[illegible] of the various modifications of micaceous slate [illegible] belt of [illegible] thickness. [illegible] we gathered I. further north and west I found on the previous trip [illegible] rock. Returned to Murray and drive in [illegible] by railroad. (N.B. [illegible] the left is only [illegible] 15 feet south of the bearing stone.

Friday Aug. 19. Went in town line [illegible] post between 1 and 6. Followed road north to N.W. corner of Sec. 31. The corner is about 150 steps north of Gray's shanty on west side of road on a little knoll in swamp which is composed of conglomeratic red quartzite of the Limestone formation. We intended to follow from the corner the line east to the N.E. corner of Sec. 31 but the line is so badly blazed that we lost it, went too far north and could not find the west line of Sec. 30.

So we went along the slope of hill [illegible] covered with drift and struck Pine creek about in the centre of Sec. 27, T. 39, R. 29. Followed the river upwards until we struck the road leading from Pine Creek across Sec. 30 to the townline and from there south to the Murray county road. When the road crosses the east line of Sec. 33 about 1430 steps south of the corner a trail leads along the line to testpits of McConnel in the northwest corner of Sec. 33 and partly in the N.E. corner of Sec. 37.

The pits uncovered a large succession of mica schists of grey color alternating with belts of micaceous quartzite and micaceous sandrock striking in the usual direction, W.N.W and almost vertical in position. The slate belt seems to be much wider than the testpits have laid it open as further on on the road slate pieces are abundantly mingled with the soil. On the roadside in Sec. 33 likewise numerous test pits but none of them penetrated to the Huronian ledges. Went home by road. Paid this weeks board bill.

Saturday Aug. 21. Large quartzite range outcrops in high walls in N. ½ of N.W. ¼ of Sec. 20, T. 40, R. 29.

Went with Mr. Alward and Mr. But to Lake Funee. A broad belt of limestone intersects the road in the N E ¼ of Sec. 34, but the outcrops are limited. Most of the rock is covered by soil. At Lake Funee ascended to the north line of Sec. 27. ¼ mile west of corner several testpits and natural outcrops in this locality exhibit a hard partly brecciated quartzite rock which contains bunches of South eisen stein (iron stone), on this rock the silicious ore belt reposes which is well exposed in the test pits lower down the hill side.

Followed north line of Sec. 27 to N.E. corner. From here ascended the steep hill side diagonally across the S.W. ¼ of Sec. 23. Found the lower level formed by outcrops of horizontal Silurian sandrock, the summit part of dolomitic limestone of the calciferous formation. This limerock of bit mouse odor when struck with the hammer is sufficiently pure for lime burning. It covers all the hill top.

We returned from here to the S.W. corner of Sec. 23. Followed the line north to ¼ post which is on north slope of hill. The Silurian sandstone is there at the surface and is seen in bluffs higher up on the slope.

From quarterpost took an east northeast course. Passed through much swamp land and came finally on rolling drift covered hardwood lands to the N.W. corner of Sec. 23. Thence followed from there a trail to [illegible] camp. No outcrops seen on all this route.

At Merritson camp took dinner and followed down the creek tributary to Pine Creek which flows for a good while along the north line of Sec. 14 eastward. On the south and on the north side of this creek while it flows through the N.W.¼ of the N.E.¼ of Sec. 14 and through the N.W. part of the N.E.¼ of the N.E.¼ are thrifts of crystalline limestone of micaceous and further ferruginous character, dip south under high angle. Strike W.N.W.

South of this very thick succession of limestone beds follows conformably a quartzite belt about 60 feet thick with seams of dark red iron color and inclosing lunches of quarry carbonate of iron. The main mass of the quartzite is light colored whitish. Still further south but on the west side of the creek in the N.E.¼ of the N.W.¼ of Sec. 14 are again colored micaceous and ferruginous beds, some hard, others soft, friable mica schists with considerable hematitic admixture. And next south of them again light colored white or red crystalline limestones. The rock begins to disappear here under the soil. South from there the bluffs forming the other side of the valley consist of Silurian sandrock.

From there went to the centreline of the section, ¼ of a mile north of centre. Followed it to centre where we struck about 30 steps east of centre post. The road from here went off from the road about 300 steps in S.E. direction into a swamp where hard black slate rock is seen denuded. The same sort of slate rock could also be noticed mingled with the soil in large fragments all along the road after having passed south of the limestone and quartzite belt. It seems to be the next higher member in the succession to them.

On the map I had formerly located the road in an erroneous position. It intersects from the camp almost diagonally the N.E.¼ of Sec. 14, passing close by centre of section, thence strikes almost west intersecting the east line of Sec. 15 about 300 steps south of ¼ post, then descends to creek which is not correctly laid down on the government maps.

On slope of hill in S.E.¼ of S.W.¼ of Sec. 15 are testpits exposing deeply red colored micaceous clay slates in connection with quartzite beds carrying seams of iron ore. The strata have the ordinary strike westward and dip to the south. From here no more outcrops seen on the way to Lake Antoine road. The very thick drift on the line between Sec. 21 and 22 generally covered with drift detected is in all probability like the one towering above Lake Fonse composed of Silurian sandrock capped with Silurian limestone. Expense for team 3 dollars.

Sunday Aug. 22. Forenoon office work. Afternoon to Morley. Found great hospitality and politeness at the Neuhol House by its proprietor Gehner. Found also my specimens collected at Welch Mountain there and took them to Quinnesec where Mr. Gehner brought me in his carriage after having taken supper with him.

Monday Aug. 23. By railroad across Sturgeon river bridge. From there by a good road up to the testpits in Sec. 7. Orien opened some pits in S.W.¼ of S.W.¼ of S.7. The pits of the other parties are in the S.E.¼ of the S.W.¼. In both places a similar very even bedded siliceous flaggy rock series very richly impregnated with brilliantly shining specular iron ore containing almost throughout its whole bulk enough iron to be considered as an ore. But as far as the explorations go no belt of a pure high-graded ore has been discovered. The strata are covered by from 15 to 30 feet of drift. Layers as they strike from W.N.W. to E.S.E. and in southern dip as the limestones which project in several parallel belts about 300 steps south of the pits.

[illegible] of the greatly varied with some shales have been opened which furnish evidence of a very thick mass of this slaty lean ore belt, but fresh or north there greatly richer deposits will be found as test pitting has been done. In. Dikes information the belt north of Nelson are located in Sec. [illegible] the adjoining [illegible] and slates of soft sandstone character have been opened in to north of the great quartzite belt.

From here we went up the river following a trail to an old lumbering camp supposed to be situated near the [illegible] post on the east line of Sec. 8. The high quartzite bluffs on the opposite side of the river striking W.N.W. have a plainly N.E. dip as can be seen by the direction of the outcrops in that direction.

At the camp we followed a road with S.E. course but leading afterwards into an eastern. We crossed the centre line of Sec. 8 on a high drift covered hill about [illegible] of a mile north of the [illegible] post on the south line. Followed the road which passes 50 paces south of the centre post of the S.E. [illegible] of Sec. 8 and went on that sub-division line north. Found at about 400 steps distance a creek not marked on the map. Across this small stream rises a very high quartzite ridge with large rock exposures but on top covered with drift.

Going over it and having descended its equally brisk north slope, we are in a ravine which opens directly at the foot of the Falls and is on the one side formed by this quartzite ridge, on the other north side by a large dioritic belt interposed between granite, which composes a much lower ridge than the quartzite and forms the bedrock of Sturgeon River. The granite rocks and the quartzites are here plainly in a discordant contact and dip in different directions, which same observation I have previously made in other localities. The lowest quartzite beds nearest to the granite or respectively diorite are somewhat of a schistose structure by intermixture of micaceous thin linear seams. Other quartzite strata are very compact, glassy milk-white or sometimes of pale reddish tint.

We returned to the road and followed it to its intersection with the east line of S. [illegible] short distance beyond in Sec. 9 the road crosses the aforementioned creek which on the governments maps is marked as entering the river above the Falls, but actually runs a few rods [illegible] and enters the river [illegible] mile below the falls.

North of the road after crossing the sunny creek valley the section line passes over a high quartzite ridge on which the quarterpost is situated. This ridge is a direct continuation of the one we passed previously. When going northward from the centre post of the S.E. [illegible] of Sec. 8 it extends in easterly direction into Sec. 9. Is interrupted by a [illegible] through which the road leads and continues in a somewhat south-eastern strike in an equally high ridge with steep rock walls across Sec. 9 to its central part but is lost under the drift before the east line of the section is reached.

North of this quartzite ridge towards the river swampy lowlands extend with granitic outcrops in the river bed within the limits of Sec. 16 but disappearing in Sec. 9. From here returned to Quinnesec.

Thursday Aug. 24. Rain in the forenoon. In the **evening** went with Mr. [illegible] to Sec. 17, T. 42, R. 29. Inspected the different test pits and roads line. The test pits in 17, after sinking through some strata of Silurian sandstone with pre-conglomerate at the base, then find a very thick deposit of hematite in apparently horizontal position. It seems to be a secondary Silurian deposit.

Wednesday Aug. 25. Went with Hall to Ironwood. Examined the test pits in S.E.¼ of Sec. 21 T. 45, R. 1 W. The strata in the pits, the rock and mottled shales resting on the direct line ore belt on Stephens property are found there and underneath is an iron bearing quartzose rock with good ore scale which seems to be corresponding with the Emmet ore belt.

Diagram

Thursday Aug. 26. Went to Sandy portage on Menominee river. After passing a good distance over drift covered line drives by going south from the railroad through the east half of Sec. 11 T. 41 I found in the S.E.¼ of the N.E.¼ of Sec. 14 numerous masses of dioritic rock most massive but mostly so loose. These others a increase in size by going south towards the S.E. corner of Sec. 14 from there a row of vertical bluffs 100 feet high extends from the corner all the way up to the Quinnesec falls. The rock is further a massive diabase of different grade, partly a schist of the same chemical composition. The strata are permeated by an abundance of seams of carbonate of lime and partly of quartz with masses of chlorite. East of the corner the rock disappears under heavy drift masses but the high bluffs continue down the river being now more rounded in outline.

At the rapids the first rock met with is a dioritic or chloritic schist of considerable thickness partly in a much corrugated condition and alternating with belts of massive dioritic or diabasic rock. Strike N.N.W., dip vertical or rather to the north.

Following the rapids down stream consequently below the schists which together with the diorite belts amount to 4 or 500 feet in thickness follows a large series of slaty quartzose hydro-mica schists differing in hardness and color, some rapidly disintegrating on exposure into a sandy clay mass or in splintery pieces easily crushed into powder by the pressure of the hand. Others are quite hard. They for for a long distance the shore of the river. Subsequently the dioritic schists are diorites strike on the river bed again in a curve which the river describes, they form the apex of the curve. They are clearly north of the hydro-mica schists which form at this point the Wisconsin shore. As it rained I returned from here to Quinnesec.

Friday Aug. 27. Went per wagon to Pemenee farm on the Menominee River. All day heavy rain and thunderstorm. No particular observations on the way. Arrived at Pemenee farm about 4 o'clock in the afternoon. The falls are about 1½ miles above. At the farm some low outcrops of massive dioritic rock are seen in the river bed. See specimens.

Saturday Aug. 28. Went with canoe up to the falls. Weather clear and bright. The falls are about 1½ miles above the farm. No outcrops in the river until near the falls at the mouth of a large creek coming from the east. From there up the river for over a ¼ of a mile the massive rock belt crops out in bulky masses on both sides of the river but disappears some distance off from the bed under drift masses mostly composed of Silurian limestone pebbles.

The dark colored fine grained and compact rock of flinty brittleness is a chloritic feldspathic almost amorphous ground mass interspersed with larger feldspar crystals partly of red, partly of white color.

A part of the rock contains also large portions of quartz and could with propriety be called a diabasic granite. By closer inspection the rock which appears to sharp eland sub-crystalline masses exhibits delicate lines indicating a strong corrugation of the rock like a diabasic condition. Other portions represent a minutely brecciated structure with crystalline masses fragments interbedded. Sometimes also the rock has a coarser well developed crystalline structure but most of it is a porphyritic lava. Faintly indicated schistose structure is sometimes observed. This whole rock belt retains throughout its whole thickness the same chemical character and is no doubt of igneous origin.

Returned to Pelense farm for our wagon and went back towards Quinnesec, stopping over night on Stephensons farm east of Pesquaebon-one falls which I intend to visit tomorrow.

Sunday Aug. 29. Went with wagon to an Indian camp ¼ of a mile below the mouth of Holmes creek. Engaged the Indian to take us down to Quiver falls. Not far below the Indian camp are rock bluffs on the Michigan side of the stream where about 6 or 800 feet of strata are exposed which are in part richly impregnated with iron oxyd. They dip under a high angle east and and strike approximately north and south.

The highest beds are a schistose rock of a red or greenish color, cleaving in very irregular splintery manner and often rich in oxyd of iron. Lower are well stratified banded jasspery beds with ferruginous seams of a mottled or striped character. Some are considerably corrugated. With them are seams of an argillite lithologic red and white mottled. Below is a large succession of a silicio-calcareous rock with talcose (?) matter in its composition. Part of it is earthy porous and seems to be a product of decomposition of the former. It also cleaves very irregularly into angular splintery fragments. Their thickness amounts to not less than 500 feet, perhaps much more. After a short interruption lower down the river dioritic rocks crop out all the way down to Quiver Falls. Also opposite the ferruginous strata on the Wisconsin side a large body of diorite bulges out.

Quiver Falls are all surrounded by dioritic massive rocks. Some have a oolith structure by lighter colored feldspathic globules from the size of a pea to that of a hazelnut, densely dispersed through the dioritic ground mass. Also white quartz seams are abundant. And on the surface are many large boulders of rapitic dyke rock deposited but I could no where discover a dyke of this nature or any other eruptive dyke mass.

From Quiver Falls went west for ¼ of a mile and found large knots of the same dioritic rock dispersed over the pine plains. Returned to Indian camp and started for home. On the way about a mile from Holmes creek in several places the diorite comes to the surface from under the drift masses which cover most of the undulating mid pine over which the road passes. Arrived at Quinnesec just 6 o'clock.

Monday Aug. 30. Packed and labeled specimens in the forenoon.

Tuesday Aug. 31. Went over the lines with the American Association of Mining Engineers.

Wednesday Sept. 1. Left for Iron river and surrounding country in company of Mr. Kemp actr.

In [illegible] we visited Commonwealth and Florence Mines. Took Dinner at Florence and arrived in the evening at Porters camp in Sec. 34. In portions west from the old testpits have found strong indications of an enclosing ore belt. The courtzose [illegible] in little or [illegible] still the prevailing rock [illegible] which ore are plainly seen to have a northwest strike and northeast dip. Within these schists are here and there narrow seams of iron ore similar to the Florence mines ores with some hydrated oxid. The superficial portions are shattered into small fragments and within this loose rubbish a large quantity of good solid ore is imbedded. The ore seems to belong to a larger body of ore underneath or close by but so far only lean silicious rock masses have been struck by the test pits.

Thursday. Sept. 2. Went to Armstrongs outcrop in Sec. 13. From here I look at this bulloch of ore the less favorably I am impressed with its value as a big mining location. It lies in a swamp surrounded by bog ore deposits. Its strike is almost north and south but in neither of these directions any signs of a continuation of this ore mass is perceptible in the testpits along the line of strike.

They found silicio-ferruginous schists if any ledge at all and the hills on both sides of the outcrop are the same silicious schists in a succession of great thickness without any change in the rock. These schists are the general surface rock for many square miles in all the surrounding country. The outcrops of diorite in the much lower swamp levels between Sec. 34 and Sec. 11 are horribly mutilated.

Left Porters camp in the afternoon and went by road to Chicagon Lake, a distance of about 7 or 8 miles and camped there on the shelvement of the lake. On the whole traveled distance no well disclosed rock outcrops could be seen although in some of the very steep hill sides we surmounted the ferruginous quartz schists were noticeable in fragments mingled with the soil.

Friday Sept. 3. Went over a very poor road to Iron River. A distance of about 9 miles over high hills with no outcrops but drift masses filled with large granitic and dioritic boulders. We passed an exploring camp about 3 miles from Lake Chicagon but saw no rock ledges exposed at the exploring camp of Sheldon where we arrived about noon. We pitched our tent.

The Iron River flows here in a south course. The sides of the valley rise into high steep hills composed of the iron formation which consists in a great variety of ferruginous quartz schists more or less of jasper nature or by argillaceous admixture shading through all gradations into a sandy slate or into an argillaceous hematitic schist.

Between these are rich seams of iron ore of the nature of the Commonwealth or Florence mines of an amorphous compact resinous fracture and bright red streak or of a brown streak and much mingled with hydrated iron oxid, partly in the well crystallized stalactitic form of jasper ore. The formation is very much shattered on the surface and the testpits are generally sunk through a thick layer of crushed angular rock pieces of which neither dip nor strike can be determined. However in some places the pits are deep enough to show a dip of the strata towards the hill so as to make the ledge at the base of the range the lowest in the stratified series.

At the different localities in Sec. 35 and Sec. 25, T. 43, R. 35 [illegible] ex-ploitations [illegible] of rocks is [illegible] differs [illegible] that a rich belt of ore [illegible] character of a mixed [illegible] quartzose rock [illegible].

Instead of describing specially the rock found in the different locations I refer to the specimens collected. It is only remarked that with the [illegible] siliceous and argillaceous iron bearing rock [illegible] are found in-terstratified.

The argillaceous [illegible] and often full of [illegible] and converted [illegible] testpits of [illegible] south of Sheldons are particularly [illegible] Iron River valley.

Saturday Sept. 4. Went down the river along line between Sec. 1 and 2 and further on between Sec. 11 and 12 to S.W. corner of 12. Thence S E. to centre of N W $\frac{1}{4}$ of Sec. 13 where I found a low ridge of diorite striking in N.W. direction. Except this outcrop I did not see any others but [illegible] in the N W $\frac{1}{4}$ of N W $\frac{1}{4}$ of Sec. 1, T. 42, R. 35. From the dioritic outcrops we went N N.E. through swamp, crossed the river and found a ridge of ferruginous slates and ferruginous quartzites extend-ing along the east side of the river on the west line of the N.W. $\frac{1}{4}$ of Sec. 12 and continued into the S.E. $\frac{1}{4}$ of Sec. 1. Some seams of quartzite with bands of iron ore in it but little show of larger deposits. From there we struck for the wagon road on which we came to the camp. Struck it about in the centre of Sec. 1 and followed it to the camp without meeting with any outcrop.

Sunday Sept. 5. Went on west side of Iron River across the centre part of the east half of Sec. 35 and thence to a mining camp near the centre of Sec. 26. Thence west to the $\frac{1}{4}$ post between 26 and 27, where another camp or homestead is situated between the two camps. On the slope of the hills bordering the south side of Iron River are outcrops of a yellowish sub-porous quartz rock with irregular silvery cleavage dipping under high angle to the south. North of it are banded and brecciated quartz rocks mingled with seams of rich ore of which most is in brecciated condi-tion. See specimens.

Returning we went to the river in the N.E. $\frac{1}{4}$ of the northeast quarter of Sec. 35 and found the bluffs composed of the different varieties of ferruginous quartz schists and slaty rocks characteristic for the ore formation of this country and analogous with those connected with the outcrops and testpit exposures of the op-posite river side. See specimens.

Afternoon went over Sheldons testpits. Collected various specimens of rock con-nected with the ore belt which on the surface is so much broken and scattered that rarely the exact dip and strike of the formation can be ascertained. However it is found to be dipping northeast where recognizable. Thence we ascended the high hills and went over the top to near the centre of the west half of Sec. 36 where a ridge of hard blue sub-schistose rock extends as a low undulation from southeast to north-west. See specimens. It constitutes the lower part of the iron formation.

Monday Sept. 6. Left at 8 o'clock for return trip. Crossed the lake of Chicagon Lake with Mr. McDonald south of the dam to the Bluffs which we struck at the south corner between Sec. 21 and 22, T. 40, R. 14. Went 200 steps east and crossed the river, T. 41, R. 14 of Sec. 15, Bibelot Survey. Where close to the river high rock bluffs rise in massive walls which are found to consist of a diabasic diorite with interstratified seams of quartzite. The belt amounts to not less than 500 or 600 feet and extends in east and west direction for more than a half a mile ascending the bluffs. The top of the hills is found covered by boulders drift but a ¼ of a mile south is another ridge consisting of diorite. See specimens.

From here we went down the river about ½ of a mile and found on the Wisconsin side and in the bed of the river the ferruginous quartz schists and slaty rocks of the iron formation well exposed, diabasic dikes and ore bearing seams among them.

We crossed the river in the east part of Sec. 15 and struck the Indian trail to Chicago Lake close to the river. On the top of the bluffs is an Indian camp where good outcrops of a greenish partly massive, partly schistose (dioritic ?) rock can be observed. The same rock comes further on on the trail in several places to the surface. Further on near the lake south of Chicagon Lake the surface is crowded with large boulders of various granitic-dioritic and silicio-ferruginous character besides quartzite blocks. Arrived at Chicagon Lake at 5 o'clock.

