



FIELD NOTEBOOK - DIARIES
of
CARL LUDWEG ROMINGER, STATE GEOLOGIST
1875 - 1884

Transcribed by Mrs. Margaret Reilly.
The original notebooks are deposited
in the Historical Collections, University
of Michigan.

- I. Rominger , 1875 Excursion to Monroe, Rifle River, and Lake Superior.
- II. " 1877 Marquette District.
- III. " 1877 Upper Peninsula.
- IV. " 1877 " "
- V. " 1877 " " In other handwriting(Wagner ?)
- VI. " 1878 " "
- VII. " 1878 " "
- VIII. " 1879 " "
- IX " 1880 " "
- X. " 1881 " "
- XI. " 1882 " "
- XII. " 1883 " "
- XIII. " 1884 " "
- XIV. " Exploring trip to Joplin and Northern Arkansas Region
- XV. Register of Fossils, Corals and Publications as of Jan.1,1906
compiled by C. Rominger
- XVI. Register of Fossils of Environs of Louisville, Ky.



Diary May 18, 1975.

C. Rominger.

Exploration on Rifle River, visit to Smith's alabaster quarries. Excursion to Monroe. From there to Newark, O., thence to Sandusky and environs. In August examination of Lake Superior District.

Notes on fly leaves. 3 hour. Belleville Ohio. Newark Rd St. I promised to be at Park Palace at 12. For Sterling Monroe road. Deslureaux on list for reports. 5:55. Preston House, Newark. Ramsperger - 331- 41 Str., between 1 and 2nd Ave. Town 20, R.4, Sec. 18 and 11, bog iron. Dunhein and Whipple. Sandstone. 21, R. 3 east. Rapids. Rifle.

Diagram

Oceana Ct. Carb. limestone. Deposit of fossils, loose but supposed to be in place. C(entral South(ern))(R.R.) leave Detroit 8:55, arrive N.Y. 7, joining at Rochester with N.Y. Central. Leave Rochester 7:25 A.M. arrive N.Y. 7. Another train leaves Detroit 11:50 A.M. Arrives N.Y. 12:50 P.M. From Ann Arbor to N.Y. 17.55. Deposit with Menter \$300. July 7. Received of Governor check for \$500.

Left Ann Arbor May. 19 at 12 noon. Arrived at Owosso 7. Departed from Owosso 10 A.M. May 20, Thursday. Arrived at Bay City at noon. After dinner I went to the house of Mr. E. M. Fowler who was not at home. His wife directed me to Mr. Chapman and while inquiring for his residence I made the acquaintance of another gentleman who directed me to the owners of the presently opened field for exploration Mr. Gustin and Merrill. Mr. Gustin invited me to his house with irresistible kindness and I accepted it. During the afternoon I was introduced to many different parties, of most of which I forgot the names. Among others I met again with Mr. Smith, the owner of the alabaster quarries. I learned also that a settler with the name Bennett found the coal first and brought it to notice of some persons in Bay City. He made consequently application for a certain place under the homestead law and was cheated out of it by Fowler and Chapman which found out his design and took it in advance of him who is a poor man and an actual settler.

Friday May 21. Went to Rifle River accompanied by a young man in the employ of Gustin and Merrill. At Torry's Stat(ion) Art(esian) well 75 ft. deep in drift flowing sweet water.

Dam on Rifle River. River bed cut down to the rock. Bluff on south side of river from 80 to 100 feet high, above sandy, below boulder drift resting on the rock.

Top layer of rock a brownish yellow fine grained sandstone with iron geodes and vegetable remains, calamites; rock easy weathering 5 feet exposed. Below irregularly laminated shaly, sandrock full of black dots interlaminated thick are of evidently of vegetable origin and sometimes have vegetable structure. Met also pebbles of ferruginous stone and numerous slate fragments are intermixed with this slaty rock. Its visible thickness is also about 5 feet, its color is grey but by weathering it turns to be of rusty brown color.

Further down the river about 1 mile from the dam, they have sunk a shaft to the depth of 27 feet, almost on a level with the bed of the river at the foot of a drift terrace there are first penetrated about 11 feet of loose clay and drift material. Then follows light colored sandy shales 5 feet below 5 feet of a white sandrock which partly is very rich in sparry cement.

Below the sandrock commences a dark bituminous shale rock which by degrees downwards changes into regular cannel coal. The upper slaty layers amount to about 4 and 5 feet. The cannel coal is known to a thickness of 7 feet.

About 10 rods from the shaft a boring was made to the depth of 120 or 30 feet, the register of which I have to get at Bay City. Across the river from the shaft about 300 yards they made a boring of 45 feet depth which struck sandrock about 25 feet below surface and remained then in sandrock strata without finding the coal. In the shale there are very numerous lingulas. The shales are entirely similar to the lingula shales of Williamston.

Afternoon visited the Rifle River again near the dam. The water was shut off and the river bed was much better exposed. About 10 or 12 feet of sandrock strata with intermediate shaly arenaceous seams of dark bluish color were seen.

The upper strata are mostly a fine grained yellowish more homogeneous rock than the rest of the strata but it is too soft for building purposes and easy disintegrates. It contains in the lower part some harder ferruginous concretionary portions which sometimes inclose well preserved calamites. Under them a few feet of a shaly sandstone of uneven undulating and wedgelike interlocking lamination. The laminae are coated with black organic substance and the sandrock is in places quite micaceous.

Then follows a band of from 10 to 15 inches of a dark blue laminated arenaceous shale with many kidney ore geodes and the stratification not only discordant in the usual way but also broken up and considerable plexured and dislocated with ferruginous or shaly pebbles inclosed.

Diagram of above.

Below is a soft friable white sandstone visible to the thickness of about 6 feet which contains very numerous small shale fragments and iron nodules besides black carbonaceous matter in paper thin seams. The iron nodules are apparently waterworn pebbles like the morsels of shale in it. In the shaft similar shaly sandrock is penetrated before striking the black shale and the cannel coal. This sandrock in the shaft is in a band of 3 feet thickness very rich in calcareous cement and consequently very hard with sparry glistening fracture.

Returning to the house we passed the drill hole sunk on the lower terrace of the river about 20 feet above watermark. They had gone down at the time 50 feet still remaining in the stiff bluish drift clay.

Diagram of shaft.

Monday 24. Returned to Bay City after noon.

25

On Sunday went to Omer, in the centre of Sec. 15, Town 19, R. 5, situated close on the river where the sandrock of the coal formation crops out in the bed of the river. The river has there an elevation of about 14 feet above the lake. Higher up the river on Mr. Kinsy's Farm the rock has also an outcrop on the river and not far from it the rock comes to the surface on top of the first terrace which is about 40 feet above the riverbed.

North of Omer in Sec. 3, 4 and 1 of Town 19, R. 5, the carboniferous limestone comes to the surface, and in Town 20, R. 4, the big falls of the river run over carb. sandrock again.

Gypsum in Town 21, R. 5. on branches of Au Gres and in Sec. 20 of same town. 7 miles back from Alabaster on Aux Gres fine plaster exposure in the riverbed.

Tuesday night to Alabaster. Arrived 5 o'clock morning. 5 miles below Alabaster Point on the shore a natural section of the gypsum formation is seen. First about 5 feet of drift, below arenaceous-calcareous beds and partly sandrock of a greenish grey color from 2 to 3 feet in beds of from 4 to 6 inches thickness. The surface is all polished and scratched by drift marks directed from northeast to southwest. Below are about 10 feet of soft green arenaceous shales and below about 4 feet above the level of the lake gypsum beds the thickness of which I could not see.

A few steps further on above the drift marked beds five feet of arenaceous shales of green color with interstratified banks of flinty limestone are seen superimposed. In places these upper strata are a continuous seam of soft friable sandrock with discordant stratification and above the flinty limestone bed forming a separate band of about 15 inches thickness or more.

The arenaceous slabs tumbled down into the foot of the bluff are ripple marked. The arenaceous shales above the more solid gypsum beds are interspersed with gypsum nodules.

Lucker, in the centre of T. 21, R. 5, Sec. 21, limestone and gypsum within a mile of his place. Go off from Standish to Crier.

Friday 28. On the road to Whitefeather and towards town 21, R. 5. Sec. 20, 21, T. 21, R. 5 and Sec. 1 of same town, in main branch of river outcrop of gypsum. Limestone in creek Sec. 23 of same town near camp of Keystone Company.

Saturday morning May 29, at 6 left Fr. Charman's farm on 19, 4 E. southwest of Sec. 25. From there went on section line one mile north, one east, one north, then 3 miles east, 3 north, then 1 mile east and then northeast crossing the Aux Gres river near a dam on Sec. 20 where the gypsum is exposed in an excavation made by the water, under the sluice.

At that place 3 branches of the creek unite right in the centre of Sec. 20. Upwards in the main stream of the mentioned creeks in Sec. 30 northeast part, there is between two other dams an outcrop of the carboniferous limestone. The limestone contains *Allorisma clavata*, several *Productus* *Fenestella* *Cyrtogopora* ectr. with globular flint nodules. About 3 feet of the upper strata are a comparatively pure limestone. Below are 4 or 5 feet of calcareous sandrock beds or arenaceous limestone slabs. Also thin seams of dark silicious shaly strata are noticed and a dark seam penetrated with irregular cylindrical stems. The strata are in the emersionment about 12 feet above the low water mark. In the bottom of the river there are scarcely any rock ledges to be seen. It is formed by boulders and in part by drift clay beds.

Stayed over night at Fr. Scott's farm in 21, R. 4, Sec. 35. Crossed from there Sunday to Rifle River in town 21, R. 3, Sec. 16. where the river bed is for $\frac{1}{2}$ mile formed by sandstones without any fossils of discordant stratification, coarse of grain, greenish or bluish color with specks of rusty color.

I suppose this to be the upper sandstone of the Waverly group as near Fort Austin about 3 miles down the river there is a limestone forming the river bed which contains many fossils, and is identical with the limestone of Bass River and Oak Point near Caseville.

