit such layers may be found and in another close by none of the interposed rock ledges is found.

The crystalline limestone which I found on the previous visit is over laid or joined on the north side by micaceous clay slate and next to them which do not amount to great thickness are the siliceous lean ores composing all the higher part of the hill. On the south side of the limestone no pits are opened in close proximity but from those in the neighborhood south of the place must be inferred that the large succession of mica slates is beneath the limestone or incloses it from both sides. There are also schistose hydro-micaceous quartzites found in this association which resemble those found north of LakeElisa in Wisconsin.

A very peculiar brick red colored porous rock is found in the bottom of a testpit near the centre of the section. It underlies the greenish colored porous argillaceo-siliceous ore deposits which are found at the base of the hill slope and are directly overlaid by the jaspery mixed ore varies. Some argillaceous layers are also connected with this sandy brick red rock which resemble in a degree the nyrdeloids of the copper district. Sent a collection of the rocks from testpits near centre of Sec. 31, T. 42, R. 30 to Quincy for assaying. Found large outcrop of mica schist in S W ¼ of 36, T. 40, R. 30 which I will subsequently examine.

Tuesday Aug. 10. Went from McKinney camp east to Woods camp. Visited the trenches south of the corner. Found first north micaceo-ferruginous schists. Next to them a large series of reddish partly cellulose and conglomeratic quartzites 100 feet wide with partly [illegible] inches wide of a fine quality of granular ore and are partly impregnated with octahedric martite crystals. South of the quartzite are again mica schists alternating with quartz seams. All dip regularly north. By going further east. Testpits further south expose other lower strata of considerable thickness. These are mica schists with belts of quartz. The mica schists are partly red, partly dark green chloritic and south of the chloritic rock is again reddish mica schist. These schists all inclose disseminated martite crystals and some seams are almost entirely composed of martite forming an ore mixed with sand granules and argillite.

From here we went to the road and saw except some outcrops of Silurian sandrock no more ledges along the road to Woods camp in Sec. 16, T. [illegible], R. [illegible]. Took dinner at Woods camp. From there we followed a trail leading to Coreys camp at Felch Mountain but left it after short time and followed another one branching off in southeast direction to the exploring pits of Wright where I had been before. Took inspection again of the large succession of banded jaspery lean ores with seams of metallic shining specular ore which strata are the only ones disclosed under the cover of Silurian sandrock.

From here we ascended the high hill range again in northeast direction and struck the old trail to Felch Mt. Arrived there at 4. Went to the various pits with Mr. Corey and Mr. Rose whom we met there and which directed our attention to various outcrops and artificial denudations I had not seen previously.

The resumé of all I noticed there is this: the strata are all in a nearly vertical position but evidently dip to the north. Beginning from the north the first testpits uncover quartzose strata more or less impregnated with iron oxyd. Partly they are of a sub-micaceous schistose structure partly compact or cellulose. Also argillitic seams charged with iron ore are interlaminated. Next south of these a large series of real iron ores partly in the condition of an earthy hematite, partly in compact hard masses sub-metallic grey color but usually by subsequent alteration changed partially into brown and yellow ochreous oxyd.

Most of these ores contain also an abundance of sparry material and are not all of sufficient grade to be valuable as considerable belts of this seriès are mingled with arenaceous matter, and other seams in the succession are almost destitute of iron, mostly quartzose, rarer argillitic. South of this main ore bearing belt is the great quartzite belt over 100 feet wide, dark colored by iron oxyd and inclosing an abundance of pure crystallized iron oxyd in concretionary masses. These strata form the summit of the ridge and a precipitous slope is formed by this rock belt towards the south side. In various places they can be seen resting directly on a gneissoid hornblende rock outcropping near the base of the slope.

Following this crest of quartzite westward and surmounting it we find on its southern less precipitous slope first micaceo-arenaceous schists of a reddish and partly of a greenish color, besides seams of quartzite of a lighter color than the great quartzite belt and often cellulose and cherty. There is also Silurian sandrock and ore conglomerate deposited over the Huronian rock.