Went with wagon in company of Mr. Goodman to Hunters camp in the N.W.¼ of the N.W.¼ of Sec. 23, T. 42, R. 13. We noticed on the way frequent outcrops of the ferruginous quartzschists. After crossing Armstrong Creek in Sec. 22 the road ascends a remarkably steep hill, the slope of which shows limited outcrops of diorite in the bed of the road, and on a higher level the ferruginous quartz schists overlying the dioritic rock. These schists are the surface rock onto Hunters camp but most of the surface ledges are hidden under heavy drift deposits.

Tuesday Sept. 7. Left for Florence with wagon, arrived at noon. Afternoon went with Mr. Key and Mr. Wm. Sheldon to Lake Ellis by Indian trail. From Key's camp went to the rock bluffs in the centre of S.E.¼ of Sec. 25, T. 40. R. 17 which are composed of a great variety of slaty and schistose rocks of a quartzose character or more ferruginous or actinolitic or argillaceous and graphitic.

North of the large belt of actinolitic schists with seams of sandrock are schistose hydro-micaceous quartzites, partly flight marked and amounting to a belt several hundred feet in thickness. The quartzites are in places interlaminated or intermingled in a breccia style with hard schistose seams and also with seams of iron ore in interrupted irregular masses.

South of the quartzites and west of the first mentioned outcrops are in a great number of testits schists and slates more or less impregnated with iron and in the most various modifications, also graphitic and argillaceous and jaspery seams with pure iron ore or richly charged with it are very abundant but so far no larger ore belt was discovered. All those testits are south of the quartzite and also south of the actinolite schists. No regularity of sequence can be recognized. By going south across a swamp the so-called repeated alternation of schistose jaspery argillaceous-graphitic and quartzose beds is encountered again. In the best site, At one of these sites the seams the strong massive crystalline rock resembling a metamorphosed diorite is found intercalated between schistose beds. See specimens. S.E. of N.W.¼ of Sec. 7, T. 42, R. 17.

(See map in pocket are copied in ink in the next paragraph of Sec. Sect.6).

Between Sept. 1. went to Florence that day in S.E.¼ of S.W.¼ of Sec. 11, T. 40, R. 17. Here we took a near north line of the 40 acres lot. Found a hill two miles east of the ferry house quartz schists in close contact with a soft friable yellow sandrock conformable with the formation which strikes from S.E. to N.W. with northern dip. At the lower parts of the slope and on the base of the ridge are numerous testpits various ferruginous-quartzose-schistose and slaty layers exposed which generally are found in much shattered condition and allow rarely an exact determination of dip and strike and far less the position in the order of succession. Between these are chertable seams carrying masses of a rich semi-hydrated iron ore of fine quality. Some seams amount to only 4 or 5 inches, others are several feet wide. The strata are locally found sometimes almost horizontal and a large portion of the ore in hydrated condition is evidently decomposed there by secondary atmospheric infiltration as it covers the surface of fissures in the quartz rock.

The really stratified intermixture of ore seams in the formation is not often seen and then the ore is always of a more impure character either by siliceous or by argillaceous ingredients.

The slates are often almost devoid of iron and light colored or black colored by graphite which occurs in large belts or so much of hematitic oxyd is combined with them as to amount to 30 or 40 percent of the rock. The frequent repetition of graphite seams and other characteristic slaty or schistose deposits in the test pit system crossing the strike of the formation indicate numerous plications and consequently repetitions of the strata, but it is so far impossible to ascertain the different axes of flexion.

Went from Pratt pits to other pits in S.W. of S.W.¼ of Sec. 14 where similar rocks as the former are exposed with ore seams between. Thence we went to Mr. Fo's the exploring pits in N.W.¼ of S.W.¼ of Sec. 14 with the same alternation of slay slates, quartzose and aluminaceous schists and with richer partly actinolitic ore seams than in any of the other pits. One hematitic and actinolitic ore belt of well stratified character inclosed a large amount of carbon bearing hematitic actinolites.

From there we went to the testpits of the Union Iron and Steel Company in the S.E.¼ of the N.E.¼ of Sec. 21 but there generally slaty and aluminous strata are uncovered with very little ore between them.

From here we went to the so called Surprise mine in the S.W.¼ of S.E.¼ of Sec. 24. Here we find the dark matter less colored quartz schists and aluminous beds in close proximity with the large quartzite belt on the north side of the schists, which forms a continuous line of rock outcrops on the crest of the hills from the centre of the S.E.¼ of Sec. 25 diagonally across the centre part of Sec. 14 to Sec. 13 where it strikes the Menominee river.

In these Surprise mine pits a hard sub-metallic fine ore is found in quite promising seams but the work is not yet sufficiently developed to say anything more than its very promising prospect. From here we went back to camp on Lake Elias and after taking dinner there went to Florence with a pack of about 75 pounds of specimens.

At Florence expected to meet Mr. Kemp and party but they were [illegible] in Jonartel without waiting for me as previously agreed. Found Mr. McHenry with a team and accepted his invitation to ride with him to Quinessec where we arrived after 7 in the evening.

Thursday. Sept. 9. Packed specimens in the forenoon.

Friday Sept. 10. To Lac Water with wagon. With boat upstream to great bend of river where we took dinner. At this spot in centre of Sec. 31 outcrops of mica schists in close connection with coarse banded quartzite for a [illegible] wide belt. The mica schists are north of the quartzite and next to the west, while the strike of the strata is near north and south or rather N.E. S.W. But the quartzite and the schists exhibit many changes and in quite intricate fashion. There is of quartzite irregularly [illegible] folded.

Saturday Sept. 11. At 8 o'clock in the morning arrived at the falls of Michigamme at the junction with the Menominee. The Menominee schists very regularly striking west northwest and dipping south under a dip angle for a succession of great thickness. Some quite fissile other layers harder and coarser. The specimens I collected are in the centre of the N.E. ¼ of S.E. ¼ Sec. 17. T. 41, R. 31.

Upon falls of the Michigamme we went up a dirt road on Brule River. On Brule about 100 steps above south mica schists in bed of river and in the banks strike west northwest, dip north. Little further the strike of strata in a continuous series of exposures with the former is to the northwest and their dip southward.

Further on at the falls on the strike of the strata is almost northward, their dip nearly west and in other places east. This whole series is composed of mica schists and of harder gneissoid rock belts which sometimes are traversed by calcareous veins. The mica schists are found in a numerous variety of modifications the thickness of the succession amounts to at least 600 or 700 feet, furthest up stream, and lowest at the commencement of the outcrops, the hard gneissoid rock belt occur. In the central portion of the exposures is also a well laminated silky talcose schist.

Further up large series of mica schist at the end of the outcrop which amounts to more than 600 feet in width. Strata strike west, dip south, nearly vertical. Above in the south bank of the Brule continuous series of hard massive diabase-chloritic rocks with four interstratified seams of mica schists is noticeable on both sides of the river. We returned.

Our camp is in N.E. ¼ of S.E. ¼ of Sec. 16, T. 41, R. 31. The strata here strike E.N.E. and dip south. The harder beds are so intimately connected with the micaceous-schistose beds by numerous transitions and repeated alternations that both must be considered as of sedimentary origin.

Sunday Sept. 12. Went down the river, halting at every outcrop and collecting specimens thereof. Loaded just below the islands about in the centre of the S.W. ¼ of Sec. 17. Large outcrops of mica schists and massive beds. Strike N.E., dip south.

[illegible] on Wisconsin side in [illegible] of Sec. [illegible] of [illegible] Power. There are here a [illegible] of [illegible] rocks, [illegible] Sec. [illegible] [illegible]. On left in the [illegible] [illegible], usually. Short distance below are the river [illegible] on Wisconsin side. Sec. [illegible] N.E. of [illegible] of Sec. [illegible], other outcrops of similar partly so below and [illegible] rocks [illegible] [illegible] inland to the river. See specimens. Strike N.E. Dip south.

Little below this are very big bluffs (cliffs) on Wisconsin side which are in the N.E. of N.E. of Sec. [illegible]. The rocks seem to strike east and west and dip south. They are very different from the last outcrops on Wisconsin side and correspond here with those on our on ping place.

Landed again in S.W. of N.E.¼ of Sec. [illegible] where more bluffs are on Wisc. side. Strike N.E. but dip seems to be inverted being north instead of south as in previous outcrops. Belt very wide, most of the exposed rock, little or no [illegible]. It may be I made erroneous calculation of the distances. The last mentioned outcrop would then be just above the island and below the mouth of the creek coming in from the Michigan side in Sec. [illegible].

The outcrops on the islands in Sec. [illegible] strike N.W. and S.E. and dip south. Rock similar to former outcrops. On the Wisconsin side near the east line of Sec. [illegible] are considerable outcrops of fern-[illegible] schists striking N.E. and dipping south. Little distance below is the place where we took dinner when going upstream and there the outcrops of a quartzose rock and of schists are found which we first encountered on our river trip in the S.W.¼ of N.W.¼ of Sec. [illegible], T. [illegible](41), R. [illegible].

Monday Sept. [illegible]. To Sec. [illegible]. In shale horizontal Silurian sandrock without veins of ore. In sandstone a large vertical fissure filled with ore conglomerate. Both walls clean sandrock. In another shaft large masses of the ore formation. All surrounded by sandrock with regular succession of beds and dip to the north.

Sent by freight [illegible] boxes with rock. 1 wooden trunk. Paid to Mr. Day 14 dollars for wagon [illegible] days including 1 dollar for delivery of boxes to railroad. [illegible] dollars for victuals. 10 dollars rent for room.

Diagram

Tuesday Sept. 14. Went to Negaunee. Bought from Ahlwardt store 4 dollars worth of specimens. In this station buried urns are Pyrolusite. I cannot not determined.

Wednesday Sept. 15. Went in the forenoon to McCaller mine. Noticed the great flexures and contortions of the formation and its immediate contact with the dioritic formation, partly dipping away from it, partly towards it. The lowest beds of the ore formation have there some resemblance with the actinolitic schists of the Ironington mine but are usually only a few feet thick and much softer, easily splintering in angular and sharp fragments.

Diagram

Commonwealth No. 150 here W. of quarter between [illegible] and [illegible]. Depth of soil 15 feet, [illegible] ft. clay soil [illegible] feet mixed ore and Silurian sandstone, [illegible] ft. loose ferruginous white, red and brown [illegible]. Strike E and W. Dip south.

[illegible] mine.

Drilled from [illegible] near the center of Sec. [illegible], T. [illegible], R. [illegible] (on top of a hill) in an extent of [illegible] ore body in [illegible] siliceous [illegible] considerable iron. Fresh water which was on the spot was I will [illegible] going east along the road [illegible] the [illegible] on the [illegible] side of [illegible] rock [illegible] the ore pile and not directly on that road but a short distance to the right from it. Brooks identifies the Commonwealth ore belt with this [illegible]

Diagram.

Sturgeon Falls. Entrance on both sides quartzites striking from S.E. to N.W. Dip northeastward. Falls from northeast to southwest. Schists fom (ation). Strike northeast to southwest. Dip southeast.

Redbridge mine July. 8. Strike of strata E S.E. to W.N.W. Dip of strata on declivity of hill, the dip is decidedly northward but going deeper the strata are vertical or even have a southern dip.

Diagram.

In the main openpit the ore strata are vertical and seem to change at a greater depth into a northern dip. The ore is in the siliceous lean ore belt much mingled with low graded siliceous lean. The rich soft bluish ores must be further to the north.

Diagram.

Nickels board 15 . 16. Paid Nickels 10 dollars, Saturday June 26. Nickels returned to me in service on Tues. July 6. Paid his board bill in quinesec up to Saturday night July 10. Paid for blanket 3.75. Paid on account of his [illegible] 2 dollars. Sunday July 11. Nickels was suspended (3 days) from June 26 to July 6. His contract commenced on June 15.

From the German . The black fibrous masses in the quartzite-chloritic veins of the diorite are Tourmaline Crystals found in the Chemion mine

July 27	Cash on hand	[illegible]
	Drawn from [illegible]	[illegible]
	Balance left on deposit [illegible]	
Aug.	Sent for draft of [illegible] and receipt it.	

Notes from back of book. Sarp. strike S E to N W. Dip south. [illegible] Nickel [illegible] miles west of Florence

Brien mine N W ¼ of N.E.¼ of Sec. [illegible], T. [illegible], R. [illegible]. Into near swamp dip south. Ferruginous-siliceous schists several hundred feet in thickness. Continuing in the E. lot mine east of the Brien mines a large productive seam of a brown ore. Beneath the schists another big seam of bluish soft ore, under it grey micaceous slates, rather soft and in degrees so much charged with iron ores it to be a lean ore. Behind it in the exploration pits rest of Brien mine [illegible] series [illegible] ft thick of rich jasperry rubbish is denuded and contains several nuggets of good ore. All the ore formation is now covered with shattered fragments of the formation which in the Silurian time became [illegible] . And above is the Horizon of the White Potsdam sandstone.

Accounts (outstanding) ([illegible]).

D. Bobrible [illegible]. Dated Oct. [illegible], [illegible]. Int. at [illegible].

[illegible] Brown $[illegible]. Dated Nov. [illegible], 1876. 7%. Secured by [illegible]

John Heiner $[illegible]. Dated Dec. [illegible], 1877, 7% secured by [illegible]

" " $[illegible]. Loaned Nov. [illegible] Note secured by Heimerdinger

D. Boynton $[illegible]. Note Dated [illegible] 1876. [illegible]. Int. due [illegible]

" " [illegible]. Dated Oct. [illegible] Secured by [illegible] Int. due [illegible]

Gottfried [illegible] $[illegible]. Dated Apr. [illegible] Secured by [illegible]. Int. due [illegible] Apr. [illegible] Paid interest to Apr. [illegible]

Mich. [illegible] $[illegible]. Dated June [illegible], 1873, Secured by [illegible]. Interest [illegible] to June [illegible] [illegible].

Gottfried Dielmann $[illegible]. Dated Nov. [illegible], 1875 [illegible] Secured by [illegible]. Int. paid to Nov. [illegible] Land Interest bought by [illegible].

Christ. [illegible] $[illegible]. Dated March [illegible], [illegible] [illegible]. Int. [illegible] from [illegible]

Conrad [illegible] $[illegible]. Dated Aug. [illegible], 1876 7% Secured by [illegible]. Int. paid to Aug. [illegible]

John [illegible] $600. Dated July 12, 1876 8% Secured by [illegible]. Int. paid to [illegible]

George [illegible] $[illegible]. Dated Oct. 12, 1876, 8%. Secured by [illegible]. Int. paid to Oct. [illegible]

Savings Loan stock $1500. Semi-Annly Int. at [illegible]. Loan note due July 1, [illegible]

Savings Loan Deposit $[illegible] to May [illegible].

Andrew [illegible] $1000. Date Feb. [illegible], [illegible] 7% annually, Secured by [illegible].

[illegible] $[illegible]. Nov. [illegible], 7%, secured by [illegible]

" " $[illegible]. Nov. [illegible], 7% secured by [illegible]. Int. paid to Nov. [illegible]

[illegible] $7[illegible]. Dated Apr. [illegible], [illegible], Secured by [illegible]. Int. due

Mich. [illegible] $[illegible]. July [illegible], 7% secured by [illegible].

[illegible] $[illegible]. [illegible], 7%. Secured by [illegible]

[illegible] $[illegible]. [illegible], 7%. Secured by [illegible]

[illegible] $[illegible]. Dated [illegible], 7% Secured by [illegible].

Sundry $[illegible]. Note secured by [illegible].

Diary C.R. Rominger May 1881

Left Ann Arbor May 11, 1881. Railroad fare to Menominee 16.65 Carriage .50

May 14. From Negaunee to Marquette and return. Ordered maps drawn on cloth at one dollar a piece. At Marquette went to lighthouse point. Near the sawmill the novaculite schists well exposed inclosed on both sides by green schists usually considered as dioritic. These schists are merging into the fine grained dioritic rock which is quarried there. The

The doleritic dyke composing the lighthouse knob and extending westward into the quarry has in its contact with the schists often caused their shattering into fragments which are re-cemented by calkspar. In such seams also incrustations of brown garnets occur besides epidote and red feldspar. The schists are often next to the dyke quite abundantly intermingled with flesh red feldspar.

The aphanitic green colored dyke described as occurring in the quarry and extending to the shore near the sawmill seems to be a modified form of the doleritic dyke as in one place such a green narrow dyke seems to form a mere side branch of the blackish coarsely crystalline doleritic belt.

Sunday May 15. Rain in the forenoon and cold. Afternoon fine weather. Visited the different Haematite mines south of village. Convinced myself of the intimate connection of the ore-bearing strata with the ferruginous flags on the north side of the valley, (those forming the knob near the iron furnace). Some test pits lately opened at the base of these knobs demonstrate the jasper banded haematite ores immediately to underlie them in apparent conformity.
Sent postal chart to Julius Bien.

Monday May 16. In the forenoon went to Cascade mines. Afternoon to LeAnse. Railroad fare 2.50.

Tuesday went with Conrad to Taylor Mines May 17. The mines are near the north line of the N.W.¼ of Sec. 9. Strata dip south. Are very much contorted. North of the mine the railroad cuts first through a thick series of graphite schists then follow banded ferruginous quartz schists, then again slate Plumbago schists, then again and again ferruginous quartz schist. Beyond again Plumbago schist and south of them again ferruginous schists with some impure ore or narrow seams of pure ore. Road at Taylors mine north and south.

Diagram

Strike of form(ation) E.N.E. to W.S.W. Strike of diorite dyke N.E. and S.W. N.W. corner of Sec. 9 400 steps west of dwelling house of mine. From house 280 steps to railroad where the line crosses the diorite dyke at the road. Strike of diorite E.N.E. to W.S.W. The ore formation runs almost E. and W.

Wednesday May 18. Walter P. Beaches exploration 1861 drifted into a hard micaceous ferruginous quartz rock. Dip south. Ledges rather massive if not schistose. Situated near the centre of Sec. 16.

Wednesday May 18. Went with Capt. Hendricks first to Conrads exploring pits, thence south across Plumbago Creek, south side of creek formed of bluffs of schistose granite as seen the previous day.

Went from these bluffs S.E. until we struck the west line of Sec. 15 near ¼ post Dioritic outcrop. West of here schistose granites, near centre of Sec. 16, high bluffs consisting of micaceo-ferruginous schists dipping south underlaid by ferruginous quartz schists. From here northwest come to a creek flowing into Sturgeon . Bluffs on south side granitic; high hillsides on north side at the base likewise exposures of schistose granite. Higher up graphite schists and ferruginous quartz schist which on the northside adjoin a belt of eruptive rock probably diabase, a continuation of the eruptive belt mentioned yesterday. From here to ¼ post on west line of Sec. 9. Outcropsthere of hydro-micaceo-ferruginous quartz schists of partly aphanitic grain and of silky lustre partly granular crystalline unhomogeneous.Dip south under a very large series of banded ferruginous quartz schists and further north Plumbago schists and again ferruginous quartz schists with much iron ore of good quality but in narrow irregular concretionary streaks.

Afternoon went across the north line of Sec.9 into Sec.4. Then crossed the railroad 300 steps north of the trestle works. Found numerous natural and artificial exposures of the Plumbago schists and iron bearing quartz schisrs which in places contain very fine ore, granular and of metallic lustre, or brown blackish with smooth aphanitic flinty fracture like commonwealth ore.

The ore formation is noticeable in outcrops in the whoel south half of Sec. 4. Good exposures are on the Sec. line between 4 and 9. Also the continuation of the diabase dyke crossing the section line at the railroad is observable 60 steps north of the ¼ post on the south line of Sec. 4. Returned to Taylor mine camp. Stayed over night.

Thursday May 19. Met the train going east at 10 A.M. at Taylor mine junction . Returned to Negaunee. Iron formation trends south of east to north of west, at Taylor Mine Camp. Board at Taylor Mine 2dollars. Railroad fare to Negaunee 2 dollars. Mineral et Wetsteins (and wetstones) (?) 40 cts. Wrapping paper and 2 boxes 75 cts.

Northampton mine. Strike of ore belt S.W. and N.E. dip N.W. Under the ore are graphitic slates conformably succeeding,visible outcrop about 30 feet. Strata on South side of hill. Strike S.E. to N.W. dip S W. Sandstone 200 feet graphite schist 50 feet. Then an interval of 120 feet colored by ochre. Then actinolite schist. Strike east and west, dip north almost vertical.

Actinolite schist east of Champ furnace. First outer strike N.E.and S.W. Dip N.W. Second lower outcrop east and west, dip north. At Champ Furnace Strike N.E. to S.W. Dip N.W. lowest actinolite above Plumbago schist.

Friday Ma y 20. Morgens nach(Morning at) Marquette. Railroad fare .52. Resielt (?) (Received or secured) von (from) Vice President Hornby a pass over the road. After noon to Cahmpion mien station Went to Newhampton mine in the S.E.¼ of Sec.30, Town 48, R. 29. Followed the newly built sidetrack to the mine. Foot of hill drift covered. First outcrop on road a hard flinty bluish colored well laminated Quartz rock forming heavy beds strike and dip not ascertained. Further on drift. Then actinolite schist in bulky hard banded rock masses with nearly eastern and western trend and northern almost vertical dip. Actinolite belt large.

North of it is a covered space yellow colored on the surface by bog iron deposits. Higher up the road commences a belt of graphitic slates to be exposed which amounts to about 100 feet in thickness.