Further on the river has no more rock exposures. On the rock partly a diluvial vegetable deposit of black color with trunks of trees rests partly a gravelly hardpan. Above which in the bluffs a yellow sand deposit rests. The river has generally cut its bed into the drift about 75 feet deep. Some parts we traversed are arid pine plains but the towns 20, R. 4 and 5 contain considerable very fine hardwood land with good soil.

Monday May 31. Sent specimens to Sterling Station. Went to Mr. Ortman's boring on Sec. 3 in a side valley of the river. Surface material 37 feet present depth of the well about 52 feet, shales and arenaceous strata.

I learn that in the shaft of Aureka mine the sandrock which I thought to be a solid layer was merely a loose piece of large dimensions. Borehole on Aureka farm now 65 feet deep, of which 60 ft. drift, the rest first sandstone, now blue clay. On Ortman's boring they are in the same clay at a depth of 52 ft. below the surface.

Deep river well 25 feet below surface. struck rock. A flowing well at base of drift.

The men boring the well for Ortman reported that on Tuesday eve the borehole was sunk to a depth of 72 feet. After I left they were 42 feet deep in blue shale. This continued for 4 feet. Then they struck upon a more hard brittle and darker blue shale continuing to the mentioned depth.

Monday June 7. Left Ann Arbor for Monroe. Left Toledo 6 eve. General (?) Waterline Diag.

8. Arrived at Columbus. Visited state quarries at noon.

9. To Dublin 18 miles north of Columbus on Scioto. Velderberg group all the way. River excavated in the rock. The formation is there at least 75 to 80 feet thick. Upper strata thin bedded, flaggy sometimes almost shaly. Below solid banks of limestone with seams of flint throughout but in certain locations rarer than in others.

In the upper part which is sometimes weathered into nodular wedge-like intercalated masses, fossils, figures (?). The middle beds of formation are in larger useful blocks. Below hornstone is again more abundant.

In these lower hornstone beds are at Dublin a large number of finely preserved gastropods of small size, also Meristella and some bivalves and Orthocerata one of which is annulated and covered by finely cancellated shell. In the upper beds Cyrtoceras nautilus, Gomphoceras are very common but rarely well preserved. Comparing the large exposures with others the limestones are comparatively much poorer in good fossils than the Sandusky and Indiana or Michigan Velderberg limestones.

Connerston (Thursday) June 10. To Newark. Examined some of the quarries, which open about 40 feet of the strata. Uppermost are thin-bedded greenish sandstones with arenaceous shales amounting in all to at least 30 or 40 feet. They contain dispersedly Productus, crinoid joints, Rhynchonella, Spirifer, Latyceras etc.

Below the sandstones form a more compact body, interior to which are bluish arenaceous shales, perhaps 5 or ten feet. Then solid fine grained sandstone irregularly fractured but in very large massive blocks. Then comes a 5 feet seam of hard core argillaceous rock and under it again about 5 or 10 feet of a solid fine grained sandrock which forms the base of the quarries, underneath are nacreous shales following). Shells are rare but certain seams abound in them and generally each seam has a prevailing form so there are seams exclusively with crinoid joints; others contain only large spirifers with isolated shells ectr. The sandstone is of very fair appearance but seems to weather very readily after some years of exposure.

Friday 11. Excursion to 3 other quarries. Structure in all the same. I. Above thinly laminated sandstone and arenaceous shales solid sandrock with an intermediate hard argillaceous layer below which sandstone again. Lowest blue arenaceous shales in striae, visible thickness about 100 feet. In the upper part of the sandstones a seam of conglomerate with pebbles of the size of a pea. In the shaly seams Fucoid like ramifications and other plants.

In the sandstones occasional local seams and nests of fossils which are in general not very abundant. *Cynictites*, *Orthoceras*, *Fucula allorisma*, *Rhynchonella*, spirifer, *Orthis*, *Aviculopecten*, crinoid joints. The strata are evidently contemporaneous with the point of Barques greenstones.

June 11. To Marble head. The entire promontory is underlaid by the upper division of the Helderberg limestones which are quarried in many points. On the part of the landspur connecting with the mainland the lower Waterline strata are at the surface and below them considerable gypsum deposits are mixed.

South of Sandusky the highest beds of the formation containing fish remains are extensively quarried. These beds are bluish and very hard.

In one of the quarries belonging to the Lake Shore Railroad a stratum entirely composed of *Eridophyllum strictum* is superimposed on this blue rock. Flint nodules and seams of it are occasionally met with in every horizon of the limestone formation.

The Island of Put-in-Bay and those west of Welley Island are all belonging to the Waterline group with many strata of brecciated structure. Fossils generally rare but sometimes in nests abundant. *Leperditia alta*, *Meristella Lewis*, spirifer *Vauxeni*, some bivalves and at Beach Point of Put-in-Bay *Thryptenus rectipes* (*rectipes*).

In the brecciated limestone *Strontiania coelestin*, Fluospar, calc-spar are quite common minerals. The rock contains many caves. On Put-in-Bay Island the surface rock of the island is deeply carved by drift action. Particularly fine exposures of drift carving on Welleys Island.

At Fort aux Peaux the same brecciated limerock is exposed. It contains some seams with fossils, casts of *Meristella* etc. and very many vegetable stems, but *Aurypterus* I could not find. *Occlestin* and *Dalmanites* very abundant but no *Fluorspar*.

In Plum Creek quarries the surface rock is higher than the brecciated limerock. It is the same as the rock 5 miles south of the village of Ida representing the horizon of Criskany and strata below.

The brecciated rock is not reached in the quarries but is dug out from holes in the bed of the Plum Creek and is found in another quarry little distance south of Plum Creek. The lower Helderberg strata furnish only road building material. No finer stone for dressing.

Many borings in Monroe are made in the last few years to a depth of about 300 feet, all generally penetrating through limestones of various character with intervening beds of shale. No accurate record kept. Water in all rising to surface but rarely overflows. Water sulphurous. No gypsum found in any of the borings which certainly reach to the Niagara group or cliff limestone.

The brecciated limestone of the Islands and Monroe Co. is of a lower position than the upper portion of the breccia at Arch Rock on Mackinac Island. However the lower portion of this continued breccia at the foot of the island seems to be identical with the Monroe breccia. The disturbance noted on the island of Mackinac during the time including the upper Helderberg limestones while it was in Monroe at that later time no more perceptible. An unconformability of upper and lower Helderberg group is not observable as far as the outcrops shown.

Sand.	30 ft.
Clay	150 ft.
Hardpan	150 ft.
Grey lime and shale light, balance dark grey lime and slate, in all 325	100 ft.
Blue shale with soft streaks of same matter	775 ft.
Solid blue shale	150 ft.
Red shale	130 ft.
Limerock with streaks of shale and soft lime	300 ft.
Salt bearing rock with streaks of sand	50 ft.
Limerock and shale light	50 ft.
Dark colored limerock down to gypsum	250 ft.
Gypsum and lime in streaks	50 ft.
Down to 2648 ft. little change lime and gypsum alternating of it	145 ft.
From 26 to 2627 rapid and various changes, dark limerock loose and porous. Entire depth	2627 ft.
(Above are pencil notes with no other explanation).	

Wentwater has a very good harbor. Dunes along shore all the way to Ludington and down to Muskegon. South of Ludington about for 2 miles high drift bluffs partly red clay. No more dunes. Height of drift bluffs in places 100 feet and over.

Friday 20. To Manistee with boat. Arrived 9 A.M. shore lined with dunes, river forming behind the shore a large lake basin lined by numerous large saw mills. The north side of the river is all arid sand hills. The south side is composed of clay hills, red clay on top, below sand and gravel strata. Manistee is much larger than I expected and the part situated on the hill on south side of river is not without natural beauty, offering good soil for gardens and elevated above the sandy borders of the river.

The lake behind the mouth of the river is quite large in extension and serves as a splendid reservoir for an immense amount of logs. Mr. Ruggles took me out in a buggy to the environs which made a very favorable impression on my mind. The soil of the lower part of the valley is quite sandy but not destitute of loamy materials to such a degree as to prevent the growth of vegetables and its susceptibility of cultivation. The dune hills of the shore form a marked contrast with the clay hills behind.

Mr. Ruggles informs me of a very equal gradual descent of the river without any rapids. One-third of the land intersected by the lower branches of the river is fertile clay land, the rest is sand soil. A part of the very best pine timber lands are on clay land. They told me that back of Ludington the land is yet better for agriculture than the land back of Manistee.

Saturday June 23. Left at noon with steamer to Frankfort. On north side of Manistee river mouth about 1/2 mile or more of dune hills facing lake. Then again clay bluffs for a long distance. On top of bluffs generally good farm land but little of it cultivated.

3 miles below Frankfort high sand bluffs of 200 to 250 feet the base for half the height sometimes is seen to consist of the red clay. The top part is loose dune sand and has its origin from later date equal with the dune formation in front of Manistee estuary. Further on the clay part remains to form the bluffs and the upper sand tops gradually become only isolated. Water deep close to shore.

Near Frankfort bluffs 150 ft. high. Above mixed gravel and clay of reddish color. Then intermediate beds of fine sand or clean (clear) gravel frequently, wedging out everywhere discordant but distinct stratification. This alternation is so irregular and local that no general rule for the sequence of beds can be given. The lower part of the bluffs is formed by the well stratified hard shale-like red clays at least 20 feet in thickness.

In a certain horizon above a streak of indurated sand and gravel is noticed which by calcareous cement forms a very hard solid rock.

The waves of the lake wash out a large quantity of black iron sand. The pebbles of the gravel are partly distinctly drift marked and most of them seem to be derived from the Niagara group. Of course metamorphic rocks intermingled. Numerous clear springs originate on top of the well stratified red clay. Underneath the clay are seen thin pure sand strata.

Sunday 27, by tug to Glen Arbor. Clay and sand bluffs of variable height and locally interrupted by glens are bordering the lake all the way. Their height is frequently about 300 feet, generally over 100. Sleeping Bear may come near 500. The Sleeping Bear and all the way between it and Glen Arbor is entirely free of vegetation, a barren sand accumulation with only a very few widely separated shrubby trees, no grass nor anything else covering the sand.