From there we descended into a swampy depression with no outcrops but soon ascend another high elevation whose structure is by a row of trenches well opened for the observer. It consists of a large succession of quartzose lean ores partly of flaggy character partly breaking with quite irregular cleavage in shapeless angular morsels. Some of the beds are of high percentage in iron but rarely in area promising to furnish a salable ore.

Seams of compact quartz and argillitic belts are found in alternation with the lean ores which all together amount to 300 or 400 feet. Dip regularly north under high angle. Arrived on top of the elevation. These beds are seen resting directly on a series of limestones of highly crystalline structure and of a white color and forming compact solid ledges amounting in thickness to not less than 100 feet as far as I could see. Further south the outcrops disappear and again ferruginous compact quartzites strewn over the surface abundantly in angular blocks let me suppose a quartzitic rock seam beneath the limestone . Further on the south slope of this hill is all covered by drift. The location of this hill with limestone is in the S.W.$\frac{1}{4}$ of the N.E.$\frac{1}{4}$ of Sec. 32, T. 42, R. 28 and in the S.E.$\frac{1}{4}$ of the N.W $\frac{1}{4}$ of the same section and can be followed for some distance east and westward.

Wednesday Aug. 11. Went with Corey along trail to limestone in Sec. 33. By examining the location of the limestone and granite outcrops in the evening I found them to be further south and more east than I anticipated. Instead of N E of Sec. 33 I locate them now in the north part of the S.E $\frac{1}{4}$ of Sec. 33, T. 42, R. 2[illegible]. We went from there east, mostly through swamp and thickets to the $\frac{1}{4}$ post on the north line of Sec. 34 and returned following the line west until we came to the granite knobs and gneissoid hornblende rocks near $\frac{1}{4}$ post of Sec. 33 without seeing otherwise a single outcrop. From there we struck for Corey's camp and arrived there at 4 o'clock.

(By mistake omitted ahead of this days record). We went with Corey along trail until we passed on the east side of it some knobs of which the next was composed of limestone dipping N.W. and amounting to a thickness of several hundred feet. South and under it are heavy quartzite ledges of a banded character carrying seams of iron ore and chloritic dioritic mica schist. The limestone is full of a tremolite like mineral. North of the limestone are again heavy belts of quartzite and north of them a broad belt of ferrugineo-arenaceous mica schist, soft and easily decomposing are laid open in several testpits.

North of them is the ore belt of Felch Mountain with ferruginous argillites at the base of the great ferruginous quartzite belt north of which the ore bearing rock series of the Felch Mountain testpits is exposed, overlaid by horizontal Silurian sandrock. South of the limestone before described and south of the quartzites next below a belt of gneissoid hornblende rock underlies them inconformably as it dips S.E. The gneissoid belt is little distance further east [illegible] in [illegible] both sides between a red gneissoid granite dipping the same way as the gneiss-hornblende rock which has there a width of about 50 feet and is in part very much twisted and corrugated by the intrusion of narrow seams of granite between its [illegible].

Diagram

Thursday Aug. 12. Went to [illegible] and [illegible] exploring pits in the N. half of the N.W.$\frac{1}{4}$ of Sec. 19, T. 42 R. 28. The pits are about $\frac{1}{4}$ of a mile south of the trail which follows the north line of the section.

A swampy depression separates the hill on which the pits are from the higher granite ridge over which the section line runs. In the pits there are about [illegible] feet of rock been laid open, of which one half consists of quartzite beds and lean ore. The other half is rich [illegible] iron ore [illegible] of [illegible] metallic lustre, partly soft friable of steel grey glistening hematite. The strata dip north or are vertical. The north slope of the hill is very drift and below is a swamp.

A part of the ore belt is drift polished on the surface only covered by a few feet of drift. Another part is overlaid by horizontal Silurian sandrock with an ore conglomerate at the base. This is decidedly the richest ore deposit known on the Felch Mountain range. It is a direct continuation of Coreys ore bearing belt but much richer in good ore.