Which conformably overlies a heavy bedded vitreous quartzite of dark blackish grey color amounting as far as seen to a thickness of about 200 feet. Some narrow graphite seams are interlaminated with the quartzite beds. These last described strata trend from S E to N.W. and dip under a high angle S.W. The exposures reach to the plateau like top of the hills.

Further on a broad space is covered with boulder drift. Then appear graphitic schists again in a belt much over 100 feet in width. Their direction is from S.E. to N.E. and their dip N.W.

The graphitic schists are conformably succeeded on the north side by a large belt of iron ore of hydrated nature like the ore belt of the Commonwealth mine in Wisconsin I have not had occasion to ascertain the width of the ore belt, nor have I learned yet the nature of the next succeeding higher strata.

The actinolite schists amounting to a belt of much over 100 feet in thickness form the hill slope at the Champion furnace and east of it they dip northwest under high angle. Strike N E. and S.W. On the north side of them black graphite slates follow conformably.

Samstag (Saturday) May 21. To Dalaby mine on road near the farmhouse of the Dalaby ppty(property) an outcrop east and west, dip north, of actinolite schist interstratified with a belt of glassy quartzite of dark grey color. Engine house about 200 steps north of it. Dalaby mine S E ¼ of S.W.¼ of Sec.29.

From Dalaby mine followed a new road leading west through the centre of the north half of the S W.¼ of Sec. 29. It bends south then and goes to the Northhampton mine. In the centre line of Sec.30, 400 steps west from the east ¼ post are large outcrops of black glassy quartzite trending N.E. and S.W. dip north or vertical. The belt is several hundred feet thick.

South of this quartzite belt are Plumbago schists trending the same way, dipping also northward. There are also Plumbagineous seams interlaminated with the quartzite. The quartzite seems to form an anticlinal arch as on the south side of the ridge.The strata dip S.W. instead of N W. on the opposite side.

South of the graphite schist follows conformably a large belt of ore which is about 300 steps north of the Northhampton ore belt. Lake Michigami first cut of railroad. Through actinolite schist trend N.E. and S.W. Dip S.E.

Afternoon followed road to Champion on top of hill east toward the Keystone.Upper actinolite schists are near Keystone a coarse breccia with various banded silicious rock fragments cemented by a micaceo-chloritic mass containing garnets.Under it as described before, quartzites of hydro-micaceo-schistose structure and massive glassy then ore, then banded silicious and magnetic rocks sometimes very rich in iron many hundred feet with belts of slate ore inclosed.

Sontag(Sunday) May 22.East half of S.E.¼ of Sec. 4, T. 47, R. 30. Outcrop of compact contorted banded micaceo-chloritic and dioritic rocks inclosing an abundance of garnets. Trend N.E .to S.W. Dip N.W. Near mouth of creek a belt of eruptive augite. On it garnetiferous banded rocks partly in massive belt dioritic and very hard contorted.

Diagram

Outcrop on Michigami lake in N E corner of Sec. 36, T. 48, R.30. Compact micaceous actinolite schists much contorted well laminated. Strike east and west. Dip north

Sunday May 22. Followed the oldrailroad track along the east side of Lake Michigamee, in the N E ¼ of the N E.¼ of Sec. 36, T. 48, R. 30. On the shore of the lake outcrops of massive banded rocks in a considerably contorted condition, trend east and west, dip north in portions, in others vertical or even south. This rock belongs to the upper ? horizon of actinolitic schists of which characteristic outcrops dipping and trending in a somewhat different direction are seen on the opposite side of the lake. The rock as great resemblance with the rock belt south of the Keystone mines south of the road track.

From there along the shore no more outcrops can be seen until I cameto the S.E.¼ of Sec. 4 T. 47, R. 30, where a large belt of massive but distinctly banded and partly brecciated rocks forms the shore line. It trends N.E. and S.W. Dip N.W. A large creek enters here the lake and on the opposite side similar outcrops are noticeable. Lowest in position is a massive belt of not laminated crystalline rock which I consider to be augitic. On it succeeds a large series of contorted banded rocks in bulky massive form, fine grained laminated silicious seams alternate with coarsely crystalline actinolitic and micaceous seams which locally are crowded with garnet crystals.

A part of the rock apparently being the highest portion is a coarsely brecciated by intermixture of large angular fragments of a light colored silicious well laminated rock with the actinolitic-micaceous ground mass. Other portions of the rock are amygdaloid by dense interspersion of nodular concretions of calkspar within the mass. Also chloritic seams and milky quartz veins intersect the rock. The similarity of portions of this rock with the garnetiferous and micaceous rock hoisted from the Keystone mine is very great and I feel by this similarity inclined to consider them as equivalent in position. The rock of the Keystone mine makes transition into a slaty iron ore while the rock in Sec. 4 does not carry much of free iron oxyd in grains or scales.

But also the brecciated schist north of the mine are equally similar to those garnetiferous rocks and connected diorites. On the east side of the railroad at Keystone mine the schists and diorite belt are well exposed. See specimens.

These garnetiferous rocks are found to succeed immediately beneath the Michigamee lake Staurolitic-mica schist and are therefore a younger rock tham the one hoisted with the ore of the Keystone mine but equivalent to the upper garnet bearing schists of that locality.

Two diagrams

Sontag Abend(Sunday Evening) Became ill with diarrhoea caused from drinking water. Monday morning feeling better went to Negaunee. 3 days hotel 3.50. (Entire notes in German and this is the substance of it).

Monday May 23 Revisited railroad cut to Northhampton mine. Ascending first actinolite about 100 feet wide approximately trending east and west. Dip north nearly vertical. Then a space of 300 feet covered with bog iron. Then graphite schists east and west but dip decidedly south, almost vertical.

The graphite schists closely connect with a large body of quartzite in heavy compact glassy beds of dark grey color. Some Plumbagineous seams are interstratified with them. Thickness of quartzite about 150 feet, Plumbago 100.

Returned to Negaunee. Received telegram from Bruckman of the arrival of Steamer Rhera at Southhampton May 18. Sent letter to Family and another to Dr.Jones (?)

Dienstag(Tuesday) May 24. Went forenoon to Ishpeming. Went to office of Lake Superior mine. Received information about a drill hole No. 11 on the Company property not far from the depot in which 242 feet of quartzite was bored through at first, then jasper mixed with ore seams to 285 feet from surface. Then 200 feet of soapstone of various color partly chloritic. Then 11feet of jasper. Soapstone again 41 ft. Then grey banded rock effervescing with acids called by the miner dolomite which is probably carbonate of iron banded with silicious seams, 88 feet. The same rock carbonated was met with in a drill hole on the Cleveland mine property.

Wed 25. Zuhet(paid) Sperly for board 6 dollars. At Michigamee. In begleitung from Mr. C Y. Osborn. In Sec. 27 actinolite form(ation) N W.¼ of N.W.¼ of 27. Strike N.E. to S.W. Dip N.W. Anticlinal to the exposures at the east of lake.

Left the cars on the west line of Sec. 22, T. 48, R. 30 went to the N W.¼ of N.W.¼ of Sec. 27. Under a light cover of drift the actinolite schists are found to form the ridge which borders the shore of the bay. The strike N E. and S W. and Dip N.W. The series uncovered by the first pits amounts to about 500 feet. The schists are very rich in granular magnetite mingled with the dark colored actinolite. Narrow seams of a few inches in thickness are a rich magnetic ore but no larger belts of it are found.

North of the actinolite schists are graphitic slate rocks with much sulphuret of iron. North of them is a swamp parallel with the range in which the Northhampton hematite ores are to be looked for if they exist in this locality. Further north near the railroad are some shallow test pits in which the hydro-mica schists and jasper banded lean ores of the Michigamee ore belt are recognizable, but the testpits are not sufficient to demonstrate whether there exists a belt of valuable ore. North of the railroad are diorites and further on the granite.

We went from here west on the railroad and then south to the N.W.¼ of the S.W.¼ of Sec. 21. Crossed there first a large belt of coarsely crystalline diorite and leaning on its south side we found the red jasper banded lean ores of the Michigamee ore formation dipping to the south and striking about east and west.

According to my opinion the valuable ore deposits if there are any must be in the bed of the lake. The outcrops of these jasper ores are close on the lake shore and amount to about 150 feet in thickness as far as visible. A little further west the diorite comes close up to the shore. Returned to Negaunee in the evening .

Thursday May 26. Sent letter to Jul. Bien. Went per buggy to Saginaw mine. Examined the strata underlying the ore belt. These are a banded quartzose rock with seams of actinolite and of magnetic iron. It has a dark brownish grey color and amounts to a thickness of at least 800 feet. The strata underlie the ore formation conformably dipping to the north.

They are indubitably lower beds identical with the actinolites schists underlying the Washington mine, the Keystone mine and Republic mine but are not so rich in actinolite as these. Returned to Negaunee at noon.

Friday May 27. Ragen(rain). Went to Teal Lake mines, following the railroad track. The ore foramtion borders Teal Lake as far as to the westline of the S.E.¼ of Sec. 35. The hills south of there and further west are composed of a large series of black slates, banded grey slates with intermediate belts of granular somewhat porous quartzite. The highest most southern strata of this series are red and greenish or whitish banded argillitic schists. They all dip south. From the mines near the quarter post on the south side of Sec. 35 these banded schists are immediately overlaid by the Teal Lake ore formation which likewise dips south but the inclination of the ore bearing strata differs from that of the banded argillite schists abruptly; the latter are more steeply inclined and the change in rock character is rather sudden.

The productive belt of soft haematite ore lies in that mine on the banded argillite schists, is not stratified and evidently is filled in into a then existing fissure, as the ore belt also on the south side joins the regularly bedded part of the ore formation in irregular manner.

Diagram

The hills north of the mining pits consisting of schists and quartzitez abruptly terminate near the centre of the S.E.¼ of Sec. 35 and the ore formation extends on the lower levels up to the lake shore. There some dyke-like belts of a silky schist penetrate the ore series and divide it locally in a northern and southern belt. The ore formation as developed there in the pits near the shore in the west part of Sec. 36 consists in the lower part of seams of a rich flag ore banded with Chalcedonic quartz seams. The higher beds are more like the ordinary strata of the McCumber mines. The ore series is from 800 to a thousand feet thick in this locality.

Diagram

Saturday May 28. Rain. Ging mit(went with) 10 uhr(o'clock) hour) to Clarksburg Station. South to Conrad mine in S W.¼ of S.W.¼ of Sec.7, T. 47, R. 28. On the way outcrops of the arenaceous Slate group in great thickness banded silicious dark colored rock but there(these) not actinolitic. Evidently under it and south of the formation, which dips partly south, partly north are the mines, the strata of which dip to the south. North is a hydro-micaceous schistose and brecciated quartz rock of dark color interspersed with much iron. Then follows an ore belt south of it, in one place bright slate ore, in other parts(pits) a dark granular ore of fine grain or of coarse grain with octahedric crystals.

South of the ore is a large series of hydro-mica schists. Further south at no great distance the diorite crops out, but on the west side of the ore range the massive actinolite schists which underlie the Washington ore belt succeed conformably. The whole series is to all appearances in an overturned position, the lowest above, the highest below.

South of these pits in Sec. 18, another company has put up a diamond drill and bored 250 feet into the actinolite schists below the ore formation. I therefore gave them the proper advice and told them to stop work in that locality as they never would strike the ore formation there.

East of said localities are high diorite hills. I went from the mines with Mr. David west to the hill group next to the Washington mine, which consists exclusively of the dark compact schists of the arenaceous slate group. Some slatelike, others massive dioritelike and often brecciated. Those contain actinolitic hornblende. The strata near the railroad all dip south. Those on the hill range further south dip north, as also do the same beds forming the high hills on the northside of the railroad.

Sunday May 29. All day rain.

Monday 30. To Clarksburg with 10 o'clock train. Went again to Conrad mines crossing the hills direct north of them. No outcrops but a great number of large boulders of the dark colored banded schists of the arenaceous slate group.

From the mines ascended the hills south of them. They consist of an immensely thick succession of the banded lower actinolite rock dip south. Some strata are mostly composed of a fine grained drab-colored actinolite. Others are micaceo-chloritic with an abundance of garnets. Other belts are formed of alternating seams of a saccharoidal quartz rock and of magnetic iron ore inclosing garnets. There are also much contorted massive rock belts of schistose structure which are crowded with angular fragments of various quartzose rocks which are hard to discriminate from similar brecciated layers of the actinolite schists. On the northside of Clarksburg south of this formation the granite comes out.

We went thence west to the north part of the S.W.$\frac{1}{4}$ of Sec.7 T.47, R.28, near to the west line where large outcrops of a compact light colored quartzite are seen dipping northward. Several test pits are opened there by Mr. Kidder. Some hydro-mica schist seams are connected with the quartzite. The ore formation must be not far to the south in a swamp but nothing is uncovered.

Going north from the quartzite outcrops over a covered space 300 steps wide an outcrop of the banded schists of the arenaceous slate group is met with. They dip also north. Contain dispersed granules of magnetite. North of them near the Escanaba river are testpits opened in which a great quantity of slabs of black slate are dug out but the ledges are so far not found.

From here went to the hills on the northside, where large rock bluffs of the conglomeratic schists of the arenaceous slate group are following the valley. There are not only specks of carbonate of lime and iron copiously disseminated through the rock but belts of limestone of considerable thickness are mingled with the extremely contorted rocks. Also angular fragments of this limestone and other silicious banded rock fragments are copiously intermingled with the mass. Other strata are not conglomeratic, well laminated, approaching a slate rock but much harder and scarcely fissile.

I saw also in one place the schists intersected by an augitic dyke. See specimen. This massive rock belt amounts to a great thickness, 1000 or more feet. It is identical with the rocks north of Saginaw Station whence also limestone belts are connected with the formation. It is often very difficult to distinguish these schists from the lower actinolite schist of like loose brecciated structure.

They are sometimes also actinolitic and garnetiferous but by some experience a distinction of the two formations by lithological character is possible. The upper formation is generally darker colored and most always more or less calcareous. Stayed with Mr. David the night.

Tuesday May 31. Went with wagon to N E.¼ of N E ¼ of Sec. 5, T. 47, R. 28 over low swampy plains without timber. On the way near S.W. corner of Sec. 5 passed a knob of the schists of arenaceous slate group like those at Clarksburg Station. In the N E.¼ of Sec. 5 is an isolated ridge of light colored compact quartzite dipping north and on the northside, adjoined by the jasper banded ore formation with promisingseams of hard ore inclosed. The quartzite belt amounts to about 200 feet in thickness and the ore formation is likewise very thick, dip nearly vertical to the north. Further north is a large lake and beyond it a granite range.

This series of quartzite and banded ores is evidently in an overturned position. It is a direct continuation of the Boston mine rocks which dip regularly to the south and the ore beneath instead (of) above the quartzite. From here we went to the S.E.¼ of the N E.¼ of Sec. 4 of the same town where another isolated quartzite knob is, with the ore formation on the north side and the grey banded quartzose rock on the southside. Dip of the strata likewise north, consequently overturned. This is the only locality in which I have ever seen the direct conformable sequence of the banded arenaceous rocks, the quartzite and iron formation. The arenaceous slaterock appears to be the lowest, the iron formation then highest. The banded lean ores are rich in iron but so far no larger belt of ore has been discovered. There is on the northside of the hill a weathered crumby rock connected with the ore belt which seems to be a decayed dyke mass of dioritic or doleritic nature.

Going northeast we found in the N W ¼ of the N W.¼ of Sec. 3 a range of diorite dipping south. Short distance south of the range a diamond drill has been worked to the depth of about 150 feet. Nothing but dioritic rocks partly massive, partly schistose were encountered. Among the cores I see also a piece of blackish rock, probably part of a doleritic dyke which was intersected. South of the drill a few hundred steps in the southhalf of the N.W.¼ of Sec.3 is a ridge completely composed of the jasper banded ore formation in a belt more than 6 or 800 feet thick steeply erected and dipping south.

Southeast from this ridge north of the centre of the section is another much higher and larger hill composed of a mighty thick succession of light colored compact quartzite beds dipping north, and north of them rests directly on the quartzite a thick stratum of conglomeratic iron ore like that of the Excelsior mine.

Next above it is another seam of thick bedded quartzite and then follow banded jasper ores all dipping north on that side of the depression while as before mentioned on the opposite ridge of jasper ore the strata dip south. We have therefore also here the quartzite and part of the ore formation in an overturned position. The south side of the quartzite hill is deeply covered with drift and no outcrops seen. Further east the quartzite is not seen in outcrops but its continuation in that direction is proved by test pits.

Wednesday June 1 went with Fitzsimons Sperly to Schweitzers mills in Sec.6, T. 46 R. 26 per wagon. 3 dollars.

South of the Cascade mines the granite begins to occupy all the ground for several miles southward. The surface is broken up into inn umerable knobs. The granite is of variable nature, generally fine grained, reddish other times greenish, partly well laminated, gneissoid in structure. A part of the granite is lighter-colored, consists of large crystals of feldspar, interwoven by a network of quartz. The granite is intersected by numerous large transverse dykes of dioritic nature. Some of them may be augitic. Others approach by their micaceous constituent a gneiss, or the mica is partially replaced by chlorite-like mineral.

Also large belts of quartzite of a stratified schistose nature in connection with massive glassy quartz masses are frequently found inclosed by the granite, or also bands of schist in scaly fissile condition are wedged in between the granite, which evidently is a fused and altered sedimentary formation of olderage than the Huronian but its eruption to the surface seems to have occurred later.

2 miles south of Sec.6, in Sec. 19 Mr. Lonsdorf and others have opened test pits for iron ore in a formation which lies directly on the granite and seems to correspond with the strata of the Taylor mine, consequently a younger formation than the Cascade ore. Plumbago schists and actinolitic seams of magnetic iron ore are characteristic for that locality.

As Thursday which was intended to be spent in examination of these southern exploring pits, was a rainy stormy day I returned to Negaunee without having accomplished my design. Paid for services 5 dollars to Mr. Fitzsimons besides other expenses of trip.

Friday June 3. To Republic mine. The ore formations describes an arch surrounding Smith's bay with the layers dipping in steeply inclined position all around towards the bay.

A knob next to the hotel consists of an eruptive hornblende rock of coarse or finer crystalline grain. It contains a good proportion of white feldspar and also considerable quantities of black mica, also garnets are in certain portions abundant. This rock is parallel with jasper banded specular schists and incloses strips of these schists next to the junction of the two rocks.

Diagram

The strata are almost vertical going across the formation. We find towards the bay a very large series of banded specular schists which at certain horizonz inclose valuable beds of specular ore from 5 to 30 feet in width. Within the banded jasper strata I observe in the mine a thick belt of quartzite of partly hydro-micaceous, partly of epidotic admixture.

Not fat apart from it is a brecciated stratum of quartz rock mixed with ore fragments. On the other side of the first mentioned granitiferous hornblende rock which is about 150 feet wide, are again banded ferruginous rocks, darker colored than the jaspery beds and gradually assuming the nature of the banded actinolite schists.Then follows another belt of hornblende rock in the succession and again a belt of actinolite schist.Hornblende rock again and actinolite schist again. Commencing at the periphery of the arch we find the following sequence.

Diagram

On the spur on west side of Smiths bay

Diagram

the above represented distribution of rocks is observed. The ore formation is the same as of the Republic. The upper strata next to the quartzite are a coarsely brecciated ore mingled with quartz and jasper fragments.

Going from here south toward the waterworks we see south of the ore bearing schists the actinolite schists again, amounting to great thickness but not separated into distinct belts as it is in the north part of the arch at the Republic mine and likewise at Klomans mine. The hills on the northside of the river at Klomans consist of granite. In the Kloman the strata are perfectly identical, quartzite ore formation actinolite schists, diorite belt and again actinolite schists are the succeeding rocks of a cross section from the mine to the river.

Saturday June 4. From Republic to the mining locations up the Michig(amee) river.

with Mr. Wright of Toledo to Sec. 28 T. 47 R. 30.(Erie mines). Examined the hills on left side of road in Sec. 35. Found large exposures of the garnetiferous schists with diorite belts in part constituting a brecciated mass of intermingled strata. These rocks were intersected by dykes of a coarse grained granite. Further on were similar exposures all along the hill range.

In Sec. 28 is the location of the Cannon mines and further west of the Erie mines adjoining the Cannon location. At the Cannon location about ¼ mile of the road we find first outcrops of a micaceous quartzite dipping towards the river. Under it are the red jasper banded specular ores with some seams of good slate ore. Under them are the banded ferruginous actinolitic schists similar to those of the magnetic mine. They are interstratified with micaceous garnet bearing rocks besides seams of granular sub-magnetic ore but not in productive seams. Further west on the location are other pits in which the garnetiferous schists and diorite belts are promiscuously intermingled. They inclose fragmentary masses of the mixed banded slate ores and also of the lower banded magnetic strata which are in a brecciated condition. It appears as if the garnetiferous and dioritic rocks had intruded and broke through the ore bearing strata and inclosed within their folds large masses of the ore formation (Republic ore belt).

In the adjoining pits of the Erie mine are similar conditions. The garnetiferous mica schists have evidently intruded in irregularly tortuous seams the Republic ore formation which there contains very fine specular slate ore within the banded jasper ores. There are large seams of mica schist and of micaceous quartzite connected with the red jasper banded ore formation but the strata are so confusedly intermingled that no regularity in their succession is observable.