Diagram of Sleeping Bear

Hillsides in and north of Glen Arbor Bay all abrupt, densely wooded. At the north point a naked bluff again.

Small diagrams without explanation.

Monday July 28. Left for Detroit and Saginaw valley. To Utica flat but good land. From there undulating or paddy hilly, fertile, gravel. Creek with swift current and clear water. At Rochester deeper cuts through well stratified sand and gravel. In some parts along creek the lower hardpan visible in the embankments. Gray sticky clay with pebbles in other cuts. The gravel and boulders are evidently not stratified, representing . Land gradually getting more hilly and broken, near Orient and Rochester and intermediate space. Near Orient many small lakes with clear water. Sandy soil. Oxford 45 1/2 miles from Detroit, 64 1/2 from Bay City.

From Lapeer to Vassar the timber is generally intermingled with pine, often the latter is prevailing. Towards Tuscola River the land becomes less hilly and forms a gradual sloping surface. Much of the timber land is burnt over and more wild lands than hitherto seen.

Confidential. Standish boring of Mr. C. W. Stanton. Drift clay 53 feet. Sandrock 25 ft, then fireclay a few feet. Then blue shale down to 116 feet. Soft and hard black spots of coal.

28. Left with Mr. Whitbauer for Standish - St. Helena. Deep River boring. 120 feet deep. Coal at about 100 feet below surface. At the bottom of well struck limestone.

St. Helena is the sawmill of Mr. Whitbauer & Co. situated on the shore of a beautiful lake from which one of the branches of Sabje river emanates. The surrounding country of this river is very low marsh land. The soil of the dry land is sandy and pine is the prevailing timber.

39. Moon returned to Deep River. Limestone all along the road, on the high plateau. At Clyde and vicinity good new farms with clay soil also at Sterling.

Deep River.

20 ft. drift.

37 ft. light sandstone

7 ft. blue shale

5 ft. blue dark shale

2½ good coal

Below clay-like rock and seams of sandrock with sulphurete of iron.

Below shale with calcareous nature.

Lowest solid limestone, went through 2 feet.

A strong flowing well of sweet water rises from the borehole.

Different borings at Deep River indicate the sandrock of the coal formation. 1 borehole near the river 28 feet drift. At the Hotel 50 feet of drift. 1 mile north only 16 feet of drift. south of the hotel they went 45 feet through drift without finding the sandrock.

At Sterling they bored a well to the depth of 30 feet without finding the rock. Near the dam at the mouth of Deep River. They bored quite deep, near 100 feet or over and remained all in drift.

30. Went to Rifle River, Eureka Mines. Shaft full of water. 1 heap of coal and slate thrown out. The coal now is seen to be mostly of inferior stony quality. Below the coal beds of hard fireclay with plants are dug out. They drove a gallery westwards in the shaft about 30 feet long and stopped. In the afternoon went with train to Standish.

Standish.

52 drift.

27 sandrock.

Blue shale with different harder beds and a whitish clay (d

At 106, they struck a band of coal 15 inches and before they found several thin bands of coal not amounting to over a few inches.

Below coal shale again and then some bands of sandrock.

At 120 feet a band of sandrock 2 feet.

Near that lower sandrock a band of iron pyrites. Of this also some seams before occurred. The shale is blue of color.

Below this sandrock shale again to 133 ft.

Ortrans borehole on north side of sec. 3, T. 19, R. 4 East. Lowest a seam of iron pyrites and black shale. Then dark shale. 190 fess(feet).

Above most all blue shale of various shades. No sandrock in the boring.

In a other locality, sec. 17, same town, boring to over 100 feet without finding rock.

Ramsdell boring in T. 19, R. 3 East.
 31 ft. clay
 53 ft. sandstone
 54 blue slate
 8 ft. pyrites
 14 ft. slate.

Dr. Ramsdell drilling on Sec. 10, T. 19, R. 4 East.
 Drift 75. Sand
 35 clay
 Sandrock 7 ft.
 Then 75 ft. further all through slate and about 4 ft. of fireclay
 and various kinds of blue shales or blackish.
 Total depth 200 feet.
 At bottom dark gray rock hard.
 No seam of coal observed.

Another hole on 19. 3.
 37 ft. drift all clay.
 Sandrock quite thick.
 Under it thick strata of blue shale with seams of iron pyrites.
 Total depth 123 feet.
 No coal.

One hole not yet finished in Sec. of T. 19. 4 is in 122 feet not yet penetrated through the drift.

Monday Aug. 2. to Summit Station. From there road to Rifle River 4 miles. We followed an old overgrown log road and struck the river about 1 mile above the Island Rapids. Crooked river and took trail on top of hill.

At Island Rapids the limestone dips across the river about south west. The lower strata are slaty structured, limestone full with the peculiar vegetable ? The beds above are crowded with shells and Orthoceras ectr., but little of them is perfect and all intimately incorporated with the rock mass.

Returned on trail. Followed it about 4 miles north and came to the upper rapids which are in T. 21, Sec. 9. A new lumber camp across the river gave us night quarters. Island Rapids are in Town 21, R. 3, Sec. 28 and 29. This is not far from Alger Railroad station. Returned to Ann Arbor Wednesday 4. Alger is in Arena Township. The Islands rapids are the south part of Ogemaw Co.

Monday Aug. 25. Left Ann Arbor 2 P.M. for Marquette via Chicago.
 To Chicago 7.50
 Sleeper 2.
 Cannibus .50
 To Marquette 13.30
 breakfast .50
 Dinner Milwaukee .75
 Cannibus 1.50
 .05 Misc. str(eet)
 Registers Block A. 11.
 Bossert(or Bossers)
 Wasser(Water)Str(eet) Ost(East)
 236.

At Green Bay Omnibus	.85
Hotel	2.50
Left Green Bay 10 o'clock in the morning	
Wednesday 30, dinner	.75
Hotel	3.50
To Negonee goss Sperling	.55
27 Excursion with Mr. Armstrong for meals and railroad	3.00

Diagram

At Negonee Hotel	4.
Assistance	2.
To Marquette Saturday evening	.55
Hotel at Marquette	6.
Monday to LaAnse	3.

Morgan Furnace limestones. Limestones about 2 to 300 feet partly approaching to shale, partly in a distorted and partially brecciated condition throughout with silicious lamination.

Diagram of above

4 full page diagrams

Drift marks on cliffs on front of Northwestern Hotel. Extremely plain and constant in direction. One set has without consulting the compass about a north and south direction or northwest to southeast, while another direction crosses it from northeast to southwest. The one from north to south is the first and prevailing one.

Diagram of above

is is is

The south face of the cliffs if vertical or nearly has, it always escaped the drift carving. The more horizontal declivities are also drift marked and bottoms of depressions. Drift marks 15 degrees east of north to 15 degrees west of south.

Sunday Aug. 29. Observed the cliffs near Northwest Hotel southward. The almost erect strata strike from west to east (10 gr. south of east to northwest) intersecting the road almost rectangular. The thickness of the beds composing the bulk of the landspur amounts to about 400 feet, partly composed of massive green fine grained rock which makes gradual transition into chloritic shales and schistose rock with many jasper quartz and calkspar veins of lenticular masses, also occasionally copper pyrites. Northwards the continuation of similar rocks as far as the ore docks are exposed, having also the same strike and are evidently forming a narrow synclinal fold on the quarry north of the hotel.

Diagram

The massive rock of granular structure has frequently its stratification much obscured but intermediate slaty bands which exhibit many signs of flexure and sliding pressure from the uplifting force demonstrate the stratified nature of the entire mass.

No crystalline diorites help to compose these masses. Strata along the road to lighthouse all strike east and west dipping north. The same continues on Lighthouse Point.

Character of rock chloritic schist of various grain and interspersed with seams of quartz, calcspar ectr. Some strata are approaching to the wet stones of Teal lake thickness apparently several thousand feet.

The centre of the lighthouse spur is a massive black crystalline feldspar ? hornblende ? rock which appears to be intrusive between the schistose strata all of which dip north.

Monday Aug. 30. Large heavy drift masses observed on hight of Negonee road, partly with distinct stratification. The limestones of the Huron series as seen at Morgan Furnace seem to be decidedly in a position below the productive ore beds.

Diagram

At Jackson mine west end, the contact of iron ore and diorite immediate.

Diagram.

The diorite with the iron beds all are of the crystal eruptive sort, like the rock of Marquette lighthouse.

Heavy boulder drift granitic along Michigami. The road passes south of very massive diorites which join to the north immediate with a granite range. South of the diorite are the banded jaspery magnetic rocks. At Michigami village immense boulders accumulation. In some places the ore beds are immediately incumbent on the diorite dipping south.

Diagram.

The other side of Michigami after passing 3 lakes in the vicinity of the road all outcrops disappear and only heavy boulder drift with dark grey slate rock fragments is seen .

Near Sturgeon river the first outcrop of a diorite and granitic rock is noticed on Section 21 of the road 16 miles from LeAnse The diorite and red granite are mixed up in bands and I should not call the rock granite except for its bands of red color contrasting from the green of the diorite. Summit Station elevation of about 1200 ft above Lake Superior. Drift up to this hight.

West along the shore to Mr. Hurleys quarry. The upper coarse grained beds of Laughing Whitefish Point but little finer in grain and some softer more like the brownstone at the west portage entry. The rock is about 6 to 7 feet thick, below the beds are gravelly.

Returning towards town I found about 1/5 of a mile the Huronian slates of a argillaceous softer character red and white or greenish variegated striking east and west dipping south generally but in some places also north so that I suspect several repetitions.

Otherwise the whole series would be about 5000 feet thick. There are 5 or 6 times intervolutions of massive crystalline diorites (Brabase dykes) which often are easily weathering into a friable sandy mass. Between the slates conformable to them and sometimes in beds alternating with slate seams or other times with obscure stratification in thick masses resembling igneous origin in one place, the sandstone is seen unconformably resting on the slates, filling out a funnel-shaped crevice and with layers somewhat adapted to the inclination of the walls.