From here we went on the section line to near the north quarter post of Sec. 31 where a large outcrop of quartzite is found. Dip northward. On its south side is a outcrop of red iron colored mica schists but they are very limited and can only be seen under the roots of fallen trees. From here we followed a trail over the high undulating top of the ridge and came out at Woods exploring camp near the centre of Sec. 35, T. 42, R. 29 without seeing any outcrops except Silurian sandstones which cover all the top part of the ridge. Our teamster went from that camp south to the river and found near the river bluffs of mica schist in the S.E. ¼ of Sec. 35.

From here we went to Whellers camp in Sec. 26, where a large series of ferruginous mica schist forms the north slope of the hill. They dip north under a high angle. South of the schist near top of the ridge is a thick quartzite belt exposed. From Wheelers camp we crossed the creek and went to Kemps explorations in the north half of the S.W ¼ of Sec. 26 and in the S. half of the N W. ¼.

Ascending from the river we soon strike unto bluffs of hornblende gneiss and dark mica schists, partly in contorted and flected condition. This rock forms a thick belt By crossing over it we came to a swampy depression and found on its other side Kemps location which is on the slope of another second elevation. His pits are crossing it in a north and south direction for a distance of over ¼ of a mile.

The most southerly pits are hornblende schists and gneissoid rocks partially in a soft decomposed condition and north of them similar friable schistose layers which partly are a decomposed granite, partly a decomposed gneiss friable by pressure of the hand into a fine sand. Some of the layers are light colored others finely speckled, still others red colored by hematite and all richly filled with mica scales.

I never saw a larger belt of decayed granitic and gneissoid rock masses which are well indicated by an evidently sedimentary striation. There is not the least prospects for iron ore deposits in this series and I advised Mr. Kemp to quit work at once, which he did. Returned to Mr. Taylors camp in Sec. 31, T. 42, R. 29. Arrived there at 5 o'clock.

Mr. Taylor told me that he found other limestone outcrops ¼ of a mile east of the before mentioned ones. The one at the eastern quarter line of the ridge near the summit part and on the south slope. Their approximate position is in the N.E ¼ of Sec. 31 near the east line.

Friday Aug. 13. [illegible] ¼ of a mile north of Rogers camp [illegible] outcrops of schistose micaceous quartzite like those in the trenches south of [illegible] and not far off the granite comes to the surface. In the S.E.¼ of Sec. 36 about ¼ of a mile north of south line [illegible] a large outcrop of limestone.

Started at 5 o'clock northward on our road. Near ¼ post on east line of Sec. 36, T. 42, R. 30 some new testpits with reddish limestone at the bottom. From there the road follows a depression between two hill sides and ascends the north slope of the southern hill whose crest is formed by a large quartzite belt striking about east and west but dipping at different places of the outcrop in quite various directions.

North of the quartzite belt the road crosses a large outcrop of micaceous quartz schists in a nearly vertical direction, all of which outcrops are in the south half of the southwest quarter of Sec. 36 T. 42, R. 30. From there the road makes a bend to the south. We pass the section line between 1 and 2 of T. 41, R. 30 and find ourselves on granite which is exposed on both sides of the road and is seen almost without interruption of the outcrops across all of Sec. 2. The granite and connected gneissoid hornblende rock are distinctly laminated, and dip northward.

In the east part of Sec. 3 we turned on a road northward. Passed the south line of Sec 34, T. 42, R. 30 and came ¼ of a mile further north to a camp situated on the bluffs of a creek which is not marked on the map. Close to this camp is a large hillock of crystalline limestone and not far from the limestone on the slope of the bluff micaceous quartz schists are exposed under the roots of fallen trees. After crossing this creek and going north short distance west of the east section line we ascend a hill sparely covered with low aspen underbrush on which drift covered hill a number of exploring pits have been sunk but without finding any Huronian ledges under the drift but Silurian sandrock. In the drift masses of this hill are large blocks of limestone with masses of the mineral inclosed which Brooks describes as cyanite.