It is here plainly evinced that the dioritic belts and garnet bearing schists occupy no definite horizon with regard to the Republic ore belt and the actinolitic ferruginous schists but are intrusive and broke through them . As circumstances favored an eruption but there exists a sort of parallelism between them.

Lost my spectacles south of Republic. today.

Monday June 6 Paragraph in German

Crossed Michigamme river in boat. Found the gneissoid quartz rock which forms the point on Smiths Bay on the hillside forming a very broad massive belt dipping steeply towards the river. The strata on the point dip in the same direction. Behind this quartzrock follows a large body of granite in immediate contact with it in front of this quartzrock more toward the Kloman mine is a very big belt of dioritic rock closely connected with it and partly intermingling with the quartzrock.

The strata of the St.Clair mine are wedged in between the quartzrock on the point and the granite on the other side. They dip in an opposite direction from the sandrock under the river bed and towards the granite.

Diagram

Paid hotel bill 6 dollars for 3 days. Returned to Negaunee. Found letters at Post Office from Hahn and Reuttinger. Received proof sheets from Jul. Bien. Read proof made the necessary alterations in text.

Tuesday June 7. Went to Lake Bancroft and convinced myself fully of the analogy of the banded ferruginous actinolite schists with the actinolite formation of the Washington and Republic mine. The underlying sub-calcareous rock is a true diorite inseparably connected with the dioritic main body of the hill. That diorite is in places full of angular pebbles of stratified quartzose rocks and also garnets occur in it. I consider it therefore as analogous with the garnetiferous diorites connected with the actinolite schists of the Republic mine and surroundings.

Wednesday June 8. Went in the morning to Lake Godwin near the west ¼ post of Sec. 12, T. 47 R. 27. Found the banded ferruginous schists in some outcrops surrounding the diorite knobs in the N W.¼ of the section. The schists resemble much the actinolite schists at Lake Bancroft but contain no actinolite. They are highly charged with magnetite. On the north side of the diorite hills the strata dip north . On the south side in the valley of the creek which enters the lake they have a southern dip. The strata on the northside of that valley are the banded jasper ores of the regular ore formation. On the south side of the valley are the dark colored banded magnetic schists which plainly succeed the ore formation in conformity.

Diagram.

I am now perfectly satisfied with the correctness of my former observations. These blackish banded ferruginous schists are directly incumbent on the ore formation but the strata of lake Bankroft are so very similar to them in general aspect that I feel not quite satisfied whether I made a mistake of classifying them with the lower actinolite schists as I have done in my report while correcting the proof.

In the afternoon went to the N E ¼ of Sec. 18. Found a large series of the same ferruginous blackish colored strata above the ore formation. As examined in the morning they dip towards the diorite which in places bulges out through them. They occupy the highest position on the slope and under them succeeds the iron formation, conformably, which direct superposition I had not observed before. But this time I could see it to full satisfaction.

I mentioned in former descriptions a bed of calcareo-dioritic rock as interstratified with these schists but I noticed now distinctly that it is not an interstratified bed but a portion of the underlying diorite formation of intrusive nature.

Donnerstag(Thursday) June 9. Went with Kirkwood to Sec.12, T. 47,R. 28 where he sunk a good many test pits in the S W.¼ of the Sec. All the surface is covered with drift to a depth of 50 and 60 feet. In the bottom of the pits he finds either black slatey ore, the glassy quartzite of the 5th group. I advised him to quit at once as he had no prospect of finding ore in that place. The black slate belt lies in the prolongation of the knob further west in the curve of Carp River which consists altogether of slate.

From there I went to the Excelsior location. The hills west are deeply covered with drift and nothing can be seen. The outcrops on the hill north of the mine represent the banded jasper ores of the horizon of the McCumber mine. The belt is very thick and can be traced north of the diorite knobs for quite a distance east. The strata dip south but are nearly vertical. Further north are everywhere traces of the arenaceous slate group by the occurrence of a large number of boulders of the banded slaty beds. I have in my report to make so far an alteration as the beds on the south part of the hill lands belong to the iron formation. The north part to the 5th group. Returned in the evening to Ishpeming and thence to Negaunee.

Diagram

Friday June 10. Went to Eagle Mills and walked back observing the quartzite outcrops in Sec. 33 and 32. The quartzite forms two principal large belts. The lower is partly conglomeratic, is associated with the novaculitic strata next below the quartzite are fine grained silky shining steel gray schists. These again are resting on chloritic dioritic schists. The slates and sandrock belts above the quartzite are well disclosed in the railroad cuts in Sec. 32. Part of them is grey or greenish or blackish. Other portions are impregnated with red oxyd of iron which deceived many ore hunters to open there exploring pits. The slates and sandrocks of the fifth group seem to succeed the quartzite formation conformably. Afternoon went per railroad to Smiths mine S E ¼ of Sec. 18 T. 45, R. 25.

Near the eastline corner not far south of mine old pits of Smith are in Sec. 20. A part of the new mine is in Sec. 17. The hard ore mine is in the N E.¼ just over the line. Smith mine is opened on the west side of the Escanaba river. The first openings made by Smith are in the N W ¼ of the N.W ¼ of Sec. 20. The presently worked pits are in the S.E ¼ of the S E ¼ of Sec. 18 anda a new pit is just begun to be opened in the S.E.¼ of the N W.¼ of Sec. 18. The latter pit exhibits under a heavy cover of drift sand quite massive ledges of a hard ore of very good quality. A portion of it is brecciated by intermixture with schist fragments. The ore consists of a dense amorphous oxyd in association with an abundance of bright grape ore seams (Goethite). The ore belt is considerably thick.

As far as I have observed the structure of the formation it strikes from S E. to N.W. dips N E. Highest are brown partly cellulose silicious schists much shattered and twisted, narrow seams of soft grey ore or of the purplish micaceous kind, or (and) ochraceous masses help to compose this belt.

Under it are productive pocketlike irregular seams of soft haematite with harder lumps of glistening sub-crystalline grey ore. Lower follow rough cellulose quartzites brown colored by iron. Lower still are hard white and brown mottled brecciated quartzites which in part are a regularly banded jaspery rock.

It amounts to a thickness of about 100 or more feet. Under this succeeds a large belt of black hard slates with intermingled seams and lenticular masses of a black granular quartzite. These 3 mentioned rock belts can be followed in regular order for a mile and over without interruption.

Saturday June 11. Went down to river near western new pit. A tunnel is driven into the hill in which first were struck 40 feet of graphite schists. Then came light grey colored argillite schists readily decaying into small angular fragments. Then comes the ore bearing rock with yellow jasper and gray glistening ore like the ore in the east part of the mine, and with this also occurs the massive ore belt with botryoidal Goethite veins which ore is only a local modification of the main ore deposit Zuhet (paid) Sperly June 3-11 inclusive 12 dollars. At Smiths mine 1.50.

Sunday 12.

Monday 13. Paragraph in German. Rain. Sent letters to family. Corrected 120 sheets of manuscript of his report and sent it to Jul. Bien

Went in the afternoon to quartzite range north of Negaunee. Met first with outcrops of the fifth group. Strike of formation N.E. to S.W. Dip S E. Composed of schists partly conglomeratic with interlaminated belts of a compact bluish colored quartzite. The outcrops amount to several hundred feet and between them and the quartzite bluffs of the high range is an interval of 6 or 800 feet covered with drift.

The quartzite range there consists of a compact belt of heavy quartzite ledges about 100 feet thick. Below this are hard lead colored fine grained argillite schists with thin bands of quartzite all amounting to about a hundred feet. Then follows another compact light colored quartzite belt of about 200 feet in thickness, again a belt of dark grey schist, and then another belt of coarse grained and conglomeratic quartzite which contains pebbles of jaspery lean ore and pebbles of white quartz. The cement is a hydro-micaceo novaculitic substance. This rock resembles exactly the conglomerate rock which overlies the ore belt of the Cascade mine. Under it are greenish gray hydro-micaceous schists which in seams contain an abundance of good sized octahedric martite crystals and these are followed by greenish colored dioritic schists. The novaculite quarries belong into this lower horizon between the conglomeratic quartzite and the dioritic schists.

The schists below the conglomeratic quartzite filled with martite crystals are an exact equivalent of similar martite schists which underlie the ore formation of the Excelsior mine, and by this instance I have become fully satisfied that the Negaunee ore formation belongs beneath the quartzite and of the equivalency of the Teal Lake quartzite and the quartzites above the ore belt of Negaunee. See specimens collected there and marked accordingly.

Telegraphed to Mr. Osborn whether he is ready to go to Michigamee tomorrow. 25 cts.

Tuesday June 14. To Michigamee. Went towards the lake shore south of hotel. Found a large outcrop of dark ferruginous actinolite schists. Dip south. Afternoon to Spur mine. Passed the schistose exposures on railroad track west of Michigamee village. They resemble much the mica schists on the south shore of the lake and also closely connect with the actinolitic strata north of them.

Went to the slope of hills where large outcrops and huge loose masses of the actinolite formation are exposed. The actinolite is intimately connected with dark micaceo-chloritic rocks. Some belts are quartzite with considerable magnetite granules dispersed. Also are intermixture of the schists and transition into white speckled diorites of great hardness are seen. The rock often constitutes a coarse breccia. Towards the creek on the east side of Spur mine the exposures are particularly fine chloritic belts with garnet and Margarite are interlaminated and in a tortuous manner mingled with the banded actinolite schists. At the creek on the west side the red jasper banded specular ores crop out and are evidently above ?

The actinolite schists seen on the east side of the creek but above the red banded jaspery strata and again a large succession of dark banded strata composed of magnetic ore seams and of white granular quartz, which are likewise crowded with actinolite crystals. Then follow the ore belt below and above it chloritic beds and uppermost a thick belt of dark compact quartzite partly brecciated.

Below the red jaspery lean ores are in this place(west of the creek) the actinolite schists plainly seen to underlie but also above them are similar strata and further west a large belt of speckled diorite. Still further west the jaspery lean ores are not underlais by actinolite schists and repose directly on as the on former occasions described actinolitic-diorite rock. But if we go across this diorite northward we find on its other side again a large series of banded actinolite schist of quartzose and magnetic character.

The different strata of the Spur mine locality are very much differing in their order of succession, in various places quite near to each other. It is however certain that the actinolite schists form very similar belts above and below the ore formation which is actually an integrant part of them.

Diagram

Wednesday June 15. With boat on Lake Michigamee down to its outlet. Devils Island in the north part of the lake the first island met with which is not marked on the map. Consists of an eruptive rock probably of doleritic or diabasic nature. South and east of it is Manitou Island which consists of a very thick series of compact micaceo-quartzose schists belonging to the Staurolitic mica schist formation. Strata almost vertical. Dip to the north. All the other islands we passed belong to the same Staurolitic mica schist formation.

After reaching the outlet of the lake returned. A quarter of a mile above the outlet is a island close to the shore which consists of a series of blackish banded schists weathering light grey and being more distinctly banded on such faces. They represent a part of the Staurolitic mica schist formation. Position of this island in the S E ¼ of the N W.¼ of Sec. 9, T. 47, R. 30.

The islands in the N E ¼ of Sec.9 and in the S E.¼ of SEc.4 and also the mainland in the S E ¼ of Sec.4 represent all the mica schist formation. All these strata of very great thickness strike from north to south and dip west. The rocks which I collected some weeks ago in the S.E.¼ of Sec.4 are lower beds belonging to the same series. The outcrops are (a) little distance east of those now described.

Landed in the S W.¼ of the S W.¼ of Sec.29 where the mica schist formation forms large bluffs which represent a succession of nearly a 1000 feet of hard compact but well laminated micaceo-quartzose schists. All the series similar in appearance.

There are in this rock also Staurolite crystals and concretionary seams of a silicious rock full of hornblende crystals the soft fissile mica schists underlie it.

Re-examined Michigamee mine. Found a large belt of red jasper banded specular schists directly incumbent on the diorite south white banded magnetic lean ores on them a belt of magnetic ore from 15 to 20 feet. On this a belt of compact dark colored quartzite 50 feet on this conformably overlaid. Actinolitic quartz schists impregnated with magnetite and sometimes exclusively quartzose 120 feet on these banded actinolite schists contorted and conglomeratic or brecciated in certain layers. 500 feet rich in seams of magnetic ore partly fine grained compact silicious, partly gritty sandrocks of a porous structure

Diagram Spur mine.

Thursday June 16. Rain. 9 pages of German.

Monday June 20 Returned to Negaunee. Received proof sheets read and corrected them and sent them back. Paid to Sperly for board 5 dollars. Paid at Humboldt 4.75.

Tuesday 21 to Quinnesec.

Wednesday 22. Went over the Quinnesec mine. The strata if the entire hill have a regular dip to the north. The limestone north of the ore belt is so near to a vertical position that it is impossible to ascertain whether its dip is likewise north or not. The dip of the large outcrops east of the mine is decidedly south, but going some distance north over the bluffs we find locally also a northern dip. West of the Quinnesec mine are new exploring pits in which the formation dips likewise north and the limestone is found on their north side. It seems therefore in these localities that the limestone is the overlying rock. And then the silky shining grey schists would be the lower strata underlying the ore formation and resting on thedioritic rocks south of the Menominee river. The limestones of the Norway mine are then in an overtilted position and the sericite schists north of them likewise. In this case the Commonwealth ore formation would be a higher instead of a lower series of strata.

Went to slope of ore hills on west side of Quinnesec and convinced myself by the rock exposed in numerous test pits of the error in which I previously fell. The silky shining slates are the truly underlying rock of the ore formation and the lake Hanbury series is consequently an older rock than the ore formation.

Thursday June 23. Paid to man 1 dollar for guiding me ½ day. Went to Norway. The stone lime belt behind the ore belt is according to my recently adopted views in an overtilted position and the seritic clay slates north of it are actually higher strata. The limestone is interrupted on the east side and the eastern part of the formation is several hundred steps more to the south. It runs along the south line of Sec. 4 but disappears under the silurian sandrock towards the middle of the section.

The old test shaft of Stephenson now again explored by Mr. Sexton is not far from the N.W. corner of the N.E.¼ of the south half of the N.W.¼ of Sec. 9. Another party owns the N.½ of the N.W.¼

I had formerly on the map indicated the extension of the limestone belt too far south, only little of it shows itself north of the shaft in Sec. 9. The main belt is in the N.½ of the N W.¼. The lower strata of the limestone formation are pre-eminently a quartzite of partly brecciated character and somewhat red colored by iron oxyd.

Dinner at the Wendel House at Norway. Afternoon went over the N.½ of the N.W.¼ of the Sec. Found the ore formation well exposed in the swamp south of the limestone ridge. Returned to Quinnesec.

Friday June 24. Rainy. Walked to Iron Mountain City and to Chapin mine which is situated in the S.E.¼ of the S.W ¼ of Sec. 30 while the next adjoining new mine in direct continuation of the Chapin mine ore belt is in the N.W.¼ of the N.E ¼ of Sec. 31. Dip of the strata north. Above and below the ore the soft hematitic argillites. The Iron mountain mixed jasper ores underlie the Chapin mine and the limestone belt north overlies it.

At the Ludington mine the strata are upheaved into a vertical position. Partly they dip south but on the upper side of these ledges are the imprints of ripple marks which appear by the sharp crests they exhibit to prove the overtilted position of the ledges. On the west side of the Ludington hill range are large exposures and many test pits . On the south slope of the range hill(or with) a southern dip or in a nearly vertical position. The most southern ledges exposed in the valley are soft hematitic clay slates. In a drift hole at Ludington mine the limestone is shown (struck) right under the ore.

Saturday June 25. Read proof sheets of my report. Rainy.

Sunday June 26. Rainy. Went in the afternoon to Lake Furnace. The ore found there is a fine blue ore like the Vulcan mine ore. It is found about 60 feet south of the old pits in the swamp. Going up northward from the mine on the hillside some test pits lately dug have uncovered a compact quartzite of light color which contain seams of a coarsely crystalline calcareous rock. East from there are a number of other pits in which the following succession of beds is observable:

Next under the jaspery lean ores are dark blackish colored partly banded argillitic quartz schists and red colored argillites which repose on the before mentioned quartzite. Some lean Hematites which are however much mixed with rock. Under the quartziteare dark red colored silicious, sparry and partly micaceous silicious limestones of considerable thickness which I formerly observed but mistook for silurian strata which they are not, as I saw them in an uplifted position conformable with the other Huronian beds. They are the lowest strata seen there. See specimens collected 10 in number, all from below the ore bearing series.

Monday June 27. Went with Mr. McMinn to test pits in Sec. 6 west of the Cyclops. Ascertained the summit part of the ridge to be composed of the quartzite layers of the limestone formation which occasionally inclose argillitic and ferruginous seams Dip south. On their south side follow light colored schists of argillitic sub-micaceous character containing little granular martite. On them succeed similar schists colored dark grey by an abundance of a granular martite. Some jaspery often brecciated seams cemented with calkspar are often seen interlaminated with them.

This seems to me also the horizon of the blue ore deposits of the Cyclops mine as some narrow seams of such ore occur there but no larger belt. Still further south are intensely red colored partly jaspery, partly argillitic strata representing the jaspery ore belt underlying the ore belt of the Quinnesec mine and inclosing narrow seams of good hematite or hard specular ore lenses but not enough of them to be of great value. The strata dip all regularly to the south.

With the noon train went to Florence. Took dinner there. Went then to the junction of Brule river with Paint river. There are the mica schists and harder rock ledges identical with those exposed at the mouth of the Michigamee. The strata dip south stri across the river bed but the largest outcrops are on the Michigan side. (ke

Lower down this rock series is succeeded by a very large succession of softer schists of more or less micaceous character. They overlie the others and dip like wise south. Still higher schistose beds of a more chloritic character succeed them in exposures on the Wisconsin side and these dip right towards a body of massive diorite which crops out about a ¼ of a mile below the junction of the rivers.

Diagram

Dienstag June 28. With Mr. Nelson to Crystal Falls. We find after crossing the Brule river quite large exposures of the mica schist formation in Sec.35, T.42, R.32. Past those are very extensive sahd covered plateau lands on which at times a knob of diorite projects, as for instance in the S.E.¼ of Sec.16. From here no more outcrops are seen until we come into Sec.29, T. 43, R. 32 where the quartz schists, slates and ferruginous strata of the ore formation are from time to time seen in small outcrops but principally uncovered by test pits.

There seem to exist dioritic rocks beneath these strata which cover in this part the surface of many square miles but are mostly hidden under the drift and surface material. One very instructive exposure is offered by the Crystal Falls. A succession of over a thousand feet of strata is exposed there striking across the river but the beds are so much dislocated that their strike often changes abruptly in a sharp or right angle. Other parts of the formation are seen bent in sharp zigzag lines hither and thither or coiled up in a spiral way.

The falls are formed by a series of over 700 feet of hard quartz schists of a banded slightly ferruginous character and sometimes interstratified with a seam of plumbago schist. Below the falls are softer more slaty rocks full of plumgagineous belts and containing right under the falls a seam of excellent ore about 5 feet wide but so far this has proved to be only a small severed mass of an ore bearing seam whose continuation further into the mountain side is not yet discovered.

On the northeast side of the falls the same rock series forms the surface and there in Sec. 21 some good ore seams have been found by test pitting. Not enough regularity exists in the displacement of this rock series that anyone could make a calculation upon the extent of a certain subordinate rock belt in it.

Wednesday June 29. Went with Mr. Bordman to Brule River. Crossed the Brule in the centre part of Sec. 17. Went to his exploring pits in the N W ¼ of the sec. We first go across a diorite ridge. Descended its northside and found at the south slope of another diorite ridge the mica schist formation through which this second diorite mass evidently made its eruption. The upper strata are not much mixed with iron oxyd.

The lower strata are dark red colored and contain in part 50 per cent of iron oxyd. Some quartzose seams are found in the lower part of this series next to the diorite which in its surface portions is much weathered, earthy, and portions of this quartz rock are much mixed with hard specular iron ore which seams are irregularly mingled and wedged in between the dioritic rock.

This mica schist and iron bearing schist is said to lie south of the mica schist of the falls of Michigamee. Also considering the outcrops of hard mica schist at the junction of the Brule river with Paint River the hard mica schist is the lower formation and the soft strata containing the iron are the upper in the succession .

The soft schists on Brule River described in the diary two days before seem to be the identical beds met with in the mines or testpits. There are test pits of the Menominee Iron Co. on the Wisconsin side of the river which are essentially in the same beds as those on the Michigan side. The next underlying rock is always the diorite which crops out on many places on the river, and on the interval between Florence and the road to the river. The schists are as it seems inconformably deposited on the diorite, but the lower beds partake much of a dioritic character.

Thursday. June 30. Went with Mr. Morrison and Brodmann to Pumpelli's hill south of Keys lake, which is composed principally of ferruginous quartz schists and partly of plumbago schists. Thence west to Sec. 1 in the western town where numerous test pits are opened in red colored sericite schists but no indications of richer ore seams. From there south into Sec. 12 where a ridge of diorite trending east and west and dipping north is found. On the diorite are dark actinolite schists.

Afternoon went with Mr. Lindner, Kempts man to Ellwood mines. The high part of the ridge on Wisconsin side of the river is diorite which on the slope is surrounded by the ferruginous mica schist formation, like the one seen in Kempts exploring pits. The diorite in contact with the ore formation is decomposed and represents an argillite. The next sedimentary strata on the weathered diorite are mica schists intensely impregnated with Hematite. They incrust the whole rounded surface of the diorite and contain as much as 50 per cent of iron. The fissures in the diorite are all filled with a rich hematite which is mingled with hornblende ? crystals and with quartz nodules.