Diagram

Diagram

And so on, general character of slates and diorites little differing along the whole exposure.

Slates at the Roundhouse LeAnse in riverbed. Striking 20 degrees north of west to south of east and dipping southwards and eastwards. Very powerful, at least 1000 feet visible.

Silver Creek. Strata on bridge, slate with hard quartzite rock in rather thick beds striking from northwest to southeast, dipping south. Considerable contortions of strata. Majority of rock quartzite. On road further on slate dipping south and striking a few degrees north of west to south of east.

Pitched camp on Sec. 25, near northeast corner Town 51 (or 31), R. 32. Had crossed the river about some place in Sec. 27 of same town. Slate quarry about the centre of Sec. 28 T. 51, R. 31. Actual amount expended by the Company is today about 12500 dollars and no sales made yet which amount to anything. Man superintending was a negligent drunkard. Now another man from Vermont installed as foreman.

From camp north and east in T. 51 R. 31, Sec. 30 and 19, a very high hill composed of about 400 to 500 feet of quartzites of blackish color and dipping and striking like the slates which very powerfully lay in front of us. The Bay of Huron seen short distance north from hilltop. Walking obliquely across the strike to the south I found the quartzites again regular slates forming the declivity of a deep gorge.

Diagram

Following in the gorge the creek downwards in westerly direction and then going north we arrived by the trail in our camp.

Mittw. morgen (Wednesday morning). Towards the slate quarries on the side of the second creek which we passed a high hill of quartzite is situated near the centre of Sec. 30 which is exactly the same thing we saw yesterday.

Those hills are marked on the maps as trap hills but they are black quartzites imbedded in the slate series. It seems as if there is a repetition of the strata so that this and the other quartzite hill represents the identical beds but there is no change perceptible in the intermediate space in regard to the dip which in both cases is southwards and a strike constant in a direction a little south of west to north of east.

Small diagram

Diagram Section of a vein crossing the slate in quarry.

Was crossed by a hard slate rock with the ordinary strike and dip. Returning to said corner we went north for $\frac{1}{4}$ of a mile where we found a belt (20 rods) of eruptive not stratified rock (hornblende rock) with quartz veins inclosing chlorite, striking from east to west 70 (or 10 or 20) degrees declining from the true south of west and north of east in front and behind in contiguity with hard slaterock with the same strike and dip to the south. The belt of eruptive rock is about 50 or 60 feet wide. The slates in front and behind continue for a great distance.

Diagram. Hornblende rock with cleavage under oblique angles but no visible stratification.

Friday with river from slate quarry towards Huron Bay 2 miles, and then crossing to Silver Creek on State road. About $\frac{1}{4}$ of a mile from slate quarries the dark quartzite rock similar to diorite crosses the road having the same strike and dip with the slates. Thickness a few hundred feet. Then follow a few hundred feet of white quartzites stratified and subsequently slates again.

2 Indians 4 days	16.
Hotel at LeAnse	3.
Armstrong	5.
Railroad to Negonee	2.04 cts
At LeAnse iron ore from Spur mine with garnets.	
Summit Station 1100 (or 100) feet.	

Saturday Sept. 4 To Marquette and back 1.10 . Meals 1 dollar.

Sunday Sept. 5 To Excelsior mine. Strike of formation west northwest to east south-east. Dip southwards. Ore imbedded foot wall. Diorite hanging wall, chloritic schist. Ore of conglomeratic character.

Diagram. Section at the western end of the mine.

Diagram. Very irregular disturbance within the limits of the mine.

Diagram Excelsior mine

Barnum mine. Strata striking east and west or also west south of west to east north of east. Dipping south. The needle does not work well. Ore between a jaspery rock as underlying and a chloritic schist as hanging wall. Much micaceous iron ore interspersed in the Quartzose veins of the jaspery layers.

Chloritic schists visible under the drift 25 feet to 30 and in places 50 feet. One belt about 20 feet. Lean ores banded with jasper in places a rich slate ore very thick - 100 feet about. Stratification remarkably regular and the undulated surfaces of the beds exhibiting a very marked striation from the sliding motion of one bed over the other. The conglomeratic ore beds as in Excelsior make part of the banded jaspery beds of Barnum.

Superior mine is a continuation of the Barnum. In the juncture of both mines at once a great disturbance in the strata is perceptible.

The strata are partly vertical and tilted over and finally we find them in the Superior dipping north instead of south. In the Barnum the contact of the disturbed strata dipping in opposite directions is often seen but the loose flexures are so complicated that not every minor circumstance can be clearly followed in their entangled position.

In the Superior the variegated chloritic slates are the basis on which the ore lays and in some places the ore dipping both ways in a synclinal axis forms one central body between the slates of the opposite sides.

Diagram

Lake Superior mine at the end near Lake Angeline. Strata dipping both ways in a synclinal partly vertical centre filled with soft ore probably hard ore in a weathered condition.

Diagram Specimen soft Hematite ore from Lake Superior Mine.

From Cleveland 1 specimen of chloritic schist. 1 specimen of diorite

Stephens, Michigami. Station agent. Recommended by Wagner. Werner Dolf Schwyr and Wagner.

The Cleveland mine has an equally disturbed irregular condition of its strata with the Lake Superior mine. The banded jaspery ores forms large hills near Ishpeming ore beds on both sides of them.

Buggy to Ishpeming 2 dollars. Box for specimens 50 cts. (Wische 30 specimens in LeAnse).

Monday Sept. 6. to Michigami in the morning. Uphill to McCumbers mine. In No. 3 pit in an opening there I see the banded jasper ores in great thickness striking from south east to northwest and dipping under an angle of 45 degrees to southwest or towards the diorite nest which rises right behind it. Further west on the same hill declivity I saw few days before the same strata dipping away from the diorite instead of towards it.

The same strike and dip mentioned in the No. 3 pit of McCumber Mine is also seen in the other principal opening to the left of it. Strata frequently almost vertical. Drift marks all over the country remarkably distinct.

Spur mine strata dipping south away from the granite ridge. Banded jaspery ore more or less rich with interposed solid masses of crystalline ore on the outside. Below green chloritic rock with iron garnets. In another part of the mine a heavy massive grey quartzite lies on top of the ore.

Diagram

The banded ore under the rich ore contains large masses of most excellent magnetic ore. Part of it is dark friable into black sand with the pressure of the fingers. Behind the greenstone ridge a granite belt about $\frac{1}{2}$ a mile behind the mine.

At Michigami mine top rock a massive quartzose ironstone of brecciated structure dipping south. Good ore forming intermediate bands of very hard magnetic ore. In general the strata are almost identical with those of the Spur mine. Behind the mine are likewise banded quartzose ores of less value. Entire valley spread over with large granitic and other metamorphic boulders.

Return to Negonee 1.50 Dinner .75

Tuesday Sept. 7 Diagram

At the northwest end of Goose Lake compact light grey quartzites are seen in conformable position with the limestones at the coal pits and probably are the next superimposed layer. The quartzites are followed by hard schists or slates very powerful at least 1000 feet or more. After an interruption of a few hundred steps by drift a knob of greenstone about 100 feet wide is cut through by the railroad. Some well stratified seams of slaty rock go through it, keeping a conformable strike and dip with the slates and at the end of the cut some strata of talcose slate lay on it.

Diagram. Railroad cut a mile from Negonee towards Escanaba.

Ferruginous slates partly chloritic with quartz seams and occasional bands of iron ore. Laminated cleavage planes rectangular with the stratification.

Sent a box with specimens 25 cts. drayage. Hotel at Negaunee from Friday evening to Wednesday morning Sept. 8, 11 meals, 5 nights, 6 dollars. Extra expense -
To Detroit 21.50

Sept. 8. The large drift deposits on the high of Huron Mountains stratified or large boulder drift are very remarkable. The scattered (or so-called) granite is fine (firm) of narrow veins. Frequently of laminated structure and very closely approaching diorite or pervaded by diorite veins.

Donnerstag (Thursday) Sept. 9 To Minnesota mines 14 miles from Ontonagon. Rock land silver specimen from Minnesota mine, 3 dollars. 1 specimen with kalkspar and Steatite 1.00. Country from Ontonagon to Rock land gradually rising, surroundings of Rockland exhibiting outcrops of the copper bearing rock. Towards Ontonagon no rock visible, all drift.

Vein east and west 30 degrees north of east. Dip north. Lowest a weathered trap rock above brown sandstone. Above conglomerate rock very thick. Then copper ore bed from 6 inches to 3 feet, then a very large massive trap rock above which amygdaloid trap with copper. Highest again trap rock.

Iron ore. 1 few miles from Beaver Bay. On congress land. A W. (or Alb.) Wieland, Beaver Bay, Lake Co. Minnesota.

The geology of Ontonagon district is very well marked by its topographical features. The Potsdam sandstone district is a rolling hilly land much lower than the broken abrupt and higher lands formed by the copper traps. Porcupine Mountains are a splendid ridge of mountains from 12 to 1300 feet above the lake and extending close to the shore.

An Indian tells me that limestone bluffs are found west of the renown LeAnse locality in Sec. 24 and 14 of Town 51, R. 35, near which locality is in the township west R. 36, Sec. 35 or so.

Diagram of above.

Friday 10. High sea, could not go to Iron River.

Saturday 11. Iron River entrance exposure of brown sandstone in thin layers with intermediate shaly matter. Very thick 800 to 1000 feet, reddish color, striking north and south and dipping east under an angle of about 20 degrees. Below this are dark grey slaty sandrock layers with ripple marks quite ferruginous and partly micaceous. At the falls $\frac{1}{2}$ mile above the strike of formation is about 10 or 15 degrees east of north to west of south and a correspond(ing) dip eastward, dark grey slaty partly calcareous strata several 100 feet thick at least.

Strike of strata at the Superior Stamp works 20 degrees north of west to 20 degrees south of east dipping east of northward.