From here we followed the trail which leads along the east line of Sec. 34 and of Sec. 27 and 22, partly through swamp, partly over steep hills composed of granitic rocks and went to the north half of the S W.¼ of Sec. 14 where Mr. Kerr had opened a number of exploring pits in weathered decomposing granitoid and gneissoid rocks almost like those in Sec. 26 where his other explorations were. The strata contain some disseminated granular iron ore or are red colored by hematitic deposit but no indication of a larger body of ore can be seen in these soft chloritic friable masses and I advised him to quit work at once, which counsel he followed.

We returned to the main road for Red Water village and arrived at Quinnesec after 7 in the evening without having made any other geological observation. The outcrops in the north part of Sec. 17 indicated on Brooks map I did not see but Mr. Brotherton asserts to have seen in that locality large bluffs of quartzite in the surrounding hills of a lake noticeable from the road at a distance of not over 100 steps.

Saturday Aug. 14. Assorted and labeled specimens. Had a visit from Prof. Chamberlin of the Wisconsin survey.

Sunday Aug. 15. Went to Sec. 18 and 17, T. 39, R. 29 on the old road leading to Sturgeon falls over sandy pine plains. (See Monday's diary). In the ~~[illegible]~~ are some small hillocks which partly consist of drift. One of them on the south side of the road consists of serpentine of a massive character and richly impregnated with chromeiron.

There are also Schistone seams and bands of [illegible] associated with the massive rock. In Sec. 7 I was told slate outcrops, could be seen, but I did not find any. The drift of the hills is full of slate fragments.

Monday Aug. 16. Went again over the same localities as yesterday. Followed at first the town line between ranges 29 and 30, commencing to enter the woods on the railroad track. Found corner between 1,6,12 and 7. Followed from there to the corner between 13, 7, 12 and 18 over various high hills and intermediate depressions without seeing any outcrops. From there followed the line south unto its intersection with the road to New York farm a distance of 490 steps. Further south.We went about ½ a mile but the line is there very incompletely blazed. Could not find ¼ post and returned in a circuit to road without seeing any outcrops.

From there we followed road westward until we found it intersected by the north line of Sec. 13. Followed thence this line westward to ¼ post. The hills of serpentine found yesterday are not as I believed in Sec. 18 but in the S E ¼ of the S.W ¼ of Sec. 12, T. 39, R 30 accurately told.The serpentine outcrops are 300 steps north of the ¼ post on the south line of Sec. 12 and 150 steps west of it. The serpentine is very rich in chrome ironstone and may be of practical value.

From here we went over sand covered pine plains to the north half of Sec. 11 where slates and quartz seams of a more or less ferruginous character are laid open in a number of testpits and have also extensive natural exposures. The strata are in a vertical position, strike almost due east and west and form a succession of at least 500 feet. The specimens collected are numbered"I " is the most northerly rock seam, a ferruginous and quite cellulose quartzite."7 " is from the most southern outcrop. The slaty strata prevail much over the quartzose seams. The denudation of the rock barely project above the drift sand which covers all the surrounding country and even hides the rock in the deep ravines washed into the sand. From this locality we returned to Quinnesec.

TUesday Aug. 17. Rain in the forenoon. After dinner visited with Prof.Chamberlin the Quinnesec mine and then the Norway mines and Cyclops. At the Cyclops I observed the hanging and foot wall of the ore to be of prevailing argillitic character decaying rapidly on exposure. The layers next below the ore are of light flesh color and can in hard specimens not be distinguished from the light colored slates beneath the limestone formation at the Norway mines. The Cyclops ore belt is evidently in a 500 or 600 feet higher horizon than the ore of Norway mine.

Wednesday Aug. 18. Went with Mr. Fitzsimons to Ludington mining location. Passed on road along S. line of Sec 35 and crossed into Sec. 36 ore reaching the centre of south line. There at the base of the high ridge lower undulating elevations are found to be composed of a rather soft dioritic rock in a commencing state of decomposition. Close to it on the north side a wide belt of soft micaceo-ferruginous clay-slates is uncovered by many testpits , they dip south.