Higher up in the series the shining mica schists are light grey colored and contain little iron. Above them is on the north side of the mining location probably in the next adjoining section a belt of graphite schists. These strata which all have a southern dip seem to overlie directly the harder strata of the mica schist formation which are exposed at the junction of Brule and Paint rivers. Going from here southwest we find schistose quartzites covering the surface in big angular slabs which inclose seams of a rich specular granular ore, the position of which to the other strata I was unable to ascertain.

Friday July 1. Paid hotel bill 6 dollars. Went to Quinnesec. From Quinnesec went with Mr. Hamilton and Merriman to their camp in Sec. 14. They have opened there a number of exploring pits. The lowest strata seen are the limestones I saw in one pit the chloritic and feldspathic limestone of which I formerly found only boulders, well exposed in place. They dip south. South of them is the before mentioned big belt of quartzite with carbonate of iron. Further north are hard argillites in a sort of non-stratified form which resembles much the weathered Kaolinitic diorite at the Ellwood mine.

Still further are argillites of more or less seritic and slaty character and also porous cherty quartz rocks pervaded with achre and Hematite,and some distance further south are the hard silky shining black slates of which I have spoken on previous pages of last years report.

Returning we stopped at the test pits of Fitzsimons in Sec. 15. We see there hematitic sericites and ferruginous quartzrocks overlaid by silurian sandstones but no larger seams of ore although some lumps as big as a man's fist may be picked up from the rubbish of quartzrock.

Saw the cores from the drillhole in Sec. 25 south of the Ludington mine and at the mine. Those at the mine go all through the limestone which at times incloses little nodular masses of ore. The drillhole south at the base of the high hill range evidently was sunk through the sericitic gray schists which are intermediate between the Lake Hanbury formation and the ore formation judging from the nature of the cores. At Quinnesec 1.50 hotel bill.

Saturday July 2. Went to Negaunee.
Sunday July 3. To Ishpeming making arrangements for the trip to Gogebic Lake.

Monday July 4. With Mr. Murdock to Sec.2, T. 46 R. 27. All granitic rocks,granite intersected by diorite and both by narrower diorite dykes of fine grained dioritic rock. Also narrow seams of silicious hydro-mica schists inclosed within the granite masses but not a trace of the iron formation except large boulders.

Gave to washwoman 8 pieces 3 shirts, 2 towels 2 socks, one coat. Paid Sperly 3 dollars up to July 5. noon. Deposited a one hundred dollar note with Mr.Griffith postmaster.

Tuesday July 5. Afternoon with Mr. Swift and others to LeAnse and Gogebic lake. Steamer to Houghton 1.50. Hotel Houghton. Stage to Rockland.

Wednesday July 6. Arrived in the evening at Rockland. Mr. Caldwell,Ishpeming. Rockland over night. Visited Minnesota mine Diamond drill holes sunk in many places. Splendid view from these hights.

Thursday 7. From Rockland to Balkans mine 6 miles this side of Lake Gogebic in Sec. 19 and 20 of T 49, R. 41.

Friday 8 to outlet of Lake Gogebic. Arrived at 10 o'clock morning. Waited for boats. All the way high bluffs of Copper trap. Afternoon to a promontory in lake Rough lake.

Saturday 9. Left camp early in the morning. Rowed to inlet of lake Gogebic without meeting on any side of the lake with outcrops but all the boulders on shore are melaphyr and porphyry. Just at the entrance into the river at south end of the lake a rocky knob cosists of silky shining hard schists and of harder thick bedded rocks of the same quartzose feldspathic and micaceous character . Up the river a swampy valley extends for about 2 miles. The river bed is very tortuous, the water deep and sluggish. Contains a great abundance of trout from 2 to 4 pounds. In the lake are perch of large size in great numbers. In Sec.9 the river forms cascades. I have not been up there this day, will examine them tomorrow. We camped in the centre of Sec.9, T. 46, R. 42.

Sunday July 10. Went to Falls of river at the head of Lake Gogebic. Large outcrops of hard mica schists of great thickness dip apparently south. From here to ¼ post on west line of Sec. 16, thence to S E corner of Sec.16, from there to S.E. corner of Sec. 15, thence north half a mile to ¼ post in swamp. On the way high bluffs passed by the line consisting of hard diorite like rock in connection with mica schists. No other outcrops seen but of rocks similar to them. Such are exposed also near the centre of Sec.15. On the west a seam of iron ore 3 feet wide is indicated near the corner of Sec. 15 but I could not find any and also the loose rock masses did not indicate the neighborhood of such a belt. The hard mica schists seem to be the only surface rock of that country. Returned in the evening to camp on the river about 1½ miles south of inlet of Lake Gogebic.

Monday July 11. Went with boat up Lake Gogebic to the FlamboIndians trail. Examined the shoreline carefully but could not find outcrops of any kind. The shore is lined with large trap and porphyry boulders with few granitic and dioritic. Monday night hard rain and our camping place transformed into a mudhole. Mosquitoes very plenty.

Tuesday July 12. For some distance went on newly blazed trail along section lines to a locality in the centre part of sec. 35 T. 46, R. 43 and returned after inspection. Outcrops of the hard schists composing the falls of river noticeable in various places.

Wednesday 13. Went on trail to the before mentioned locality in Sec. 35 where an argentiferous galena is said to occur in a quartz vein. The way to this place is indicated by blazed trees but is almost impassable by shrubs and particularly taxus bushes, cedar roots and a great part goes through thick swamps. Scarcely an outcrop of rock is seen on the whole distance. Some exposures noticed are rocks of the same micaceo-schistose nature as seen at the falls near our camp.

In the middle of a swamp in Sec.35, a gneissoid hornblende rock protrudes in a low knob. It contains narrow fissure veins of quartz but the quartz bears, excepting occasional nodules of iron pyrites no metalliferous character and the laborious exertions of the poor deluded explorers will certainly end in disappointment. Still they are at present full of hope and accept no reasonable advice. Camped on the right not far from these quartzose veins and returned

Thursday morning July 14 to our camp where we arrived at 2 o'clock in the afternoon.

Friday July 15. Left camp on river and rowed 6 miles down the lake. Camped at Flambo Indians trail which same trail leads to the exploring pits of Gillis for argentiferous galena. They are situated near the south corner below Sec.14 and 15 of T. 47, R. 43. Spent afternoon in fixing up camp near shore. In the evening a thunderstorm.

Saturday July 16. A most delightful morning . After breakfast went to Gillis exploring pits. A fine trail leads there. On the south side of it about 1 mile this side of Gillis camp are high rock bluffs consisting of granite. The most western outcrop next to the trail is a chloritic dioritic schist which incloses narrow seams of spar. Dip south. Strike nearly east and west.

At Gillis' place on northside of camp are bluffs of quartzite well laminated, partly grey, partly red and portions of the rock weathered rust colored and porous. There are also schistose layers connected with the quartzite which strikes east and west. Dips north. The quartzite contains irregular narrow seams and nests of galena iron and copper pyrites which are not fissure veins but run parallel with the stratification. From Gillis Camp a trail is cut out to Sunday lake.

Sunday 17. Left with boat for outlet of Gogebic. Handed to Mr Swift bag with 30 specimens. Returned in the evening to camp. Arrived about 3 o'clock. Hid the boat and prepared for trip to Sunday lake.

Monday July 18. Left camp at 8 o'clock. Arrived at Gillis' camp a quarter before 10 o'clock. Near ¼ post of Sec.16, T.47, R.43 dark slate rock bluffs. Dip south. 12 o'clock at Presque Isle River. Camped at 6 on a small creek about near the ¼ post on the south line of Sec. 14, T. 47, R.44. The hills surrounding the place have steep rock bluffs on their slope consisting of a compact hard greenstone of fine aphanitic grain.

Tuesday July 19. Left camp at 6 o'clock. Crossed a stream surrounded by swamp and passed on along the trail which follows the east and west section line over undulating hardwood lands and intermediate swamps to about the ¼ post on south line of sec.17, T. 47, R.44 where a high bluff of marble with eastern trend dips under an angle of about 45 degrees to the north. The marble is very thick in the succession of beds of well laminated structure. Further on no more outcrops for a long distance. Much swampland. Near the N W corner of Sec 14 and in the south part of Sec.10 and 11 adjoining are outcrops of quartzite white or iron stained massive or banded jaspery structure, dip north.

North of the quartzite are slaty rocks exposed likewise in a very thick succession of beds light grey or hematite colored of some silky lustre. Dip conformable with the quartzite formation to the north. Some test pits for iron opened on the south line of Sec. 10, T. 47, R. 45. Camped on north part of east of Sunday lake. The north and west side of the lake is surrounded by high knobs but they do not rise close by the shore. No outcrops in the circumference of the lake visible.

Wednesday July 20. Left camp during the forenoon, return examined on the way the different outcrops on the trail with more leisure. A test pit on the south line of sec. 10, T. 47, R. 45 is opened in white and red colored banded or also flaggy quartzites. Some beds are flinty and brecciated but no indication here of an ore deposit. Dip of strata regularly to the north. Further east near the section corner outcrops of slate rock in gray or also red colored strata of great thickness. Dip north. Also the quartzites are exposed there evidently beneath the slates.

Further on on the south line of Sec. 18 in the next town are high bluffs of compact red colored quartzite, seen next to the trail from here. No outcrops unto about the south line of the S W.¼ of Sec. 17 where large bluffs of limestone are found. Dip north strike East and west Camped at foot of bluffs.

Thursday July 21. The limestone continues to the S E. corner of Sec.17,T.47,R.44 From here to crossing of west branch of Presque Isle river no more outcrops seen. On the north line of Sec. 23 and 24 frequent exposures of a peculiar schistose partly brecciated greenstone which near the ¼ post of Sec. 24 contains large proportions of epidote and red feldspar, also quartz and chlorite.

Some testpits opened there by a half-breed Indian. He says to have found native silver and copper in that rock besides copper pyrites but I have not found any of these minerals in it. Camped on Presque Isle river in the S.E ¼ of Sec. 17,T.47, R.43. Silicious slate rock of blackish color exposed there and from the river all along the trail to Gillis mine to be seen in largebluffs on the hilly part, not in the big swamp intervening.

Friday July 22 returned to camp on Lake Gogebic. Arrived there about 11 o'clock.

Saturday 23. Left at 5 in the morning . Arrived at 10 on outlet of Lake.Walked to Balkoms mine 5 miles distance and from there to Fergusons where we stopped over night. All the way from the lake large bluffs of melaphyr with epidote and amygdaloid veins. Many abandoned mining locations. Copper not seen in the waste rock piles as usual in the mines of the Houghton and Ontonagon district. J. Coon carried a part of my baggage to Fergasons. At Fergusons lodging and board 2.50

Sunday 24. Hired wagon to Rockland 6.00. Arrived at Rockland at noon. Bought silver specimens 10.00.Rain in the evening.

Monday July 25. Rainy again. Remained at Rockland.

Tuesday 26. Went by stage to Houghton. 6.00 fare with baggage. At Houghton stayed in Millers Hotel. Met Mr. Ames, Mr. Sheldon, Mr. Hoar and several others. Remained with them until 2 o'clock at night. Mr. Sheldon presented me with 2 very fine silver specimens, one from Cliff mine, the other from Ridge mine.

Wednesday 27. Remained at Houghton. Saw several private collections, the Smelting works ectr.

Thursday.28. Went with steamer Ivenhoe to LeAnse 1.50. Hotel bill Houghton 4.00 Balance of page in German.

Saturday July 30. To Cliff mine Company. New discovery of an ore belt in a locality formerly examined and described by me in the report. 6 Boxes 4.80 pd. 1 trunk.80 pd. Shipped to Ann Arbor. Box 6. Silver and copper. Evening to Ishpeming to settle with Colwell.

Sunday July 31. At noon left Negaunee for Quinnesec. Hotel bill with Sperly 4.00.

Monday Aug. 1 to Norway. In the evening return to Quinnesec.

Tuesday Aug. 2. With Mr. Gehner to Indiana mine on Lake Furnace(Funce).Ore belt in swamp finely opened furnishing excellent blue ore in Sec. 26. The ore belt seems to run from the swamp into the lake. The hillsides exhibited red and gray partly silky shining argillited interlaminated with quartzose seams; lower a compact quartzite connected with quartz schists rich in ore particles and partly constituting a silicious hard ore,below are quartzites again and a thick belt of red colored sparry limerock with quartzite beds interlaminated. No further exposure of lower beds. Returned to Quinnesec at noon. Afternoon with Tom McKenna to test pits in Sec.3, T. 39, R. 29.

Wednesday Aug.3. With Mr. Brotherton to Felch Mountain by way of Norway. Nothing particular to be reported on the geology of the district we passed over. We see no outcrops until we reach the granite region which extends to the Sturgeon river from the Pine Creek. The quartzite belt on the southside of the granite usually visible along the Pine Creek is not exposed on the road crossing it.

After crossing the bridge over the Sturgeon where dioritie rocks are exposed in the river bed(on the line between Sec. 19 and 20) we ascend a high ridge with large boulders on the surface(granitic) but no outcrops. The road follows approximately the line between Sec. 18 and 17. Near the west ¼ post of Sec 17 the road turns in to Mr. Brothertons exploring pits. The camp is near the center of the S.W ¼ of the N.E.¼ on the north slope of the ridge.

No outcrops but under a drift cover of from 6 to 20 feet he finds in his test pits first nearest to the camp, a flinty dark colored quartzite dipping north. Next north of it are red more or less argillaceous fine grained or also gritty sandy mica schists of red iron color. The variations of this rock mixed with narrow sandy quartz seams amounts to about 150 feet. Then follow harder flaggy beds with less mica and somewhat more iron. Next to those on the north side are jaspery beds banded with narrow seams of an argillitic or silicious blue ore. The pits have at present not been extended farther. To the north at this part of the formation a very strong magnetic attraction is observed all along this ore bearing range.

Thursday Aug. 4. During previous evening and night constant rain and thunderstorm. Left Brothertons camp after breakfast. Went with Brotherton from Sec.17 to his former explorations in Sec. 8. The trail leads over highlands covered with Silurian sandrock. Then across a swamp into another lower hill range on which the ore formation projects in the central part below a thin stratum of sandstone while in the circumference the sandstone becomes much thicker. The strata here dip south instead of north but their sequence is about the same as in 17. Quartzite lowest, then mica schists and argillites more or less impregnated with iron and inclosing narrow seams of fine blue ore. Then follow harder flaggy beds rich in iron and jaspery lean ores. The blue ore seems to have its place intermediate between these harder silicious mixed ores and the mica schist and argillite.

Further north on the ridge the strata are in a very irregular confused position dipping in all directions and much broken up. These strata are principally composed of the silicious lean ore with some seams of Argillite and mica schists mingled with them. A very precipitous bluff is formed by these beds on the north side. Then comes a narrow swampy valley and across it the granite formation rises.

Jacobs pits are on an eastern continuation of this ridge and the formation is there in a highly confused broken condition. Fine ore seams, mica schists, argillites and silurian sandrock promiscuously intermingled in most of the pits. The ore is most excellent but it seems to me impossible to mine it with success as the strata are too much broken up and irregular. On the other side of the creek near Jacobs pits the granite is close by.

In the afternoon went on road to Felch Mountain across several rows of granite hills. The granite dips north, is generally well laminated gneissoid. Inclosed parallel belts of gneissoid hornblende rock from a few inches in width to 50 and 80 feet.

Near the south line of Sec. 33, T. 42, R. 28, north of a granite bluff another bluff of limestone dipping north the limestone is crystalline white full of tremolite crystals. Below the limestone is a compact quartzite inclosing a hornblendic or augitic mineral of greenish color in large tubular cleaving crystals. North of it are other quartzite ledges and then a large series of mica schists ferruginous and easy weathering.

At Felch Mountain passed Coreys location. Went to the northwestern mine where a new hotel is opened. Went with the Captain of the mine to the pits and ascertained the dip of the ore formation in that place to be to the south. The dark massive quartzite belt forms a prominent crest in the east part of the location. In the west part is is not well disclosed. The north side of this quartzite is underlaid by a belt of the soft blue ore and by other quartzose lean ore beds. The blue ore forms a very wide belt . On the south side of the quartzite belt it is found overlaid by mixed blue ore again and by silicious lean ores. The surfaces of the ore bearing rocks is in part overlaid by silurian sandrock which in its lower beds forms an ore breccia .

Friday Aug. 5. To Metropolitan mine,heavy rain in the forenoon. The entire thickness of ledges exposed on the location amounts to about 1000 feet The great quartzite belt is about 300 feet thick. North of it about 700 feet of ferrugineo-silicious argillitic beds with interlaminated seams of pure ore of various quality. The blue ore is hard very rich in spar and full of fine crystal druses. North of these are dark red mica schists more or less calcareous. Then follow as shown by the diamond drill a large belt of white crystalline limestone. The strataon the south rim of the formation have a northern dip or stand vertical. Further to the north the majority of beds has a southern dip.

Diagram Metropolitan mine section.

Diagram Saturday Aug. 6.

Saturday Aug. 6. Went to Northwestern mine. The great iron bearing quartzite belt is not well marked from the surrounding ore bearing silicious rock beds. The strata generally dipping south are in places also dipping to the north. South of the mines in a swamp amd across it, it is said the limestone forms good outcrops but I did not find them. I went across the swamp in south direction following the proposed railroad line for about ½ a mile. Came to a large granite knob . Thence north to another knob of granite. Further north ascended the high range and found a large belt of crystalline limestone with fine crystals of augite inclosed. North of this limestone outcrop dipping to the north are iron bearing silicious strata in contiguity with it. Thence descent into a narrow swamp. Ascent of the great iron bearing quartzite crest and then descent to the Metropolitan mining location.

Afternoon went with Mr. Dunn to S E ¼ of Sec. 33, T. 42, R. 28. A low ridge north of high bluffs of granite exhibits large outcrops of the iron bearing quartzute partly identical with the great quartzite on Felch Mountain, partly of a micaceous banded character rich in bright specular ore. Dip south but also north in places and the strata often much corrugated and contorted.

South of this broad belt of ore bearing rock are greenish dark colored mica schists which underlie it conformably. Next to the mica schist follows southward a broad belt of micaceous garnetrock which on the west side is divided in two by a belt of granite and hornblende gneiss.

South of the garnet rocks follow again green or blackish mica schists and banded micaceo-silicious ledges and then again a broad belt of Iron bearing quartzite ledges which like the former dip north. Immediately underlying this iron ore formation is the granite which likewise dips north. See section on former page.

of S E $\frac{1}{4}$ of
Diagram S $\frac{1}{2}$ of Sec.33, T.42, R. 28

Sunday Aug.7. Went with Mr. Dunn to Sec. 26, T. 42, R. 28. Followed from camp the road west for about $\frac{3}{4}$ of a mile on the high ridge covered with silurian sandrock. Descended over bluffs of it to a swamp crossed it and ascended a high ridge in the N E $\frac{1}{4}$ of Sec. 34 which I followed up to about the centre of the N W.$\frac{1}{4}$ of Sec. 35 where a mining camp is. From here went north to S W.$\frac{1}{4}$ of S.W.$\frac{1}{4}$ of Sec.26. All this large body of hill lands is intersected by a large belt of limestone in connection with light colored quartzite, dip of the strata is south in most instances or nearly vertical, but the larger part of the surface is covered with drift. No iron bearing strata seen. Returned at noon to Coreys camp. Afternoon went with Capt Wood to the limestone hill south of the Metropolitan mines where I had been yesterday.

After ascension of the ferruginous quartzite crest and descending on the south slope greenish mica schists are found in a test pit. Next to the trail they underlie the quartzite directly. Lower down towards a swampy depression are no more exposures. Ascending the hill across the swamp quartzose iron bearing strata in an almost vertical position form the whole slope and a part of the summit.Next south to these is a large limestone belt 200 feet thick which forms the south part of that hill.

Thence descending into a depression another lower hill range rises to the south which consists again of the iron bearing quartzite formation. Further on south the surface is covered for a few hundred steps and then a granite range follows. All these rocks seem to dip to the north but sometimes a southern dip or a vertical position is noticed.

From here went back to crest of limestone hill. Thence west where the limestone disappears and the hill slopes down into a swamp valley of narrow extent.On the north side of this valley the iron ridge of the northwestern mine ascends with ledges dipping south. At the base of the hill slope the limestone formation crops out in close contiguity with the ore formation. Some lean hematitic tinted quartz seams are next to the limestone. On the south side of the swamp is a low but very steep ridge consisting of Huron limestone. Its dip is not clearly ascertainable. At the base of this limestone hill close to the swamp green mica schist crops out. The sequence of the strata in this place is represented in the subjoined sketch.

Diagram of above.

Monday Aug. 8. Paragraph in German. 300 steps from foot of quartz ridge to little swamp thence a hill of rounded form on which the $\frac{1}{4}$ post is situated. It consists as shown by numerous pits of mica schists of red color. Dip almost vertical These schists form the entire plateau part of the hill. On the southern declivity of it are pits in which argillites and argillitic hematite ores are uncovered beneath a rich iron conglomerate of silurian age. Between these and the mica schist the upper part of the hill slope is covered with large boulders of granite diorite schist and limestone. From here south $\frac{3}{4}$ of a mile from north corner is a narrow swamp and beyond it granite knobs rise.