Ontonagon Superior and Excelsior join on corner of quarterpost of Sec. 24 and 13.

Diagram

At Stamp mill strike across river east and west. Dip north, a few degrees south of west and north of east. Lower down river strata north northeast, south southwest, dip eastward in proportion.

Diagram

Up the river 1 mile the silver bearing beds are found again, striking in north northeast direction, dipping 12 degrees south of east. They report at the river where this change occurs a fault where the conglomerate rock stands vertical.

From mouth to first rapids strata equally striking and dipping east northeast, striking southeast to northwest. About 1000 to 1200 feet of blue laminated argillaceous-arenaceous rock sometimes more slatelike, other times in flagstones or more massive banks compose this series. At the rapids in going up the river one descends for awhile in still lower strata. Then the formation gradually changes its direction. The strata run awhile parallel with the river dipping east. Further on they cross the river again dipping up stream.

To that for quite a long space we ascend along the rapids in higher and higher strata also amounting to 1000 or more feet. Still further the strata become again parallel with the river and finally bend so as to cross the river again in opposite directions from the former dipping downstream. All the hitherto considered beds are principally of this blue argillaceous rock with some seams of genuine fine grained sandrock.

At the Stamp mill a sandrock about 2 feet thick containing silver and also some copper follows the blue argillaceous rock and underneath brown sandrock follows which generally very hard and compact. Several large beds of conglomerates are interspersed. The general color of all the strata is dark brown. Their thickness is very great.

Sontag(Sunday) Sept.12 to Little Iron River. Beds of red brown sandstone dipping down stream first met with, thickness considerable. Following the stream upwards the strata are finally found in one place almost horizontal and soon begin to dip up-
Stream. At Scranton mine the strata run rectangularly across the river dipping south east. Followed shore road up to Union Landing at Union River mouth, then in south east direction followed the road to Union mine.

Crossed the river not far before reaching the mine. The brown sandstone and conglomerate beds are intersecting the river at the bridge. Dipping under an angle of about 15 or 20 degrees to the northeast. Brown sandstone strata, fine grained, very tough(tough) and of considerable vertical thickness this sandstone continues with occasional intermediate conglomerate beds up to Union mine, where it conformably overlies an amygdaloid trap very easy weathering and poor in copper. Dip of strata northeast under an angle of about 30 or 40 degrees.

Below the trap follows again a series of hard brown sandstones as above, dipping conformably with the rest of the strata. Trap not distinctly stratified containing spar and Lammonite druses in the amygdaloid portions.

None Such Mine. Located 50, R. 43, Sec. south half of 1 and north half of 12. Bed runs north, 50 east, pitch 30 southeast.

In the river which is the head of little Iron River the strata of the mine are finely exhibited. The foot wall of the bed of copper ore is slaty arenaceous dark rock below. A few feet deeper are other sandrock similar to the copper ore bed is found which contains metallic silver and if the analogo of the sandrock bed in the silver mines under these metalliferous beds comes out a brown hard sandstone with conglomerate seams. Above the copper are beds as hanging walls blue arenaceous slaty beds are found amounting to the thickness of many hundred of feet.

11 bu. $4\frac{1}{2}$ Unz avoirdupois out of 5 tons of rock.

Monday Sept. 13. First rock bar across Iron River. Strike 15 degrees south of east to 10 degrees north of west. Dip north east at an angle of about 20 degrees. This is in sight of the settlement and the strata remain to be of the same strike and dip down to the mouth. Rock a dark blackish grey argillaceous fine grained sandrock in regular hard beds, softer more shaly strata intermediate.

Only 100 steps above in the river the strata evidently make a curve. I find there a dip to 20 or 25 degrees south of east and a strike nearly southwest to northwest. The strata are decidedly lower than the former and are a flaggy and somewhat shaly arenaceo-argillaceous rock of dark blackish color.

Ditto 100 steps further strike 20 degrees west of south to 20 degrees east of north Dip 20 degrees south of east. Strata thinly laminated shaly flagstones. Some beds apparently partially of calcareous nature .?

100 steps further below the foot of small terrace like falls I see the strata striking across the river, a few more strata of the deeper series following but then the ascent into higher and higher strata begins. Strike 10 degrees east of north to west of south. Dip little south of east.

Diagram

Rock containing calcareous globular concretions and portions are copper bearing. Exploration pit at that place to the depth of about 40 feet, all in the dark argillaceous rock. From the falls looking up the river an ascent through over 100 feet of strata retaining evidently the same strike is noticed from there. A bend of the river closes the view within the series of ascending section in the falls. Strike of strata 20 degrees east of north to 20 degrees west of south. Dip south of east, upstream.

Higher up where the trail strikes the river again (only 1/8 of a mile) the strike of the strata is 25 degrees east of north. The dip correspondingly south of east upstream ascending through ripple marked shaly flagstones.

Arriving at the head of the falls in sight of the stamp mill the strata are found yet striking 25 degrees east of north and dipping south of east correspondingly. The river runs there almost parallel with the strike and then bending southward naturally cuts deeper into the strata, so that in ascending the river from here we step down into lower and lower beds.

Diagram

The formation is evidently swinging round in an arch there. The strike of the strata following in close connection in descending order to the former are few steps. Distance higher up the river striking 20 degrees south of east to north of and west and dipping northeast. There is no break in the formation, only a flexure.

From here up to stamp works and above we descend again in the series at Stamp mill 100 steps below. Strike southeast to northwest. Dip northeast. Strata near the silver bearing sandrock are thinly laminated, but above them about 100 feet are very thick compact beds of the blue argillaceous-calcareous sandrock. Close to Stamp mill strike of strata almost east and west. Dip north.

At Collins mine and Cleveland mine the strata strike diagonally across the river. The strike is 25 degrees east of north and dip correspondingly south of east.

Diagram

At the Ontonagon mine test pits, there is petroleum in some cavities of the rock.

50 steps above the spot where the silver bearing bed crosses the river at Collins mine as delineated above, there is at once a break in the order of things. A belt of conglomeratic brown sandstone crosses the river in a direction striking 25 degrees south of west to 25 degrees north of east, dipping northwest, at a steep angle or even vertical. The river flows from the higher beds into the lower ones.

Diagram

Only about 50 feet further on, the vertical sandstone beds join with similar beds of an entirely different strike and dip. These beds strike parallel with this part of the river northwest and southeast and dip northeast at a moderate angle. It is the same conglomeratic brown sandstone. It forms high bluffs at that place, thence the river bends southwestward and the rapids existing there flow from lower beds into higher ones. Collins mine in Sec. 24.

Diagram

Dienstag(Tuesday) Sept.14 Stark und Regen (dark and rainy). In camp bei(by) Collins mine on the river bank. Went east of south from camp. Struck Mineral river, followed it up near a branch coming into it about 1 mile from camp. Slate rock in the river bed striking northwest to southeast, dipping north.

East going up the river we descend in the series of strata, soon come to a camping place where they have boring apparatus. Situation near the corner of 31, northwest corner of Sec. 31 in T. 51, R. 41 W. From there we followed the river into Sec. 5, next town southwest.

On southeast corner of Sec. 5 in Town 50 on Mineral river, the strata at the Non-Such mine containing much copper ore (are) seen in the bed of the creek. A few feet below the characteristic silver bearing beds are seen, strike west northwest to east southeast. Dip southwest.

Mittwoch(Wednesday) 15. Returned to Iron River mouth. Storm on lake. Had to remain.

Donnerstag(Thursday) 16. Sehr Sturmisch (So stormy or very stormy) Walked down to Ontonagon.

^{Copper}
Schrifer boss in Kupfer haus. Ridgemine. Also Jos. Wilmer.

Harris agent. Ammermans Dr mine Sec. 34, T. 50 R. 42. Slate cont(ent)(or containing) 50 silv. to a ton. Bed 6 feet wide.

Argentiferous copper ore, Meads location 4 miles east of Iron River, in Sec.14 T. 51, R. 41, between red traprock, vertical vein.

Copperose from Sec. 1, T. 50, R. 42

Piece with silver from a trap range in Porcupine Mountains.

Carp Lake mine copper in sandstone and red oxid of copper and malachite.

Friday Sept. 17. Went by stage to Ridge mine. Mr. Harris the capt. of the mine led me through the mine. By a regularity in the disposition of the copper bearing belt through the trap belts of hanging and foot wall there is in the smaller scale an immense disturbance and irregularity perceivable. The trap is in very frequent instances traversing and obstructing the course of the copper bearing beds and in the contrary the copper bearing beds seem to contract or widen into large bags which often contain large quantities of mass copper.

The Adventure Mine close by has a more reddish trap mass and contains in the copper bearing a number of finely crystallized minerals epidote, stilbite, calkspar, quartz ectr.

Saturday Sept. 18. Followed a ravine from village down to river. On property of National mine many large and fine exposures of trap with bands of amygdaloid rock and epidote seams carrying copper. The amygdaloid rock often has the characters of a breccia.

Some distance down the ravine there is a belt of regularly stratified sandrock 60 feet wide intercalated between two heavy trap masses in contact between hanging trap wall and sandstone is a metalliferous seam. The foot wall trap is of this dotted amygdaloid-like kind with circular dots of a blackish green crystallized mineral sandstone trap. Dip northwest angle 50 degrees.

Diagram

I collected a specimen of amygdaloid rock of the foot wall in immediate contact with the sandstone grown in one solid mass. The layer 30 feet sandstone above occasionally inclose pebbles of the amygdaloid.
H. P. Seymour, M.D. Rockland, Ontonagon Co. Michigan.

On request of a number of citizens I visited the Ontonagon silver district with the view of giving it a cursory examination. The results of which I publish thinking it of import for all to hear an impartial opinion of a competent observer on this subject which of late has become the question of the day in this district.

The silver bearing rock generally termed a vein is actually a sedimentary rock bed spread over a large territory at the foot of the Porcupine mountains and the higher trap mountains of the Ontonagon copper district. It is of younger date than the copper bearing series but has participated in the upheavals of that period, and the general strike of the uplifted outcrops is in conformity with the direction (of the) trap range. But local disturbances have caused many irregularities. The strata are subject (to) many abrupt breaks or are deflected from the regular course, curves dipping accordingly in various directions.