North of the clay-slates are found harder more quartzose layers of deeply red colored argillites and still further north on the steep slope of the hill a large succession of jasper banded mixed ore beds is uncovered by numerous testpits and deeper shafts or drifts into the hill. Higher up the Silurian sandrock with an ore breccia forming its base covers up all the Huronian strata and attains a thickness of several hundred feet while it forms the summit of the ridge. The whole surface of this summit is however densely strewn over with large granite and quartzite boulders.

We went around the [illegible] of the [illegible] hill into the east part of Sec. [illegible] and over the south line of Sec. [illegible], all being a rolling drift covered country extending to the Menominee river. In a testpit in the S.E. part of Sec. [illegible] the bottom of the pit seems to have been formed in the Huron limestone as large angular blocks of it are surrounding the [illegible] which is [illegible] [illegible] in and partially filled with sand. It seems the limestone belt seen at the east end of the ridge near the railroad track continues through its whole length, being covered by the Silurian sandstone and [illegible] [illegible] in the low grounds on the west side under the cover of heavy drift deposits.

After ascension of the summit of the ridge in Sec. [illegible], we struck northeastward and came out on the railroad track near the south end of [illegible] Lake. No outcrops seen during our travel across this space. Went now along railroad to Menominee bridge. 100 steps below the railroad bridge a belt of micaceous argillites of delicately laminated structure full of small corrugations and of silky lustre strikes in an east and west direction across the river and forms small rapids. The thickness of the slate amounts to about [illegible] or 600 feet. Their dip is northward. Lower down the river no more outcrops are seen but drift bluffs full of large boulders form the embankments.

Going up stream from the slate outcrops for a few hundred steps nothing but boulder drift can be seen until at and above the bridge large outcrops of dioritic rocks of schistose and of massive structure commence and continue with short interruption up to the Twin Falls, these rocks striking in the same east and west direction. Dip south contrary to the dip of the slates.

From here returned by railroad track to the rock cut in Sec. [illegible], a formerly described locality with vertical ledges of [illegible] mingled with quartz [illegible] and in portions somewhat impregnated with ferruginous matter. They strike in the usual direction of the [illegible] exposures, W.N.W. and [illegible] below to the slate series exposed on the river as a lower part of the succession of [illegible]. If the slates which [illegible] the [illegible] so-called [illegible] slates south of the [illegible] and [illegible] mines very much are their equivalents one should expect below this series, the ore formation striking across the south half of Sec. [illegible], [illegible] and [illegible], toward Menominee river. But in this partly swampy and all over drift covered country no explorations were made.

[illegible] Aug. 19. Went with railroad to [illegible]. From there [illegible] to swamp [illegible] of creek to Sec. [illegible]. Followed the creek westward in swamp until I struck [illegible] under the misapprehension to go towards the slaughterhouse of [illegible]. Then returned about [illegible] a mile eastward, crossed the creek and struck the [illegible] line of Sec. [illegible]. Followed it north until I struck [illegible] ridge thence west [illegible] or [illegible] steps where I found fresh testpits near the limestone ridge and [illegible] camp. The testpits go partly through Silurian sandrock and strike in the bottom all limestone.

From here follow a trail southward to creek and find after about ¼ of a mile the creek and some distance east of it the slaughterhouse. Pits near the slaughterhouse have micaceous clay-slates in the bottom. From slaughterhouse went [illegible] steps north along trail and came to the testpits I had seen two weeks previous. The first rock [illegible] in the testpits going north is No. [illegible], an arenaceo-ferruginous slate rock. Various modifications of it follow northward. Then comes a [illegible] or [illegible] feet wide belt of graphite slate between ferruginous-arenaceous clay-slates. Next north is a quartzose rock banded by seams of iron ore in an irregular way. North of this ore bearing belt come again ferruginous-arenaceous slates. Then another narrow ore bearing quartz belt.