Returned to the high quartzitic lean ore belt of the Metropolitan mine. The foot of the range is as before mentioned formed of a thick belt of micaceous hornblendic rock of considerable thickness in massive but distinctly laminated subschistose strata. 300 steps west from the main street of village location a granite belt 16 feet wide transversally intersects the quartzose lean ore belt but is not seen to cut through the micaceous underlying rock.

Diagram

Limestone hill south of Northwestern mine in one place distinctly exhibits northern dip. The mica schist at the base of the hill seems to lie on it ?

Felch mountain hotel is close to the west of ¼ post of north line of Sec. 32, T. 42, R. 28.

Diagram

Tues. Aug. 9. Returned with stage to Norway.

Thurs. abend (evening) at Felch	1	and 1 lodging	
Friday	2	1	
Sat.	2	1	
Sun.	2	1	
Mon.	2	1	
Tues	1		
	10 meals	5 lodging	8 dollars
Stage to Norway			3 "
Dinner at halfway			70 cts.

Deliveredat Norway station agent 1 box of specimens for shipment to Ann Arbor. Evening at Quinnesec.

Wednesday Aug. 10. Received proof point from Bien for making index, other letters and office work.

Thursday Aug. 11. Hard thunderstorm and rain. Office work. In the evening with Mr. Hamilton to Merrimans camp in Sec. 14. Much exploring work has been done there since my last visit but no discovery of valuable ore has made. The order of rock beds is very obscure as few of them show distinct stratification and dip. Furthest north is the limestone of great thickness and in a great variety of forms from a minutely granular structure with conchoidal fracture to coarsely crystalline structure, partly pure white marble, partly dark mingled with mica, chlorite feldspar ectr and resembling a granitoid rock. Large massive quartz belts are connected with the limestones. Next south of those is a broad belt composed of red colored clay slates and cherty silicious beds most of them broken up into a mass of rubbish which is mingled with some concretionary masses of iron ore (see specimens). South of this iron bearing belt follow dark hard silky shining slates of great thickness which form the higher part of the hills.

Friday Aug. 12. Went with Mr. Hamilton to Dikes mine past East Vulcan, saw the irregular pocket like distribution of the blue ore in the silicious banded lean ore belt from the decomposition of which beds the ore belts seem to originate. From there went across Sturgeon River to exploring pits in Sec. 7 where lately new pits have been opened in which some soft blue ore was found in small interrupted belts intermingled with the jasper banded lean ores. A test pit has been opened near the limestone but it was too close to it as to strike the underlying strata.

Never the less it is certain that the limestone regularly overlies the ore formation of this locality and further it is certain that this ore formation is identical with the Quinnesec ore formation.

Returning I stopped at the exploring pits of Mr. Sackett in the swamp near Norway The test pits extend from the wagon road to the swamp and exhibit the whole series of the lean ore formation with narrow seams of good blue ore, in the northern part. There are still further north slaty banded argillites of light grey color found to underlie the ore bearing series. Those slates correspond in nature with the grey slates found in Wendels test pits. In Sec. 2, Next to the limestone bluffs and also here at a distance of about 2 or 300 feet the limestone rises in high bluffs consequently I came to the conclusion that in this locality no valuable ore deposits exist.

Saturday Aug. 13. Sent manuscript of index to myreport to Jul. Bien Sent letter home also to Prof. Jones. Afternoon with McMinn to his exploring pits in Sec. 32 and 33. In Sec. 32 he explores N.W. of the Keelridge mine in a depression behind the Keelridge crest. He worked through a thick series of silurian sandstones but has not commenced work with the diamond drill to lower Huronian strata. Not far west of the mentioned locality the Menominee Mining Company has drilled with the diamond drill through the sandstone but I do not know what depth.

At the Keelridge mine visited the underground work. The adit is through the old mining tunnel. The newly discovered belt of blue ore is only few feet north of the formerly worked ore belt. It amounts in places to pocket like dilatations 50 and 60 feet wide. Further north are lean argillitic beds of iron bearing strata which contain an abundance of spar. Further north are lighter colored argillitic strata similar to the slaterock on the north side of Sackets test pits. The same light colored argillites are uncovered east of the Keel ridge in the locality formerly described as exhibiting the ore formation with a northerndip.

Diagram

Went to westline of Sec. 33 near ¼ post. The mine sunk various drill holes through 108 to 134 feet of Silurian sandstone. Under it usually struck a body of soft blue ore and then the limestone formation. But in different places not much remote from each other the sandstone was often from 30 to 50 feet thicker than in others. The original surface of the huronian rocks at the Silurian line must have been cut up in high cliffs with intermediate deep chasms.

Diagram

Sunday Aug. 11. Went with Mr. McMinn to upper Quinnesec Falls by a fine trail commencing at the railroad track. Near the Keel ridge mine on striking the river below the falls outcrops of a dark colored diorite going round met near the falls with a 100 feet wide belt of Sericite schists of partly red, partly green color. See specimens from falls which run over a very thick belt of diorite full of calcareous seams and formed of indistinctly defined crystals . Followed the river up to the rapids. On the way some outcrops of schistose dioritic and sericitic rocks.

Below the rapids a large succession of micaceo-dioritic schists of greenish green color and silky lustre, some softer fissile, others more compact.

With these are harder non-stratified dioritic rock masses irregularly imbedded and indistinctly defined as if the half molton schistose masses had irregularly intermingled with the unaltered schists. There are also several belts of a gneisscid or granitic rock interstratified and partly intersecting the schistose masses.

Other seams of the schistose syccession of rock are mica schists with feldspathic and quartzose grains or crystals disseminated. Also dioritic masses of the light colored speckled sort are intimately connected with the schists and appear in places as bulky intrusive masses which connect with the schists in a streaky manner. Similar beds continue to the upper end of the rapids.

Diagram

Monday Aug. 15. Went with Mr. Jones, superintendent of Keel ridge to his mine. The ore belt of (blue ore) is few feet north of the lower graded reddish ores formerly mined. The belt of blue ore is in places 8 or 10 feet wide but expands in one part of the mine to 60 feet, all clean high graded ore. Some wedgelike masses interrupt the ore belt locally and divide it in two belts; in the west part of the mine is also another rock mass cutting the ore off transversally.

In the eastern open pit the blue ore seam is very narrow and disappears entirely. In the east part of the pit the mixed silicious ores of the southwall and the argillaceous strata of the northwall come there close together. In the mine which on the surface has ledges dipping to the south at the second level the strata exhibit a decided dip northward.

Paid hotel bill 10 dollars up to aftermoon. In the evening went with train to Florence.

Tuesday Aug.16. Hotel bill 2 dollars. Started at 9 for Iron River. Arrived there at ½ past seven. Saw nothing of interest on the way. Rain in the afternoon.

Wednesday Aug. 17. Went over the different exploring pits in Sec. 35 and 36, T. 43, R. 35. First to pits in S.W.¼ of S.W.¼ of 36 which I had seen the year before. Several new shafts and drifts were opened there. The formation is on the steep hillside much broken up. The general trend of the strata is N.N W. Dip S.S.W. Almost vertical often arches are met with and also a dip north eastward. Lowest near the river are lighter colored hard slivery fracturing silico-argillaceous schists , also dark hematite tinged strata. Then follows a hard quartzite banded with seams of good ore and often broken and re-cemented into a breccia. Large chunky masses of good hard ore intermingled with the thick-bedded masses. These are upward on the hillside succeeded by silicious ans argillitic beds(67 feet), richly impregnated with iron oxyd.

And north of them in a row of shafts parallel with the formation a broad belt of good iron ore succeeds which as far as it has been crosscut is in places 32 feet wide. North of them are argillites of high percentage in iron mingled with concretionary seams of good ore and in the pits furthest north graphite schists black quartz seams and iron ore concretions are found.

A diamond drill is now working under an angle of 45 degrees through the thick brecciated quartzites into the hillside but the hole is at present only about 25 feet deep.

Went from here to the explorations in the N W. of the N.E.¼ of Sec. 36 where higher up the hillsides than formerly was explored in several shafts sunk a very large body of iron ore was discovered, so far as known from 800 to 900 feet in length and in one place 119 feet wide, in another 81 feet. On the west side of the ore which seems to be the hanging of the almost vertical ledges dipping rather west are argillitic quartzites quite richly impregnated with iron and amounting to a thick series.

Lower on the hillside are the hard massive quartzites of brecciated nature which we found at the base of the hill in the pits in the S.W ¼. North of the ore belt are lean quartz shhists with harder quartzose belts, and also graphite schists are found in some of the test pits. But the formation on the hillside is so much jumbled up and dislocated that the exact sequence of the strata can not well be ascertained. The strike of the formation is here almost north. It follows the outlines of the hill range.

On the west side of the river separated by a narrow swamp valley are large bluffs composed of blackish colored ferrugino-argillaceous schists of great thickness and interstratified with harder ferruginous quartzite belts, the strata dip west nearly vertical. The large natural outcrop of ore not far west of the quarterpost on the east line of Sec. 35 is in all probability a loose mass inclosed from all sides by lean rather light colored quartz achists. All the superficial strata are for 20 and 30 feet from the surface a shattered broken up mass of fragments in which no regular dip and strike is recognizable.

Went (to) the McKenans explorations in Sec. 26, where a large belt of quartzite mingled with seams and concretions of ore forms a breccia . There are with these ledges ore deposits of a purer kind connected which probably represent the ore belt found in Sec. 36 but the openings are not sufficient to prove this clearly. South of there is a large belt of light colored quartzite seen in outcrops.

Afternoon went to ¼ post on south line of Sec. 35 where near the bed of a creek the ferrugino-argillaceous quartz schists are largely exposed and in these are quite large seams of excellent hard ore exposed like that in the mines of Sec.36. In other test pits in Sec. 2. are argillitic quartz schists uncovered partly of red color, partly dark bluish, rather hard, and of a banded structure. The strike of these beds is in N.N.W. but many plications are observable. During the night hard rain.

Thursday. Aug. 18. Went with Kimberle and party over the mines in Sec. 36 and afternoon again to McKennans test pits.

Friday Aug. 19. In Sec. 26. For the night invited to sleep at Mr. Seldens house. At 5 in the morning Kimberles party left and at 7 I followed with Capt. Stephens. Went to Broadmanns mine in Sec. 26 T. 43 R. 34. on the northside of Lake Chicagon. All over the road we traveled no outcrops.

At that location under a thin coating of drift the iron formation is found largely developed with a belt of pure hydrated ore about 50 feet wide besides a large series of banded ore bearing jaspery strata. The jasper bands are seen very often cross fractured with more or less dislocation of the ends or the beds are twisted and corrugated . The dip of the formation is about N.W. and S E. with northern dip but the rock is so much divided by cleavage rocks that its dip and strike is hard to ascertain.

On the south side are graphite schists in a broad belt uncovered . Next north are mixed jaspery ores. Then comes a 50 feet wide belt of clean ore. The jaspery lean ores again partly with red, partly with grey yellow or brown jasper. Further north are gritty siliceo-argillaceous flaggy beds. In the vicinity of the hard flinty looking hydrated ore belt is a layer of a fine blood-red soft hematite easily friable with the fingers into an impalpable powder. The beds generally have a nearly vertical position and in different pits apparently the strike and dip of the strata is in various directions very oftne abruptly changing.

For dinner got an excellent venison roast, as tender as I ever eat any. Capt.of Broadmann is Mr. Webb.

4 pages of German

Sunday August 21. Morgen(morning) went to Quinnesec. Hotel bill at Florence 2.00

Monday Aug. 22. Went with Mr. Grey to Lake Fumee following the edge of the lake through Sec. 26 into the S.W.$\frac{1}{4}$ of Sec. 25. In 26 I passed the diamond drill which under an angle of 45 degrees is boring into the hillside first through about 100 feet of red argillaceo-silicious dark red iron-colored strata, then into quartzite about 20 feet. It seems to me that the ore is south of the drillhole in the swamp.

In the further extent of Sec. 26, the slope of the hill is deeply covered with drift inclosing large boulders of granite, diorite and quartzite and limestone. Also in 25, the southwest part of the southwest $\frac{1}{4}$ is low ground. In test pits sunk by Mr. Grey the drift is full of angular fragments of fine blue ore. The ledges have not been found yet.

In pits further north on the slope of the hill invariably the limestone has been struck and no float ore on top of it, or only little.

Tuesday Aug. 23. Went on road to Lake Antoine unto its division at the S E $\frac{1}{4}$ of Sec.21. Followed thence the eastern road for 350 steps. Thence struck off from it towards a row of low bluffs crossing the S.E.$\frac{1}{4}$ of the section diagonally from S.E. to N.W. These bluffs are partly covered with drift sand and boulders but in other places a thick belt of limestone in a vertical position composes the bluffs.

Northeast of the bluffs on the higher ascending part of the hill slope are many test pits in which under a deep drift cover silicious and calcareous rocks of light color are struck in the bottom, which fully resemble the rock beds found in the test pits north of the ore belt of the Indiana mine.(See specimens of the limestone in the collection).

From here I went along the hill slope to the Cornell mine. Saw no further outcrops. On the high hillside in the N W.$\frac{1}{4}$ of Sec. 21 under the drift the Silurian sandstone is found in the test pits and under the sandstone the limestone appears to succeed as the Silurian conglomerate at the bottom consists principally of quartzose and limestone fragments in intermixture with pieces of ore.

In the Cornell mine at present little ore is in sight. But in the section through the series presented there the irregular distribution of the ore is plainly observable It forms seams narrowing and widening frequently so as to merge in the prolongation of the strata from a rich ore bed into a series of lean silicious banded strata.

The ore mined is also not confinedto one certain seam in the series but many such seams are observable of which in the course of mining one is found to wedge out and another begins to widen and become productive. The strata dip under an angle of 60 to the south but in places the dip is as low as 45 degrees and in others nearly identical. The strike of the formation leads through the N W.¼ of Sec. 20, but the main body of the western continuation of the ore formation is found in the south half of the S W.¼ of Sec. 17.

In some of the most southern test pits in Sec. 17 the ore formation (lean specular schists) with southern dip is well exposed. Further north the silurian sandstone covers them and is very thick. At the base of the silurian sandstone are ore breccias and as it seems horizontal hematite deposits as stated in the last years report. No new discoveries have been made there since.

Went to the test pits near the S.E corner of Sec 18 and the N.E. corner of Sec. 19 (At Moon lake). The silky shining schists similar to the schists above the limestone formation as seen north of the Norway mine seem to be represented there, a continuation of similar schists found west from there on the Wisconsin side of the Menominee, but I am not positive about the correctness of this view. Further west is all covered with drift and no bottomed pits. Northwestward in the north half of Sec. 18 the diorite forms the body of all the hills.

From there followed an old road which passing the west end of Moon lake leads in S.S.E. direction to the side railroad track to Lake Antoine by which I came to Iron mountain City. Returned with afternoon train to Quinnesec.

Wednesday Aug. 24. Went on road to Norway unto Sec. line between 1 and 6. Followed that road north to the northwest ¼ of Sec. 31, T. 40, R. 29 and then diagonally across, Sec.30 to the N W. corner of Sec 29. On the road through Sec. 30 on the north slope of the high hill over which it leads are frequent natural and artificial exposures of grey and blood red sericite schists. These are also well exposed in the test pits in Sec.29 on N W. corner. With these sericite schists occur interlaminated quartzose and calcareo-argillitic rock seams with much mica and ferruginous matter intermingled.

From the N.W corner of Sec. 29 returned to road and followed it to Pine Creek. Thence southeast on the brow of a high hill range sending spurs to towards the Pine Creek. No natural exposures but many test pits opened in the S.E.¼ of Sec. 29,all of which exhibit grey and red sericite schists besides hematitic argillites and quartzose seams which represent the same horizon as those in the N.W ¼ of the section. They are particularly well exposed on a newly made logging road leading to Pine Creek in the S.W.¼ of Sec. 28.

From there followed a trail running as I suppose not far from the sec. line between Sec. 32 and 33, southward to the water house of the Norway mines. The test pits in the S E ¼ of Sec. 32 which are mentioned in last years report are since been multiplied and better opened. They show the same seritic and ferruginous argillitic beds as those in Sec. 29. And moreover graphitic schists and banded and in a sort brecciated mixed ore deposits, and quartzites are found, interlaminated. They dip regularly to the south in accordanee with a N.W. trend.

The whole space from the limestone cliffs of the Norway mine to the quartzite bluffs in Sec. 29 and 28 on the Pine Creek is occupied by these sericitic ferruginous slate rocks with graphite and quartzose seams, the equivalents of the Commonwealth ore formation. The limestone belt of the northhalf of Sec.32 does not reach to the east line of the section .

Thursday Aug. 25. Went to Wauceeda(?). Examined test pits in N.E.¼ of Sec.13, T.39, R. 28. Deep red colored soil on surface induced the explorers to sink test pits, They find under 8 to 10 feet drift horizontal beds of the calciferous sandrock and in some places the silurian sandstones which in most instances have a thickness not less than 50 to 80 feet. I therefore gave the parties the advice to give up their work as hopeless of success.

Returning to Wauceeda I examined on the way the test shafts of Mr. Ferguson, sunk near the S.W. corner of Sec 14, T. 39, R. 28, which are about 50 feet cutting through Silurian sandstones of white and reddish color with some intermediate argillitic seams of full of fucoidal stems and other obscure traces of organic remains. In the sandstones are fragments of a lingula and Trilobite fragments quite abundant. I found head portions and tails of Dicelocephalus some very well preserved. In other pits on the Brien mine property I could not find any Trilobites in the sandstone but Scolithus is quite common in them.

Friday Aug. 26. Went to the S.E corner of Sec. 32. From there followed line 450 steps where a pit with graphite schist is opened right on the line. Dip south. Next north of it mixed ore belt. Farther north red slates but same red slates is also seen south of the graphitic strata near the creek and toward the Norway mine. Went from there on line to ¼ post through swamp. Passed on the way large outcrops of Silurian sandstone. The quarter post is on the slope of the limestone hill formerly marked on the map. Its position is in the east part in the south half of the section. Further west the limestone ridge which has N.W. trend occupies the south part of the north half of the section..

The limestone ridge is partly composed of flinty quartz beds of a brecciated nature partly of grey compact more or less silicious limestones in nearly vertical position, sometimes dipping to the north but usually to the south. The limestone ridge is interrupted on the west side by the bed of the creek, also on the east side of the section line east of the quarter post where the first outcrops are seen, no more limestone comes to the surface. The hill range in Sec. 33 is formed on the surface of the ferruginous slates and schists of the commonwealth ore formation, as can be seen in numerous test pits across this section .

Saturday Aug. 27. Hired man for 2 dollars, .50 cents for his dinner, .25 railroad fare. Wrote to Governor. Sent duplicate receipts for quarterly salary to Lansing. Asked permission for journey to Europe. Received letter from Dr. Jones.

Afternoon went with McMinn to his exploring pits in Sec. 33 Found in one of the sandstone strata thrown out of the shafts an abundance of Lingula shells and distinct traces of fucoidal plants forming large accumulations; also the so-called scolithus id est vermicular channels perforating the ledges in parallel vertical position is here observable in the Lingula bearing ledges.

The sandstone forms beds from 2 to 6 feet in thickness with intermediate narrow seams of shaly matter. Some ledges are porous, soft, others almost as compact as a quartzite, color almost white, other times red, the red and white layers alternate. A peculiar observation is to be made here and in other localities. The lower deposits are generally a breccia of ore and jasper fragments cemented by sand.

Above may follow a succession of layers of pure sandrock of white color with no other rock fragments inclosed. Then again a seam of breccia may follow crowded with angular and quite large fragments of ore and other rock material. Then pure sandstone layers again and a brecciated seam still higher in the series.

This proves that cliffs of the ore formation must have projected in a neighboring place above the bottom and shore of the ocean during the time the Silurian sand strata were deposited and from time to time such cliffs were broken up and the debris fell down on the sandy bottom which afterwards became buried in the sand continually accumulating around the base of such cliffs.

Sunday Aug. 28. Went after dinner dinner again to the test pits on Sec 33 and to the adjoining ones in Sec. 32, T. 40, R. 30. The interposition of fragmentary masses of the ore formation between the series of Silurian sandrock ledges is in one of the pits particularly well exposed. This circumstance I can only explain by the suggestion that during the time the Silurian sandstone was deposited on the shore of the ocean,cliffs of the ore bearing rocks projected high above the sand masses were undermined and fell down in large masses unto the sand bottom and afterward became buried under it. This must have occurred repeatedly as we find such ore accumulations at different horizons with intermediate thick layers, free of ore fragments and even free of iron stain.

Diagram of above.

Monday Aug. 29. Visited Commonwealth mine. Returned in the evening.

Tuesday Aug. 30. Paid hotel bill 11.50. Left for Waceda and T. 41, R. 27 where new discoveries of iron have been made. Went with Mr. Hoar, Jr. Was detained at Waceda not being able to get a conveyance.

Wednesday Aug. 31. Went on heavy wagon and arrived about 4 o'clock after noon at the camp of Hoar in the N E ¼ of the S E ¼ of Sec. 25, T. 41, R.28. From there to the test pits the distance ofabout one mile a ridge striking east and west through the south part of Sec. 30, T. 41, R. 29 is formed of the iron formation dipping in places to the south, in other places the strata dip in a northeastern direction and strike in accordance from southeast to N.W.