By far the greatest portion of this rock series is hidden under heavy drift accumulations and the exposures are confined to the ravines of the river courses where the plurality of the presently established mining corporations have begun operations.

The silver bearing rock is a grey compact well stratified sandstone interlaminated with undulating thin seams of black shaly material which is containing the principal part of the silver in metallic condition. The sandrock itself is also silver bearing but much poorer than the shaly seams so that in only rare instances silver can be detected in it by the naked eye. The thickness of the strata is from 2 to 6 feet. Their foot wall is formed by a brown sandrock of great thickness, often having the character of a coarse conglomerate.

The hanging wall of the metalliferous beds is a blue argillaceous-arenaceous rock generally called slate but not of the fissile structure of true slate. Usually it has the form of easy decaying thin bedded flagstones. Some beds are more compact and contain considerable of calcareous cement. The visible thickness of this overlying so-called slate rock amounts in many places to over 1000 feet.

Only a few feet above the silver bearing beds it encloses another metalliferous rock from 6 to 8 feet in thickness, highly charged with granulated or finely laminar metallic copper. The Non Such copper mine is working in this stratum which there is of astonishing richness but the copper is in fine leavelets and by stamping and washing it much of it is lost. The same copper bearing beds have been noticed in the plurality of the exploring shafts of the silver mining companies in the district and is also seen in several ravines some miles east of the Non Such mine but not everywhere as highly charged with copper as far as surface indications and limited denudation allow to say.

It is stated above that the silver contained in the rock is in metallic condition but not an inconsiderable additional quantity of the precious metal is combined with sulphur and makes part of the black shaly substance prevailing the sandrock in linear seams.

Several tests in larger scale have been made with the silver bearing rock mass. Taking for the experiments without selection the entire thickness of the rock mass composing the so-called vein. And the results have been very favorable.

In such experiments several tons of the rock have been stamped and subjected to the amalgamating process which evidently was not carried out to perfection and still the resulting product of silver from a ton made with rock from 3 different localities always turned out very satisfactory, yielding from 40 to 50 dollars worth of silver for every ton of rock.

The footwall of brown sandstone found in the vicinity of the bluish colored slate rock of the hanging wall are always very good guides for the explorer. More risky are explorations in places where the rock beds are hidden and to rely in such cases on the general strike of neighboring outcrops may prove in many cases very fallacious.

The mining of the rock is not very difficult or expensive, the concerned strata all being not of excessive hardness and a large margin of profit would be left to the miner if this branch of industry is carried out with economy and circumspection. Otherwise the history of our mining districts clearly shows that mining enterprises even with the richest mineral deposits by mismanagement turned out to be total failures.

Sunday Sept. 19 With Metropolis to Hancock. Dined with the clerk of Quincy Mine, Mr. Klockner. Went in the afternoon with Steamer Pacific for Detroit, 16 dollars. Stormy sea kept us in the canal till Monday night Sept. 20.

Tuesday noon left Marquette. Arrived at 4 at Munising. Loaded 350 tons of iron. Came to Whitefish Point Wednesday morning 7 o'clock. Sept. 22 Arrived at Ann Arbor Thursday night, express from Port Huron to Ann Arbor 3.50. Freight for boxes 3 from Negaunee .

Several diagrams without explanation

Notes from back of book. Greenwood slate to Island Rapids of Rifle, 7 miles or gambles 8-10 size from 4 to 6 figures on page. 2000 copies. 50 plates each or 100,000 points on 60 pd paper at \$32.50 per mille.

Diagram.

I will have on Monday a number of copies of these fossils.
E & H. Anthony 591 Broadway. Dallemeyer Lense
Rockwoods Gallery, 13 St. and corner of Broadway
Neil Leach, Manistee. Report to send.
Mr. Ruggles Manistee. Chicago, Ill (?)
Mr. McAlvay

Reported to me an outcrop of coal in the vicinity of Everet in Town 17,8 West between and 18, on town line
Mr. Ramdill second brick house on the left the principal street.

Received check for one thousand dollars for salary up to May 1, 1875.	
Deposited 600 dollars at Kanter's Bank, May 18, 1875. Took 400 dollars.	
Paid to Mack and Schmitt	38.89
to Harer	16.
Left at home	100.
Paid to Diederich	100.
Expense to June 16	138
	<u>\$392.</u>
July 7, 1875 Received payment of expense account for Geol. Survey	376.50
ditto 123.00 advanced for travel to New York.	

Account of Expenses for Geological Survey

May 13 Journey to Detroit	4.
18 To Detroit and Bay City	4.
Ann Arbor to Wenona	4.65
19 Owosso	1.50
Jackson	.25
20 To Bay City dinner	.75
21 Expense to Rifle River for meals	.75
Dinner for 3	1.40
And railroad Rifle River mills	2.50
Hotel at Bay City	3.
Other expense	1.
To Tawas	2.
At Tawas meals	1.50
To Bay City	2.25
Hotel Bay City	3.
Expense to Rifle and Au Gres Rivers for meals	3.
E. Saginaw to Ann Arbor R.R.	4.
To East Saginaw	.90
To Thursday June 3, 26 days absence. Total expense	75.
June 4 Telegram to Detroit	.60
7 To Monroe and Toledo	2.50
To Columbus	4.25
dinner	.50
Hotel at Shelby	1.50
8 Left for Columbus 9:55	
At Columbus Livery stable	4.
meals	1.50
Hotel bill	4.
9 To Dublin Horse and buggy	3.
Dinner	1.
10 Thursday to Newark	4.
At " Hotel	4.
To Sandusky	3.50
11 Friday Supper .75 omnibus .25	1.00
12 Sun. to Marblehead	1.00
To Put-in-Bay	1.00
13 Monday Hotel	3.
To Toledo	1.
14 Tuesday R.R. to Monroe	1.
Omnibus	.50
15 and 16 Monroe Hotel	5.
Horse and buggy to Point aux Peaux	3.

Dinner at Pt. aux Peaux		1.00
To Ann Arbor		2.20
Omnibus		.25
9 days travel thro Monroe Co and vicinity R.R. expenses		18.50
for horse and buggy		8.
steamer		3.
Hotel expense 9 days		27.
Freight for 4 boxes	1.75	
	2.33	
	.50	
	<u>1.50</u>	
Telegraph		6.10
		<u>.30</u>
		62.40
	Summary	138.
Total from May to June 16		
June 21 To Detroit and back		4.
23 Wed. at 11 O'clock train to Muskegon		5.30
Leather bag		5.
Muskegon		2.
To Pentwater		1.40
To Ludington		1.
At "		2.
At Manistee Hotel		2.
To Frankfort		2.
At "		1.50
To Glen Arbor and back		3.
Manistee Hotel		3.
To Ludington		2.50
At " hotel		2.
To Ann Arbor. R.R.		7.50
Meals		1.
		<u>46.</u>
July 7. Wed. to Detroit		1.35
Hotel expense		1.50
R.R. fare to New York		16.35
Sleeping car		3.
Omnibus and baggage transportation		3.
Hotel expense at N.Y. 5.00 per day 9-16 incl.		40.
Sundry small exp. for street car and omnibus ectr.		3.
Return voyage incl. R.R. sleeping cars meals		<u>22.</u>
Summary of expense		88.50
Cash balance in hand July 25	35.00	
26 To Detroit R.R. and omnibus		1.35
Hotel		2.50
27 R.R. to Bay City		3.50
Omnibus		.25
Hotel		3.
28 R R. to Roscommon to St. Helen		2.
2 days horse		6.
29 To Deep River		1.10 ?
At " "		2.
To Bay City		1.
At " "		3.
To E. Saginaw		.75
Omnibus		.25

Hotel at E Saginaw	1.
To Bay City	.50
Aug. 1. Hotel $1\frac{1}{2}$ days	4.50
2. Monday to Summit Sta. return ticket for 2	5.
Meals and lodging	3.
3. Dinner for 2	1.
Guide	4.
Hotel at Bay City	3.
Dinner	.50
4.1875 Ticket to Ann Arbor	4.
Omnibus	.25
Summary of last trip	56.
A Dallmeyer lens for 99.00 Express charges	1.00
Post stamps	1.00

Two diagrams without explanation

1 avenue car to Whitehall ferry
192 - 18 st. between 4 and 15 sts.
John B. Evans, Lapeer, 1 mile east of. Well informed about Lapeer County.

Diagram

Whiteman & Wright East Saginaw.

Diagram

Limestones $4\frac{1}{2}$ miles east of Omer. Striae limestone and continuation of Pt. aux Gres.

Diagram

Northeast from Omer, Sec. 3 or 4 of Town 19 R.5 strike limestone again on surface.
Also on Sec. 1 same town.

Scheneman - Whiteauer

Car. 84. On Carlises farm they found in a well 15 ft. below surface the sandrock of coal formation Sec.7, R.5, T. 19

L.G. Mason & Co. Muskegon Salt works 2700 ft. deep.

On dam of Rifle River Town 21 or 22 Sec.17, same sandrock seen about 20 miles distant from Omer.

Rise of river from Bay to Omer about 12 or 14 ft. From Bay to big dam about 40 ft Bluffs about 100. Total at Soorings Farm 140 ft.

E.M. Fowler, S.W. corner of Centre and Sherman

Gustin and Merrill Wholesale grocers Bay City

Chapman, 8 and jefferson

Coal found in wells T.20,R.4,Sec.29 and 33 in small loose pieces.

Omer centre of Sec. 15. Sandrock with calamites.

Steinheil lime. (?)

Diary for the Explorations of the Geological Survey

of

Michigan

During the Year 1877

by

C. Rominger

Left Ann Arbor on May 22 for Detroit. Took Steamer St. Paul at night of same day. Arrived in the morning May 23 at Fort Huron. Entered Tawas Bay at night. Stayed till morning. Went to Oscoda Salt works where the loading of 4000 barrels of salt retained the boat all day. Left toward's night. Arrived Friday 25 in the morning at the entrance of St. Mary's river. At noon at St. Mary which place we left at 5 o'clock in the evening and arrived May 26 in the morning at 7 in Marquette. The lake was that morning all over covered by a thin crust of ice which had formed during the night. Found vegetation tolerably well advanced, only about one week behind the vegetation of the environs of Ann Arbor.

Sunday May 27. Went on the road passing the brownstone quarries and Catholic Cemetery about 2 1/2 miles back to section line between 28 and 29. The land rises up to that point about 400 or 500 feet above the lake. On both sides are outcrops of dioritic schists in knolls. The strata strike all in east and west direction and correspond in general appearance with the dioritic schists and slates of the knolls at the mouth of Whetstone creek. They stand in almost vertical position with a slight dip to the north.

A number of similar parallel knolls arranged in interrupted east and west ridges fill the interval from there northward to the parallel west line commencing at the lighthouse and all of them vary very little in lithological characters. The schists and slates are here and there interposed by obscurely stratified or unstratified diorite masses. By walking across this space no distinct synclinals and anticlinals can be observed. All the beds seem to dip northward but evidences of contortion and flexion of the strata by the uplift are very plainly noticed.

In the afternoon visited Harlows mills (mines) near the centre of Sec 21. The old shafts and cuts of the mine are sunk through almost vertical strata of slate with partly talcose and chloritic character and containing irregular ferruginous seams which expand in pockets of a calcareous hematite of apparently rich percentage (percentage). Sometimes also streaks of hard magnetic ore are intermingled besides quartzose veins. The mines belonged to the earliest one discovered but were abandoned until lately. Some work has been commenced again but I do not know with what success.

Followed that day also the knobs of diorite and schists which extend westward along the south line of Sections 15 and 16.

Monday 28. Streets on top of hill running east and west 66 feet wide, width of blocks 300 feet wide. Name of streets on top of hill.

1. Ridge street, ending at the shore alongside of Holly waterworks.
2. Arch Street, in an east and west line with the lighthouse point.
3. Michigan St, striking the small island north of the lighthouse point.
4. Ohio St.

5. Mt. Vernon St. Scarcely a building erected Mt. Vernon street coincides nearly with the section line between 15 and 22, corner of 15, 22 and 14, 23 is at the end of the cemetery fence.

The centre of Michigan St. on Front St. is occupied by a protrusion of a massive crystalline dark diorite, north and south of this diorite protrusion which extends into the lighthouse point are schistose or slaty rocks in almost perpendicularly uplifted position, slightly dipping north. The schistose rock is of a silky shining talcose or chloritic nature sometimes approaching a fine grained diorite and interstratified with seams of ferruginous or calc-sparry or also quartzose composition. The strata are frequently much wrinkled and bent by the uplifting process. The beds carrying the iron ore in the Eureka mine seem to be identical with this horizon and the mine is almost exactly situated in the line of the strike of these beds.

The total amount of all the schistose rock in the described outcrops between the northside of lighthouse point and the Holly Waterworks is approximately 300 feet, all striking and dipping conformably. The crystalline diorite in the centre of Michigan Street is about 50 or 60 feet wide. About 200 feet north of it the schistose rock is so much metamorphosed as to constitute another mass of coarsely crystalline dark diorite perfectly similar to the former but an obscure stratification or intermixture with well stratified seams is perceptible in it while the former is apparently not in stratified condition.

The variety of schist, slate, calcareous and ferrugino-silicious seams is great and the diorites vary from a tough very coarsely crystalline rock to a fine grained chloritic or also smooth fracturing aphanitic rock of lighter or darker green color, partly also red by iron ore and rarely light grey, intersected by many sparry quartzose or feldspathic veins. And most of the schistose rock is of a silky shining talcose nature soaplike to the touch.

Monday 28. Afternoon ascended the high hills west of Carp Furnace. The front hills extending from the rolling mill down to Carp river are all drift accumulations, very much cut up by deep ravines and of an elevation of about 100 feet above the lake, sometimes 150. The drift deposits are found as high up as the summits of the rock ridges. West of those shore hills the high ridges have an elevation of about 500 ft. Striking east and west, the ridge I ascended ends in the lake almost in the centre of Section 36, T. 43, R. 25. This front part of the ridge is lower than the western part of it from which it is separated by a wide gap through which Carp River flows towards the lake.

The front ridge consists of vertically erected beds of a white well stratified quartzite about 125 to 150 feet thick. At the lake shore the Potsdam sandstone inconformably abuts against its cliffs which locality has been described by me in the report of 1873. The western continuation of the quartzite ridge on the other side of Carp River is as mentioned before about 500 feet high, its sides are very steep. The northern declivity is occupied by a quartzite belt about 120 feet wide. It contains sometimes small nuggets of Eisenglanz (micaceous iron oxyd). Its position is almost perpendicular dipping southward. On the south side of this belt is a depression about 100 feet wide which is exhibiting silicious slate in vertical position and partially dipping northward.

Further on another parallel crest equally high with the quartzite crest on the northern declivity rises which is composed of a very seamy silicious marble with interstratified silicious slaterock, all these beds are slightly dipping northward and have in places suffered intricate contortions by the uplift. The southern declivity of the hill at the base of which Carp River flows is very abrupt and is formed by nearly perpendicular walls of this marble and slaterock which evidently is higher (younger) than the quartzite and dips north, by being so far pushed from the southward dipping quartzites as to become vertical and finally to tilt over, assuming a dip to the north.

On the opposite side of Carp River valley another similar quartzite and marble ridge runs parallel with this one and reaches the lake shore at the eastern township corner of 48,25 and 47,25. The outcrop of this second quartzite and marble range near Harveys furnace has been described in mine and Mr. Brock's report which copied a diagram and description of the place from Houghtons reports.

Tuesday May 29. Followed Ridge Street to the west. About 5 blocks from Front St. it leads over an elevation of denuded rock, which is of slaty structure. The southward portion of the outcrop is a greenish slate or more compact dioritic schist. Northward follow about 150 feet of novaculite of light color and finely striated laminar structure exhibiting frequent (con) tortions by the uplift. Further north a thick seam of dioritic schist follows and then again about 50 or 60 feet of novaculite when the outcrop becomes interrupted by sand (or land).

About 50 feet from the northside of Arch Street another knoll parallel with the one of Ridge Street rises which reaches into Michigan Street with its opposite declivity. The strata are principally a well stratified dark green dioritic schist with several interruptions by a massive fine grained hard diorite of black color. A third parallel knoll is rising in the black north of Michigan St. extending across Ohio St. principally retaining the same schistose character as the other knolls in all these outcrops. The strike is east and west, the elevation frequently vertical but if inclined obliquely the dip is invariably to the north.

The total thickness of the described series from the south side of Ridge Street to the New Vermont Street must be about 1800 feet. In the outcrops of Michigan St. the slates and schists are interlaminated with highly ferruginous seams and bands of calcareous iron ore (hematite) identical with the beds seen in the Eureka mine.

Wednesday May 30. Excursion to Dead River, near Powder Mill situated near the centre of Sec. 10, T. 48, R. 25. On the street leading north ascending from the railroad depot I crossed the different outcrops mentioned in the notes of the day before. Beyond Vermont Street another schistose and diorite knoll is intersected which forms eastward a conspicuous elevation and prominent bluff towards the lake. But the road is at that intersection situated in a depression with no outcrop and leads rapidly down to a marshy sand plain extending to the lake, and up to Dead River the road is winding itself at the foot of a high drift terrace for part of the distance. Nearer the powder mill it leaves the terrace and a swamp is interposed between it and the road. Close to the river at the powder mill the first outcrops of rock are seen again.

The Dead River makes at that spot a very abrupt curve and the water flows in rapids over the rocks which cross the channel diagonally striking on the usual east and west direction. The embankments are in places formed by high rock walls. The rock bluffs of the southern embankments are formed by a granitic rock with interlaminated schistose or slaty rock. The strata crossing the river bed are all of a schistose and slaty character. The strata are vertical and much undulated in its layers by lateral pressure. These beds are decidedly of sedimentary origin.

About $\frac{1}{2}$ a mile north of the bridge a large body of granitic knobs rises, which front towards the low swamp plain extending behind the Presque Isle hill. Further north rises the still higher Sugar Loaf mountain which belongs to another chain of knobs extending from east to west. These granite knobs first mentioned are inconformable. Strike with the schistose rock at their southside and an immediate contact and alternation of granite and schist is observable. In the direction of east and west the main body of the granite is intersected by a belt of hard crystalline diorite 50 feet wide. The diorite is generally massive and unstratified but in places an evidently schistose stratified rock character is noticed. The granite is of different shades, from rose colored to flesh red, very compact contains numerous small crystals of iron pyrites.

Thursday May 31. With railroad to Morgan Furnace. Northeast portion of northeast quarter of Sec. 35, T. 48, R. 26 is the situation of the furnace building. The furnace is built on the base of a limestone ridge striking east and west with almost vertical bedding. Sometimes the dip is distinctly to the south, in other places it is hard to decide the inclination. In the outcrop are at least 200 feet of limestone beds exposed with various slaty seams in alternation with the limestone. Some of the limestones are tolerably fine, of silicious band and exhibit a variegated mottled or also striped appearance, red, white, bluish, salmon color, ectr. Others are full of quartz seams and the intricate curvatures of these seams on the beds prove an immense corrugation and flexion of the strata by the upheaving forces.

The limestones may be followed from the furnace along the creek for a mile downwards when by a bend of the creek they are left on the south and schistose diorites are entered while following the road to Marquette. The north side of the creek from the furnace to a mile downwards is lined by a high drift bluff with a belt of plateau land on top, behind which high dioritic and schistose hills are rising and extend eastward in interrupted knobs unto the lake shore.