The ore formation is in places naturally exposed but generally a few feet of drift covers the strata which consist of thinly laminated alternating layers of a dark bluish martitic iron ore with granular quartzite seams.In certain horizons the ore seams prevail of the quartzose seams are so rich in iron as to constitute a silicious are of about 45 to 50 percent. In other horizons the quartzose material prevails over the iron particles.

The exposures of the formation are principally in the S½ of the S.E.¼ of Sec.30, in the S.½ of the S W.¼ the drift covering is much deeper and testpits 18 feet deep have not yet reached to the ledges of the formation.

North of this ore bearing ridge is the swampy valley of a creek and in the north half of Sec 30 the potsdam sandstone and the calciferous sandrock formation cover all the surface. Fine outcrops of them are seen in ravines.The calciferous sandstone is in some ledges full of small corals and ramulets of bryaqoa but they are very indistinct and not determinable. The calciferous sandrock incloses an abundance of granular crystals of iron pyrites and sometimes of copper pyrites.

Thursday Sept.1, Went over the test pits again and through the north part of Sec. 30 which is covered with limestone amounting to the thickness of about 60 ft.

Friday Sept.2. Return to Wauceda by foot. Arrived at noon. In the evening with train to Quinnesec.

Saturday Sept.3. Rainy. Went out to Merrimans camp where by the recent explorations a large series of argillitic schists of iron color and of black graphitic color have been disclosed . The argillites inclose a narrow belt of compact reddish limestone.

Received a letter from the Governor consenting to my journey. Had a letter from Westerman ordering a volume of the third volume of my reports. Lost letter or left it in coat pockets on - . Sent 4 boxes by freight 3.00 Trunk by express 1.30 paid.

Sunday Sept.4. Took train for home at 4 in the afternoon.
Monday Sept.5. Arrived home.
Wednesday Sept.7. Went officially to Detroit to meet the Commissioner of Immigration. Expenses 5 dollars.
Freight for boxes paid to H.Hutzel 6.68. Ditto 5.00 express for trunk.
Owe bookseller 60 cts for paper. Bookseller owes me for book 5.00 Ditto Ames.

Several rough diagrams in back without explanation.

D.C MacKinnon Quinnesec. Promised a copy of report. Ditto Kemps.

Exploration of Mr. Saxton in T.42,R.28, S.½ ofS.½ of Sec.26. Large limestone bluffs and quartzite next to granite. No ore formation seen. Trail from Corys camp.

Mr. Peave camp in T. 47, R.46, Sec.16. Ashland, Corrigan house.

C. Rominger 1882

Tuesday May 23. ½ past 3 in Marquette. Lodged at Tremont House. Presented 1 copy of the 4th Geological reports to Mr. John Hornby, Vice Superintendent of H. & O. R.R.

Page of German

Large quartzite exposures on ¼ post on south line of Sec. 31, T. 48, R. 25. Dip north, trend of outcrops E.S.E. On the south side of the quartzite bluffs hard grey argillitic schists, cleavage oblique to stratification. Dip north. Below them similar more ferruginous schists and below them flaggy hematitic lean ores mixed with jaspery or flinty seams , quite a thick belt. Dip north.

Going on the northside of the first mentioned quartzite ridge we find them layers conformably overlaid by banded hard argillitic schists similar to those underlying the quartzite, of a bluish tint. Other layers bright red colored from a large percentage of hematitic oxyd. Thickness visible much over a 100 feet. Similarity of the rock with the banded slaterock of the 5th group near Negaunee is complete. Exposures on creek in S.E ¼ of S.E ¼ of Sec. 31, T. 48, R. 25.

A similar large belt of slates of partly dark blackish color by impregnation with magnetite crystals partly of lighter gray color or blood red is exposed naturally and in testpits in the centre part of the west half of S.W ¼ of Sec.31 T. 48, R. 25. Dip north. These slates are not a great distance south of the limestone exposures near the Morgan coal kilns which limestone likewise has a northern dip towards the diorite bluffs. The banded slate rock of the 5th group which is represented by these beds appears therefore to be situated below the limestone belt of this part of the district while in other parts either the limestone is missing or else these slates are not developed and the limestone lies directly on the quartzite formation.

Thursday May 25. Wrote home. Went to Michigammee and thence to LeAnse. At Michigammee inspected the explorations of Ames on Sheldons property. In the shaft they struck the mixed ore belt of the Spur mine but no larger seam of clean ore worth mining. Then they drilled several holes through the actinolite further east but at a depth of over 400 feet instead of striking ore they struck a hard quartzite. Went a few hundred steps west of the exploring pit to a large mass of chloritic massive rock belonging to the actinolitic rock series. The rock is in places full of starlike groups of crystals of margarite. In other places large mica-like but much harder crystal blades and in larger lenticular concretions are disseminated through the rock mass, besides small black mica scales and sparingly black turmaline crystals. The large crystal blades I suppose to be Ottrelite.

Went in the evening after having met with Ames at the Spur mine to LeAnse. Hotel bill over night 1.50. Hired two horse team for a trip to the slate quarries on Friday morning.

May 26. Went there with Mr. Swain of Marquette who informed me of having discovered a belt of iron ore on the northside of the Huron Bay slate quarries. The slate quarries are in T. 51, R. 31, Sec. 28. At the slate quarries the strata have a dip to the south and a trend from east to west approximately their thickness is very great, perhaps over a thousand feet but not all of it is fit to be used as roofing slate.

The cleavage differs from the lines of stratification but the sedimentary stratification is rarely plain enough to be closely measured in its relation to the slaty cleavage. North of the location in the bed of the creek the lower slate beds continue but become harder, less cleavable and in part flinty or jaspery.

North of these beds also dipping south is a calcareo-ferruginous belt about 30 feet wide in which the upper beds are a crystalline limestone. The lower strata are to a great proportion formed of carbonate of iron with red oxyd of iron and partly with grey sub-metallic oxyd besides hornblende and aluminous mineral components of green or greenish white color. The same time are at this horizon silicious rock masses in a cellulose manner interwoven with limestone or spar to be observed. And by decay of the ferruginous and calcareous beds, friable masses of a brownish black rich iron oxyd are found in pocket like accumulation. Below this iron bearing limestone belt are laminated quartzose argillites alternating with dark blue colored compact quartzite amounting to considerable thickness.

These are succeeded on the north side by a very large belt of white quartzite of glassy compact structure thickness of ot 500 or more feet. All these strata have an east and west strike and a southern dip. Further north I did not follow the rock series which is well exposed in the bed of the creek, and west of it towards the wagon road to the slate quarries the limestone belt crosses the section in its south half. The white quartzite belt runs about across the centre of the section.

On my return I noticed near the bridge over Silver Creek a large belt of compact whitish quartzite apparently dipping south. On its north side are blue slates of great thickness , also dipping south with their cleavage but they are variegated and striped by lines of sedimentary stratification which across the cleavage under nearly a right angle and dip in an opposite northern direction.

Diagram.

Mr. Swain informs me of an outcrop of graphite about in a belt of 100 feet wide in the S.E.$\frac{1}{4}$ of N.E $\frac{1}{4}$ of Sec. 25, T. 51, R. 31. Surrounding rocks slate.

Saturday May 27. Paid 5.00 for team, 1.50 hotel. Went up the creek at LeAnse extensive slate outcrops all along its bed. Slates very fissile but rather soft and readily decaying on exposure. Light grey on weathered surface. Strata according to cleavage. Dip south under a not very steep angle. Lines of stratification(sedimentary) sometimes visible and then crossing cleavage under an acute angle. Direction likewise to the south.

Diagram

The series of slates exposed in creek in regular succession is very large not less than one thousand feet. Character of rock in all that thickness uniform. At 10:45 with railroad to Michigammee. Went from here to the newly opened mines in Sec. 26, T. 48, R. 31. The locality is about 4000 feet southwest of the Spur mine. The strata all dip south in conformity with those of the Spur. The character of the rock series is very similar to the pyritous and graphitic series connected with the Commonwealth ore. Another portion is soft ochreous, also calcareous. Sometimes banded silicious strata alternating with ferruginous seams inclose the actual ore deposits.

From all observations I am so far able to make this ore bearing formation has its place on the actinolite schists of the Michigammee mine and on the micaceo-chloritic garnetiferous schists exposed near the railroad track there, but below the mica schist formation on the south side of the west arm of Lake Michigammee. Returned to Marquette Sunday May 28.

Packed and labeled specimens in the forenoon. Bought wrapping paper 30 cts. 1 bottle of writing fluid 50 cts.

Went in the afternoon to N W.¼ of Sec. 22, T. 48, R. 25. Re-examined the slate outcrops there which are intersected by a dioritic or perhaps augitic dyke. The slates are hydromicaceo feldspathic, pale greenish colored. They make transition into the hydromicaceous schist of lighter yellowish color which I formerly described as novaculitic. These beds have considerable resemblance with the thinly laminated sericite schists below the upper Quinnesec Falls.

Some of them have likewise birdseye structure from intermingled nodules of glassy quartz. With these sericitic or novaculitic schists are darker green colored schists associated particularly on the north side of them which make transition into genuine dioritic schists and these into massive crystalline diorite. Further west is a large dyke intersecting them, of chlorotic-dioritic composition, dyke about 20 feet wide in places sending out branches.

From here went along road to Steinbrechers farm passing the low knobs which consist of augitic massive dyke rock connected with schists of dioritic nature. Thence to the knobs in the S.E.¼ of Sec. 16 where abundant granite dyke intersects the dioritic schists. The granite is obscurely defined red feldspar imbedded in a laminar disposition into a hydromicaceous mother mass and mingled with green chloritic-hornblendic material.

The lamination of the granite dykes is parallel to the inclosing walls. The adjoining dioritic schists are more or less distinctly crystalline consisting of hornblende and plagioclas. These schists again are gradually merging into massive crystalline diorite. At the same locality is also a large augitic dyke intersecting the strata and between the dioritic schists a several feet wide seam of laminated quartzose lean magnetic iron ore and magnetic quartz schists is observable. These schists contain besides magnetite much iron pyrites.

Monday May 29. Went to Negaunee. Saw Foleys shaft and drill holes by which he ascertained the existence of hard ore beneath about 18 feet of drift in the valley where the road passes towards the Cascade mines. The specimens brought up by the sand pump are a fair quality of hard specular granular ore. The shaft is at present not yet deep enough to see the ledges exposed.

From here went north to Gaffneys property where at the base of the ferruginous schists belonging to the fifth group a shaft is sunk through about 25 feet of drift below which a massive dark colored crystalline diabase is struck which is apparently identical with the diabase dyke described as occurring in the hematite mines of the Jackson property. Dinner at Jackson 75 cts.

Tuesday May 30. Paid hotel bill 9.00, 2.00 per day. Made with Mr. Hall arrangement to be Thursday evening in Republic. Went to Michigammee. Bought yesterday of Westein 6.00 worth of minerals paid 3.00 with my book. Left at hotel 1 trunk, 1 bag 1 satchel, 1 bale and a box with specimens.

11 o'clock in Michigammee. Regen (rain). Went to testpits in Sec. 25 . Under a cover of a thick stratum of boulder drift with immense blocks of actinolite schists and large gneissoid or granitic rock at the depth of from 15 to 30 feet. In numerous testpits the brown hydrated ore of the Northampton mines is uncovered. It is partly soft ochreous partly in hard lumps occupying about a belt of from 50 to 100 feet wide without scarcely any intermixture of silicious bands. The dip of the strata is southward. On their northside are silicious graphite schists likewise constituting a quite thick belt, but its actual extent is not seen.

The ore bearing strata extend almost down to the bed of the river but in the test pits is not to be seen what kind of rock succeeds the ore on the south side. The hills on opposite side of river are drift covered but in the testpits in Sec. 26, south of the ore silicio-ferruginous schists similar to those connected with the Commonwealth and Florence ore belt are denuded in some testpits south of the ore.

Diagram. Supposed succession of rocks from Spur mine southward.

Wednesday May 31. Rain in the morning. Went to office of Michigammee mine. Saw drill cores of several boring experiments in the valley on south side of railroad track obliquely directed north under an angle of about 50 degrees to a depth of 850 feet. All the upper 600 feet were found to be garnetiferous chlorites and banded ferruginous quartz schists. Many of the strata brecciated just like we see blocks strewn over the surface. The lower 200 feet were more actinolitic than chloritic but likewise banded with thin ore seams, sometimes with prevalence of the ore, other times the actinolite prevailed or quartzose seams set in. The actual productive ore formation was not struck. Went with 11 o'clock train to Clarksburg.

Outcrops near Clarksburg Station partly banded, partly massive but distinctly exhibiting a former laminated structure penetrated by actinolite. Dip north at the station but on the road a few hundred steps west the strata dip south.

Went to Conrads mine. They drilled there in several places to the depth of 4 and 500 feet. One drillhole north of the old workings of Conrad was directed obliquely towards the hill. It went for most of the distance through chloritic quartz schists and then went into quartzite but was not sunk through it. The other two holes are located on the diorite knob south of the newer shaft eastward. Most of the distance the drill went through diorite and then into quartzite as it was directed northward.

Went then around the large diorite hill in the elbow of the river and crossed over to the quartzite hills south of it. (See last years description.) This quartzite probably represents a quartzite belt of the 5th group. On its south side are test pits opened in which garnitiferous mica schists in association with a brown silicious iron ore are struck, which ore resembles the Northampton ore.

Returned to the Station and went to the high diorite knob southeast of Clarksburg near the branch road to the Boston mines. At its foot a large quantity of ferruginous actinolite schists are piled up which probably came from the old Michigan mine. The diorite is all round inclosed by a mantle of banded schists of the 5th group. The strata fall uniformly away from the hill and in the contact between the stratified rock and the diorite it can be observed that the dioritic mass incloses large fragments of the stratified which plainly proves the plasticity of the diorite when the upheaval took place or even before. Went in the evening to Humbold to stay over night.

Thursday June 1. Railroad cut to Northampton first conglomeratic quartz schist, quartzose actinolite schists almost vertical but rather dipping south, about 100 feet disclosed. Then covered with bog iron ore 60 steps. Thence about 100 steps black quartzite interstratified with quartzose graphite schists, covered again all along the railroad unto Northampton mine. Just south of it some black slates seen in an outcrop, dip north, almost vertical. Ore belt large, not well distinguishable from the silicio-ferruginous strata above and below it.

North of the Northampton mine is another mine which evidently represents another belt or a repetition of the strata by folding. On the north side of the Northampton ore belt are black slates beyond which the other northern mining pits are opened. The strata are very much broken up and their dip is not positively ascertainable. It varies also in the pits and torsions,and minor folds of the strata are visible. On the north side of this mine which I suppose is called the Pasko mine are again black slates and north of it a large belt of blackish quartzite crops out.

At the D'Alaba mine about the same conditions exist.On the north and south side of it are black slates. The southern slates continue for about 200 steps or over and then an underlying quartzite belt crops out near the farmhouse. Further south no more outcrops until we come to the coal kilns at the Champion furnace.

There we see again a large belt of blackish quartzite, dip N W. Beneath is are dark quartz schists which in the lower horizon merge into actinolite schist which forms the declivity of the bluffs at the furnace. Going from the railroad depot up the road towards Champion mine we see on the hillside some testpits from which red soft sericite schists are dug out. Further up the road are more quartzose sericite schists. Then come ferrugion-arenaceous schists with irregular shaly cleavage. Further up the hill are outcrops of graphitic silicious schists.

From Champion location going along the railroad eastward we see close to the right old pits in which some iron ore seams are mingled with actinolite schists which seem to be the lower actinolite belt. South of the Champion ore belt further east on the railroad we come to some outcrops of the quartz schists of the upper actinolite formation. On their southside is the large brecciated rock belt of the upper actinolite formation which at the Keystone location forms prominent knobs.

South of the mines and south of the quartzite belt that covers the ore, this breccia consists of laminated schistose masses of a micaceo-chloritic and feldspathic mass which laminated rock is broken up and contorted into chaotically intermingled fragments.

Diagram

And intermingled with these are dioritic blocks, granitic and quartzite blocks of considerable size angular and rounded, Some portions of the schistose mass are chlorite full of little garnets. The whole rock appears like a melted mass or at any rate it must have been once highly plastic and became in this way re-cemented most solidly. The schistose mass often is partially transformed in a genuine coarsely crystalline diorite.

In the morning when I followed the road from Washington mine to the Champion mine I passed first on the lefthand side a ridge of the lower actinolite. Further on the road passed a diorite knob on the right side. Then come the banded schists of the upper actinolite formation.

Some distance north of the road they are in close contiguity with the diorite and make immediate transition into it, portions of the schists being transformed into a coarse diorite which still retains distinct traces of sedimentary lamination. It is rich in calcspar and often exhibits a brecciated structure but not as coarse as the corresponding strata north of the Keystone mine.

On the left side of the road the lower actinolite forms a high ridge which actinolite incloses irregular masses and seams of garnetiferous chlorite garnets of large size.

Went in the evening over the Republic mine hill. Observed in the red jasper banded mixed ore not only the lenticular shape of the bands of jasper ore or of the ore but in certain places the jasper bands abruptly disappear and a homogeneous body of ore extends for a certain distance until again the jasper bands set in. In places also the entire jasper banded lean ore mass changes into a whitish quartzite impregnated with epidote in the continuation of the same ledges. Also locally a breccia of the jasper banded lean ores cemented with such light colored epidotic quartzite occurs. And further on, the same belt of ledges is again regular and undisturbed.

Chippewa mining property. Granite diorite gneiss, separate ridge, narrow swamp. Quartzite 25 steps. 37 steps covered which is in other places seen to be filled by mica schists and garnet bearing rock, then banded mixed ore bearing rock(quartz) 60 to 80 feet. Iron bearing rock belt 100 feet.

Cannon property. Quartz dip to river. Large belt. Quartzose mica schist in several varieties, large belt. Mixed banded ore belt with lenticular seams of mica schist inclosed 50 feet, laminated micaceous quartzite over a 100 feet. These trend N.W. to S.E. Dip N.E. Laminated hard sub-dioritic quartz schist inclosing blocks of diorite or concretionary masses of it 50 feet. Trend almost north and south.

In part of the rock, or I may say the main mass of it is a quartzose fine grained mica schist which in places changes almost entirely into a micaceous compact quartzite or incloses large irregularly defined blocks of it. In other places a similar transition into a diorite is seen or a breccia of quartzite diorite granite with mica schists cemented occurs . In following this singular brecciated massive rock belt we find near the S.E. corner of the Erie location granite knobs forming the continuation of this belt.

Friday June 2. Walked from Republic to Erie mine which is the N.E.$\frac{1}{4}$ of the N.W.$\frac{1}{4}$ of Sec. 28, T. 47, R. 30. Looked on the way over the Kloman mine whose structure is very similar to that of the Republic. The strata are almost vertical. Strata trend N.W. On the S.W. side a large belt of quartzite, then a belt of micaceous or hydromicaceous schists more or less impregnated with ore, then banded ore belt in which seams and lenses of the pure specular ore occur. S.W. of the mines are diorite knobs.

Diagram

As we go on we pass abandoned Metropolitan mine where some fine specular ore is taken out but most ore is badly mixed with quartz. Then comes Winthrop mine or Winslow mine ?, where a deep large shaft is sunk into the perpendicular layers of the mixed ore formation. Very few steps from a granite knob at the Stanard mine and other abandoned locations the mixed ore belt with some good but narrow seams of ore is seen exposed and on its N E. side a belt of quartzite and of shining fine grained mica schists which by degrees merges into a micaceous quartz rock.

We come then to the Erie and Cannon location. The Cannon location included all of Sec. 28 with exclusion of the N E $\frac{1}{4}$ of the N W $\frac{1}{4}$, which is the Erie location. Took dinner with Mr. Wright of Toledo. Went after dinner across the river into Sec. 22, where in the S.E $\frac{1}{4}$ of the S.W $\frac{1}{4}$ a great many old exploring pits of the Chippewa Mining Co. can be seen.

A broad belt of mixed ore but very lean is encountered first. Dip towards the river and strike of formation parallel with the river. Under this ore bearing quartzose rock belt are garnetiferous mica schists and brightly shining mica schists of silvery color alternating with micaceous quartz schists of considerable thickness. Further on across the formation a large quartzite belt follows over a 100 feet wide. Then a narrow swamp follows across which granite hills rise with belts of gneiss intermingled ina tortuous way. Diorite masses intersect the granite.

Diagram.

We follow a trail into Sec. 21 where the H. & O. R.R. Co. has opened testpits all across the formation in which the before described succession of strata is seen. Nowhere a show of valuable ore deposits. Return to Erie location. On the dividing line between the Erie mine and the Cannon property the strata are in a remarkably confused dislocation, mica schists, garnet rock inclosing large masses of the mixed banded and brecciated ore formation.

6 pages of German.

Sunday June 4. Went to Lighthouse Point. Examined the slaty hydro-micaceous schists inclosing quartzose concretionary seams and in certain seams impregnated with oxyd of iron, thickness not accurately determined but quite considerable. Next north of them are dioritic schists by degrees changing into massive diorite of light greyish color full of reticular seams of calcspar and showing distinct traces of corrugation and torsion in a plastic condition. They are intersected by an olive green aphanitic dyke of very irregular transverse course and not exceeding a few feet in width.

North of these is a belt of novaculitic schists and further on dioritic schists and massive diorites continue north unto the lighthouse point quarry. In these dioritic schists several dykes of granite partly parallel with the strata, partly transversal to them are found inclosed at the Lighthouse Point; one of these on the south side , another on the north side of the lighthouse. The northern belt I have previously described in my report as a granite-like stratified rock seam, but I have now ascertained to full evidence the intrusive granitic nature of this rock.

It intersects the strata in several places transversally. It is laminated parallel to the dyke walls and cleaves into very sharp angled regularly rhombical pieces. The large augitic dyke of the lighthouse point is sufficiently well described in former report. Collected specimens of these dykes with adhering schistose wall.

Monday June 5. Sent 1 shirt 2 pr. of socks and 3 collars to laundry at Marquette. Paid hotel bill 5.00. Railroad fare to Quinnesec $4.50. Arrived at Quinnesec at 6 o'clock in the evening.

Tuesday June 6. Wrote to Mr. W.B. Lindley for a pass over the road.(Marvin Hughitt, President of the company).

Went in the morning to diamond drill in S_ec. 2 where previously several other drilling experiments were made south of the limestone bluff. The present borings are made by the Briar Hill Co. One hole was drilled about in a line with the powder house and 200 steps east of it the rock ledges were struck about 35 feet below the surface. The boring went down about 200 feet under an angle of about 50 degrees to the north.

First light gray and reddish colored hydro-mica schists of a somewhat quartzose intermixture were penetrated. Next comes a hard ferruginous quartz schist inclosing iron pyrites. Then follow dark blackish grey hydromica schist of silky lustre. Some of the layers full of reticulated seams of white kaolinite of glassy quartz and pyrites, depth 200 feet.

The presently worked hole is about 60 steps north of it and about 400 feet south of the limestone bluffs. Upper layers about like the lower in the first hole. Lower a blackish hydro-micaceous graphitic schist laminated with thin quartz seams similar to the rock in the railroad cut in Sec. 24 west of Chapin mine. Then a harder brecciated qaurtz schist of blackish color, full of iron pyrites and seams of Kaolinite. Lower at a depth of 300 feet from surface is a hard dark colored variegated quartz breccia charged with iron pyrites.

Went in the afternoon with Mr. Foster and Capt. Jones to the Iron Mountain City where a continuation of the Chapin mine ore belt has been discovered on the Ludington mine property, S.E.¼ of Sec. 25, T. 40, R. 31. The belt of pure ore found there under about 15 feet of drift amounts to about 40 to 50 feet of the same blue soft quality as in the Chapin. Dip north. This ore belt just passes the corner(S.W) of the N.W.¼ of the S.W.¼ of Sec. 30, T. 40, R. 30 at which place the Briar Hill Co. is now drilling to strike this ore belt in its northern slope. They are down about 100 feet and went through a compact quartzite micaceous iron stained quartzite and white argillites. Continuation of the boring subsequently to be noted. At a depth of 300 to 340 feet argillites of light iron stained color, quite compact.

Diagram

Wednesday June 7. Went with Mr. Alward to testpits in the N E ¼ of N.E ¼ of Sec. 31, T. 41, R. 30 little distance from Bad Water village. We find there in a ravine between two high diorite bluffs close to the river a series of calcareo-ferruginous and actinolitic strata and chloritic schists. They dip south in a nearly vertical position. The chloritic schist are on the north side as footwall. Some narrow seams of a silicious hard ore are mingled with this formation, but I have no faith in the existence of a valuable ore deposit here.

We went from here on to the N E ¼ of the S E ¼ of Sec. 5, T. 41, R. 30 where Mr. Breitung is exploring. A large bluff running east and west about through the centre of the south half of the section edged by a swamp on the northside and dipping to the north in a nearly vertical position consists of dark colored banded jaspery lean ores. These inclose softer bands of highly ferruginous quartz schists impregnated with martite granules.

South of this a large belt of white silicious actinolitic and micaceous crystalline limestone succeeds and next north of it some large bluffs of massive bedded light colored quartzites are the last seen exposures. Thence south plateau lands extend strewn over with boulders.

Ore testpits in N E ¼ of N.E ¼ of Sec. 31, T. 41, R. 30. in a ravine of two diorite ridges. Dip south, strike east and west. Went along Felch Mountain from Bad Water village. Branched off near the south line of Sec. 8 and went to east half of S.E.¼ of Sec. 5, T. 41, R. 30

Thursday June 8. Worked in the office in the morning. Afternoon went with McMinn to Indiana mine. Examined the cores from drill hole sunk in the bottom of ore shaft under an angle of 70 degrees towards the hill. Total depth 177 feet.

Beneath the ore deposit various dark ferruginous schists softer or harder and most of them delicately laminated , Succeeded. In the lower part of the hole they were softest and on exposure readily decomposing into a clay mass. Beneath these layers reddish white colored silicious limestone was struck which resembles the ordinary Huronian limestone of the environs.

Went from here to the limestone bluffs in south part of Sec. 22, T. 40, R. 30, north of which argillites and jaspery lean ores are exposed in testpits. Thence past Lake Antoine mine which is abandoned to testpits in Sec. 17 S.W.¼. There is Silurian limestone found in testpits above the Silurian sandstone. Lower down the hill are many testpits in which rich jasper banded lean ores are exposed in a large belt. Their dip is south.

On south side of them quartzoso argillitic iron schists of various intensity in impregnation with red or also with specular oxyd. The more south the more argillaceous they become. No trace of an exposure of an overlying limestone or quartzite belt seen. West on the same slope are the sericite schists opened in old pits of Frederick.

Friday June 9. Went to Wauceda and back by railroad $1.00. Visited mine in Sec.7, T. 39, R. 38. A new shaft sunk further south than the old one to a depth of about 65 feet, then drifting south 45 feet all through sandy red slaterock. Then sunk from shaft a whince 40 feet deeper and drifted 104 feet northward across the mixed ore belt. Found several seams of fine blue ore but they are so irregular and so much intermingled with jaspery seams that their profitable mining is much hindered although as to quantity of good ore the mine could compare with many others worked with success.

Convinced myself on this trip to full satisfaction of the older age of ore formation than the limestone which forms a broad belt by being folded up into a synclinal with the sides so compressed as to be parallel and dipping in the same direction.

Diagram

I observed also southwest of the mines close to the river in the N W.¼ of the S.E ¼ of Sec. 13 a high abruptly rising knob consisting of the Lake Hanbury slates trending strictly parallel with the ore formation and limestone belt from E S.E. to W.N W.

Walked across the north half of Sec. 18 and 17 on the plateau-like drift covered area supposed to be underlaid by the ore formation as north the limestone and south the Lake Hanbury slates can be traced in outcrops and by several testpits in Sec. 17.

Also the silicious and argillitic beds of the iron formation have been proved to exist. The old Brien mine is again tried to be reopened and some work is done there by half a dozen laborers and a steam pump but I cannot see much encouraging signs for a good mine.

Saturday June 10. Went to Norway. 20 cts. Dinner 50 cts. Return 20 cts. Examined the Cyclops and Norway mines. The Cyclops has opened N.W. of the old opening a pit exhibiting a large belt of soft blue ore, dip south. North of it are sandy schists partly light colored whitish, partly mottled with red or disseminated with granules of martite. Also dark ferruginous granular quartzite seams alternate with these schists. Lower succeeds a jaspery brecciated flinty quartz rock of dark brownish color mottled with red which exactly resembles the cores in the drill hole of Sec. 2. near Quinnesec at a depth of about 300 feet from surface.

Following this ore belt eastward it swings in an arch around the circumference of the hill and terminates in the Norway and Saginaw mines considerably north of its position.

Diagram

Went over to Sackets explorations and those of the Briar Hill Co. These two locations are one continuous series of rock beds but it seems in the western part the iron oxyd although equally abundant as in the eastern part is not concentrated into larger seams of pure ore which in the Briar Hill location and adjoining Curry mine is the case.

The lower next bed adjoining the limestone on the north side are grey banded argillites with more or less iron partly as grey martite granules partly as red oxyd. This rock differs from similar rocks on the south side of the ore formation by a more gritty dry nature while the others are fatty. The Silurian sandrock covers these beds locally in great thickness and partly perfectly free of coloring matter and in solid ledges which would answer a very good purpose as building stone. In the Curry mine the ledges are much twisted and strike in a part of the pits north and south. Dip east.

Sunday June 11. Went in the afternoon with Mr. Buel along the railroad track to the Indiana mine. Observed the large exposures of limestone along the creek and further on in the swampy valley again some outcrops of the limestone belt with interlaminated silky shining grey schists and also seams of a sandrock like quartzite more or less calcareous. The strata dip there north. Some of the limestone is dark grey. Other beds are light rose-colored. Buel is sinking a drill hole in front of the limestone bluff. Went in the evening to Florence . Hotel bill $10.00, R.R. fare 70 cts. Omnibus 25 cts.

Monday June 12. Visited the Florence mine. Ascending the hill on the main road graphitic and pyritous quartz schists more or less impregnated with iron and in part of silky shining sericitic nature form the surface strata on the north side of the mine. The ore belt is now very plainly exposed in the pits of the mine, is about 50 to 60 feet wide. Its footwall is a ferruginous quartz schist which on the southern side becomes less quartzose and more slaty in its nature. All strata dip under a high angle to the northeast. Trend N.W. and S.E. The hill row extends in that direction across the N.E.$\frac{1}{4}$ of Sec. 20 and the south part of Sec. 17.

The productive ore belt appears to be more near to the summit part of this ridge than to its north and basal slope where most of the testpits have been sunk. In Sec. 17 at the west end of Mr. Harveys explorations are large masses of the mica schist formation, incumbent on the ore bearing rocks but I could not see actual ledges of them. The north side of the ore bearing series is always composed of red sericitic slates.

Afternoon went again over the same ground. The hill range extends from the Florence mine close up to the Brule and is on the north side for a part of the distance followed by a parallel ridge of diorite, closely adjoining the ore bearing rock series in which latter not far from the outcrops of the diorite several belts of hard quartzite are found interlaminated with the ferruginous graphitic quartz schists. In the north part of this range indications of an iron ore bed are not as well developed as in the south part.

Tuesday June 13. Went with railroad to Crystal Falls. Hotel bill Florence $3.50 R R. fare to Crystal Falls 65 cts. Hotel $1.00, return 65 cts.

Below the Falls about ¾ of a mile on the hill side a new village sprung up since my last visit of the place. The situation is near the centre of N E ¼ of Sec. 29, T. 43, R. 32. Following the railroad from village to the Falls we come to a cut in which first a space 210 steps wide is occupied by nearly vertical ledges of a hardfine grained dark bluish black slate, some of it nearly fit for roofing slate. Trend of formation N W. Dip S.W.

Thence a space of about 100 steps exhibits no ledges but then again for 80 steps similar slates with interstratified quartzite seams continue and gradually change their nature into a more splintery clearing schist of dark rusty iron colored, full of quartzite seams and charged with iron pyrites and into a regular graphite schist which belt is about 300 feet wide, and forms the hanging of an ore belt cropping out at the falls in a width of about 10 or 15 feet but widening under ground.

The footwall of the ore is formed by a dark splintery fracturing quartz schist impregnated with iron rust and with pyrites. It forms the barrier at the falls and its banded ledges amount to a belt of about 800 feet as far as the exposures go.

The strata in a general way have a very regular uniform strike to the N W. and S.W. dip but locally very great disturbances and deviations from this rule are noticeable. The ore belt at the falls consists mainly of a hydrated brown ore and of a soft red hematitic ore but also a bright hard specular ore occurs in narrower concretionary seams associated with the other ores. The ore belt extends across the river into the S E ¼ of S E ¼ of Sec. 20 and into the south half of S E ¼ of Sec. 21, while westward it is traced by testpits all along the north half of the south half of S W ¼ of Sec. 20 and the S E ¼ of Sec. 19.

The Briar Hill Mining Co. is just opening this latter locality and the amount of ore so far discovered is very great, a belt over 100 feet wide. Found near the Falls a large boulder of the mica schist formation full of Staurolite crystals.This confirms my belief of the identity of the mica schist formation of this district with that of the Michigamee district. Returned to Florence in the evening.

Wednesday June 14. Went with Mr. Fischer to Keys lake and environs. Took road through Sec. 20 and 19, T. 40, R. 18 into Sec.24,23, and 22 of T.40, R. 17 as marked on the map.

Fischer opened in the N.E ¼ of Sec. 22 a great many testpits across the formation of almost vertical ledges of the ore bearing rock series. Strike N.N.W. Near camp not far from east line of Sec. slaty argillites of bluish grey or intensely blood red color and variable in hardness of sericitic or more gritty silicious character, form a large belt about 500 to 600 feet wide. Some quartzite seams are interstratified and in places a lean hematitic oxyd forms narrow seams.

Next follows a glassy quartzite easily cleaving in irregular fragments some iron ore mixed with it. Then a green hard schist probably a decomposed dioritic schist as with it more massive really dioritic rock masses occur. Beyond we find again red colored slaty argillites harder or softer and a belt of lean hematitic ore which however is at the surface all in fragments and no true ledges visible in the pits. As a footwall follows graphite schists full of iron pyrites, then an alternation of red argillites with graphite so as to form a succession of 500 to 600 feet.

This succession of beds represents in all probability a repetition of the strata by folding. The pits extend over a space ¼ of a mile in width. No sign of a valuable ore deposit here. By driving across Sec. 24 we found a good many testpits opened all principally exhibiting red argillites and narrow quartz belts. Near the west ¼ post of Sec. 24 and in 23 a large belt of quartzite of laminated micaceous character forms a prominent ridge. On its west side are graphite schists, red argillites with narrow belts of hematitic iron ore disclosed in many testpits. At noon rain and thunderstorm. Returned in the evening. Bought wrapping paper, 20 cts.

Thursday June 15. To S.E ¼ of Sec. 16, T. 42, R. 32. Camp of Mr. Tobin situated in N E ¼ of S.W.¼ of Sec. 16. From here testpits in a S E. direction across the formation which strikes almost north and south. Dips under high angle west. Near west line of section a parallel ridge of granite knobs. From camp for about 400 steps almost exclusively red slates of various shades and hardness with some harder gritty rock seams. Between them follow dark grey schists banded with quartz seams in a belt of considerable thickness. Gradually they change into graphitic quartz schists with some thick seams of quartzite interstratified which here and there incloses brown iron ore masses.

Further on graphite schists again and light colored silky shining fibrose hard schists which lay next to an ore belt of excellent quality principally a hard grape ore, thickness of belt not yet ascertained. This is on the margin of a shallow depression in which the ledges are lost under the drift. At least a hole 60 feet deep was still in drift sand. From the other side of this depression the base of the granite ridge begins to ascend from the ore pit to outcrop of the granite a distance of 500 steps.

From the granite knobs we went S.W. to S W. corner of Sec. 21 where a cluster of other granite knobs projects over the drift plateau. Thence without meeting with any outcrop we went S E. following the bed of the creek from centre of Sec. 28. Found large outcrops of the mica schist formation beginning near the north line of Sec. 34, mica schists hard feldspathic. Other seams softer more prevalently micaceous. Staurolite crystals in certain beds very abundant. Some layers brecciated. The mica schist formation covers almost exclusively the surface of sections 33, 34 and 35 and Sections 3, 2, and 1 of the adjoining southern town.

From Sec. 34 returned across the south part of Sec. 28 over pine plains. Turned then S W. towards the railroad depot near the centre of Sec. 31 where a row of hills extend northward along yhe course of the creek. All these hills consist of a dark iron and graphite colored quartzose slate rock identical with the pyritous quartz schists forming the footwall of the Commonwealth ore formation, all over the district. Strata nearly vertical. No other rocks seen in contact.

Friday June 16. With Mr. Tobin to exploring pits in Sec. 5, T. 42, R. 31. North of Lake Mary went up the wagon road to Crystal Falls until the bridge across Paint River in N.E corner of Sec. 4, T. 42, R. 32. Bridge broken down, crossed river with wagon road, leads from there east through north part of Sec. 3, 2, and 1. On the way in Sec. 2 and 1, several outcrops of diorite likewise dioritic outcrops along Michigamee River in Sec. 31 and 32, T. 43, R. 31.

These latter diorite hills are on both sides of the valley surrounded by a mantle of the iron bearing rocks of the age of the Commonwealth ore formation. In the test pits of Mr. Tobin which drove a tunnel into the strata in N W ¼ of N.W ¼ of Sec.5 T. 42, R. 31 the nearly vertical rock beds dip S W towards the hill. First comes a large series of red argillites, some of them highly micaceous. Incumbent on them is a belt of mixed ore composed of quartzose seams intermingled with hydrated brown ore like the Commonwealth ore. Belt of mixed ore about 50 feet wide. Then silky shining variegated hydromica schists. Further the tunnel did not penetrate.

On opposite side of river are other explorations going on. Strate the same and dip the same so that on this opposite side the variegated hydromicaceous argillites are nearest the river as a hanging wall of the mixed ore belt and behind this the red micaceous argillite follow. There is little prospect for valuable ore deposits here. Returned to Florence.

Saturday June 17. Went with a hired man to Sec. 17 and 18, T. 41, R. 31 up to mouth of Paint river. At the falls the strata have an east and west trend and dip under a high angle to the south. Specimen No.1 . The mica schist formation in hard compact layers of granular quartzite like appearance forms here a belt 3 or 400 feet in thickness. 300 steps down the river are high bluffs composed of softer schistose mica schists, also several hundred feet in thickness. Specimen No.2. Then follows another large belt of hard micaceous rock marked 3. No. 4 is similar, more gritty argillaceous. No. 5 fine grained silky shining mica schists of grey color, also a very large belt. Then follow other slaty rock ledges of various color and grain marked from 6 to 19 in succession. Specimens 20 and 21 are in close connection with the diorite. The aggregate amount of all this series is not less than 25 hundred feet.

The further exposed rocks are greenish schists partly micaceous and resembling a decomposed dioritic schist and these are in immediate contact with massive diorite of a more or less micaceous or chloritic character. In several places along the river bed down to the section line of 17 these diorites recede from the embankments and the slaty or schistose bed before described outcrop again.

In these slaty series several belts are richly impregnated with iron even seams of hematite are intermingled besides quartzose veins. I explain the structure of these outcrops as being in an overtilted position. The beds nearest the diorite being lowest and the mica schists at the falls highest although according to the dip of the series they had to be the lowest. Paid $2.50 to hired man.

Sunday June 18. Dark, rainy. Hotel Bill $7.00. Afternoon went to Quinnesec with train. Found letter from home. Weather very cold .

Monday June 19. Went with Mr. Foster to drill in N.W.$\frac{1}{4}$ of S.W $\frac{1}{4}$ of Sec. 30, T.40, R. 30. Boring most all the way to depth of 340 feet through argillitic schists which are unfortunately intersected almost parallel with their bedding.

From here went to railroad cut through slate rock belt in Sec. 24, T. 40, R. 31. Slates blackish silky shining interlaminated with thin quartz seams besides various thicker beds of granular quartzite position almost vertical , dip S.W., strike N.W. Have some resemblance with the dark slates in Sec. 18 below mouth of Paint River but I am not sure of their equivalency.

From here to bridge across Menominee no outcrops seen but below the bridge a large belt of silky schists strikes in almost western direction across the river. Dip north but nearly vertical. Width of schist belt 400 or 500 feet without any change in character. At and above the bridge not over 300 steps from the slate dioritic schists and massive diorites form the river bed and its embankments. These schists below the bridge may be an analogon of the similar schists on Brule river which are a subordinate link of the mica schist formation. Returned in the evening to Quinnesec.

N.B. South of slate outcrop in Sec. 24 in the low land a large belt of light colored quartzite adjoins the slates. The ledges at the surface are broken up into large angular blocks but occur in such abundance as to make the existence of such a belt in this place sure.

Went in the evening with Buel to his testpits north of the Quinnesec mine. He finds furthest north limestone which is the same as outcrops in the bed of the road a little further north. Dip north. South he finds hard gray and red mottled argillitic schists and more to the south softer more iron stained schists, all dipping north. There is evidently a break in the limestone formation and the subjacent strata are accessible for the explorer.

Tuesday June 20. Went to exploring pits near $\frac{1}{4}$ post between Sec. 33 and 32, T.40, R. 30. The limestone belt running across the south half of the sections is decidedly a part of this formation which during the upheaval severed from the main body of limestones and fell southward leaving a big chasm between the broken margins in which the inferior ledges of the ore formation became denuded but subsequently this chasm was filled up by horizontal Silurian sandstones which contain an abundance of lingula and scolithus. The ore formation in this range of hills does not in uninterrupted continuity connect with the Quinnesec ore belt but is in a faulted position to it.

Diagram

Wednesday June 21. Went with Mr. Alward to Felch Mountain. Stopped on the road to see Woods mine in S W $\frac{1}{4}$ of N E $\frac{1}{4}$ of Sec. 8, T. 41, R. 28. The mining property comprises also the S E $\frac{1}{4}$ of the N.W $\frac{1}{4}$ of the same section. The formations strike N.E. Dip S.E. Furthest south a large belt of quartzite is said to form the highest layers. Under it is a large belt of argillites intensely impregnated with red iron oxyd. This argillite forms the hanging wall of a large belt of blue ore in well stratified porous layers.