Friday June 1. Followed slate knobs on south line of Sec. 15. Striking west and dipping north nearly vertical slate in certain seam ferruginous. Other beds approach movaculite. The beds seem to be a direct continuation of the outcrop on the summit of Ridge Street. North of these knobs and parallel with them other outcrops are composed of an obscurely stratified diorite with rhombical cleavage. Further north the surface rapidly declines into the triangular spot of low land extending from the shore and limited by a drift terrace which commences at the foot of Ridge Street on Lighthouse Point and continues in a flexuose northwest direction to the bed of Dead River near Collinsville.

From there the course of Dead River towards the lake indicates the limits of low lands in which sporadically isolated small rock protrusions may be encountered. Also a portion of the drift bluffs from the lighthouse to the centre of Sec. 14 is taken up by outcrops of diorite and dioritic schists which present brisk escarpments interrupting the line of drift material in the terraces.

To the west from the slaterocks first mentioned the land is likewise rapidly sinking into a swampy depression which forms the watershed between Whetstone Creek and a branch of Dead River. Abrupt knobs of dioritic and schistose rocks, comprising a series of at least 1800 feet of rock strata inclusive of massive unstratified diorite belts form parallel rows along the section line between 15 and 16 and 21 and 22. The topographic representation of the surveyors maps give a very incorrect idea of the localities.

The knobs following the south line of Sec. 15 and terminating in the southwest corner of the section are formed by a finely laminated but very hard silicious schist with rhombical cleavage. Its laminated cleavage is silky shining by scales of chloritic mineral. Some beds approach novaculite in structure and composition. In others the strata are alternately lined by quartzose seams and dark hornblende seams. The stratification becomes in certain horizons obscure and several heavy masses of compact crystalline diorites are found interposed by walking across the strike of the strata.

In the knobs forming the south line of Section 16, the most southern rock bluffs facing a branch of Dead River near the so-called Deer Park are dark massive, very tough, crystalline diorites, joined on the north side by a series of schistose rocks the same as seen in the south line of section 15. In a still more northerly position is a range of high knobs composed of silky shining slate rock with ferruginous seams and bands of hematite ore, and north of these slate hills but not in direct straight line from one parallel hill range to another.

Dioritic schists with very many granite bands conformably interlaminated make their appearance in a very thick series. The granite bands are variable from a thickness of a few inches only to a great number of feet. The granite entered from the principal bands laterally into all the accidental fissures of these schistose rock so that it sometimes seems as if fragments of the granitic rock were inclosed by the schistose rock. Also quartz veins pervade the rock mass but usually not in the line of stratification but irregularly across.

The east half of Sec. 16 from its southern corner northward along the valley of the creek running into Dead River is almost totally composed of these alternations of granite and schists. A very obvious isolated projection of the granite is found remote from the higher ranges of parallel east and west chains of knobs on the northeast corner of Sec. 16 not far from the angle made by two side branches of the Dead River and close to the bed of the larger eastern creek.

Saturday and Sunday June 2-3. Examination of the outcrops of a silver lead ore vein in Town 46, R. 24, Sec. 30. Head waters of Chocolate River. Went by way of Escanabas Creek to about one mile this side of S.C. Smith mine switch and crossed the burnt pine plains in a northeast direction until we struck a hilly hard timber land cut up by deep ravines tributary to Chocolate River, close to the bed of which the metalliferous vein is denuded resting on a granite wall striking from northeast to southwest and dipping south under an angle of about 60 degrees.

The hanging wall of the vein which forms the bed of the creek is likewise granite inclosing schistose greenish seams near the vein. Granite and schists are full of small iron and copper pyrites crystals. The vein is milky quartz, has a thickness from 8 inches to one foot as far as visible and is tolerably rich in argentiferous galena mixed with a small proportion of iron and copper pyrites.

About a mile below this locality the river forms cascades by descending through fissures in the granite from step to step and over highly inclined surfaces, On height of about fifty feet. Other cascades of similar character are met with one mile below these mentioned ones. The granite is soon hiding itself under the drift and Potsdam sandstone after the cascades are passed.

Returned to Marquette on foot a distance of about 20 miles. Heavy rain in the afternoon surprised us on the road not far from Harveys Furnace and continued until I came to town all wet.

Monday June 4. Went to the Gull Islands one mile east of Presque Isle. They consist of 4 large quartzite knobs entirely free from soil. The masses exhibit no stratification except the cleavage into sub-rhomboidal blocks, but the arrangement of the hornblende crystals in parallel linear streaks gives the granite an appearance of stratification striking in an east and west direction. In the same direction from east to west the granite is intersected by bands of diorite 3 or 4 feet wide. The diorite incloses sometimes fragments of the granite within its mass and the direction of the band across the island is not straight but frequently is deflected from its course by abrupt geniculations or by a gradual curvature. Very frequently the main band of the diorite gives off wedgelike branches which prolongate themselves into the surrounding granite masses.

Diagram

These dioritic dykes are frequently intersected by other dykes having a different direction and often composed of a different rock mass on the largest most northerly situated island a vein 2 feet wide from the island in east and west direction retaining an almost rectilinear course. The rock is black, very fine grained extremely hard but of flinty brittleness under the strike of a hammer. It resembles a basalt more than any other rock species.

Of the same rock mass another much narrower vein runs parallel with this one 16 feet north of it. A cross band filled with calcspar meets the larger basaltic vein from both sides but does not intersect it. Some of the numerous dioritic bands intersecting the granite have suffered breaks with slight dislocation of the corresponding ends. The small fissures between the faulted ends are filled with a fine grained reddish granite mass rock rich in feldspar.

On return visited Picknik Islands about $\frac{1}{2}$ of a mile north of the lighthouse point. Like the Gull Islands entirely naked rock masses consisting of a dark blackish green coarsely crystalline diorite mingled with the hornblende which forms the prevailing rock material are various proportions of a red feldspathic, more of it on the island near shore, much less on the outer island where the diorite has a more uniform blackish color. Epidote seams are likewise very abundantly pervading the rocks in reticulated linear seams in bands $\frac{1}{8}$ inch thick, also iron pyrites is abundantly disseminated.

The diorite is intersected by many east and west veins of from one to 3 feet thickness which consist of a compact fine grained rock delicately striated by linear stripes in the direction of the strike like a metamorphosed sedimentary stratum. Also quartz veins pervade the rock abundantly in irregular directions and on the island closest shore concretionary irregular seams of a light red granite or feldspathic rock are inclosed in the diorite.

Some of the granite masses are by their sharp angular form evidently rock fragments imbedded in the diorite. The diorite is devoid of stratification and represents a shapeless mass divided in large blocks by rhomboid like cleavage.

Tuesday June 5. Visited the mouth of Dead River where a large granite protrusion abruptly rises above the swampy plains forming the shore above and below it. Dioritic seams of only moderate thickness pervade the granite in an approximately east and west direction. Their substance of compact fine grained or other times laminated schistose or slaty, also quartz and epidote veins are noticed.

From Dead River to Presque Isle the south end of the peninsula is formed by horizontal sandstones or red color variegated by whitish stripes. The sandstones are very argillaceous. The lowest beds are a very coarse conglomerate which rests on the elevated eruptive rocks which form the nucleus and north part of the peninsula. The rock beneath the sandstone is a reddish soft or easy weathering dolomitic substance full of sparry veins crossing each other in all directions and giving the red rock mass a finely cellulose appearance by the countless number of intersecting linear spar veins.

A number of different minerals are inclosed in this mighty irregular confused rubbish mass, jasper, chlorite, iron pyrites, copper pyrites ectr. The upper portions contain a large quantity of serpentine like mass. On top of this a black magnesian silicate of crystalline structure containing the substance (iron) which gives it the dark color in a condition soluble in muriatic acid by digestion which leaves behind a light grey semi-translucent feldspathic mineral. The thickness of this black rock is not less than 50 or 60 feet. It forms the northern two thirds of the east shore of the peninsula. In the upper portions it is pervaded by numerous white veins of spar and on top of it another apparently well stratified deposit of great thickness (at least 60 or 70 feet) comes in which is best exposed on the northern end of the peninsula.

In general rock character this upper deposit corresponds with the eruptive masses below the black (easy weathering) rock. It contains white quartzose seams, blood red jaspery seams, serpentine and spar and asbest(os) in linear cross-cutting reticulations. The main substance of the apparently stratified masses is again dolomitic. Copper pyrites, iron pyrites, galena and many other minerals are abundantly intermingled. The great variety of rock and the different condition of decomposition in which it is found make it almost impossible to give a general description of it. (See and compare specimens collected).

The west part of Presque Isle isolated from the mainland by a swampy belt of low land is entirely overlaid by the Potsdam sandstone formation which has a slight dip in conformity with the configuration of the surface on which the strata were deposited. The bay north of the peninsula has in a distance of about half a mile from it several small rock islands consisting of granite. The granite is about the same as at the mouth of Dead River. It is intersected by numerous broader or narrower dykes of diorite or of schistose rock.

Some of the dykes run east and west, others north and south. They are subject to frequent deflexions from a straight course or the dyke gives out side branches making connection with other parallel dykes. The dyke mass is generally a dark fine grained dioritic or basalt-like rock. Other dykes are filled with an apparently slaty rock.

The slate is talcose or chloritic containing considerable magnetic iron ore which has on the needle a very powerful influence. Further north and a little to the north is the larger Partridge Island also formed of granite but a lower portion of it on its southside is overlaid by horizontal red sandstone strata plainly exposed in the cliffs of the shore. Seen from the west side the island is found to be intersected by a great number of dykes running in various directions, and the same dyke frequently deflected into another direction. The rock masses filling the dykes is quite variable. Some are filled with a compact hard flinty basalt-like rock. Others, and those are generally larger dykes 50 and 60 feet wide, are composed of a coarsely crystalline hornblende rock. Still others are evidently filled with stratified schistose and slaty rock masses but the granite prevails in bulk above all the dyke material by considerable.

On the north side of the island similar dykes are noticed but one becomes entirely bewildered by the effects of the elevating forces on these rock masses. The granite and diorite bands are contorted in labyrinthical curves, streaks of granite dioritic rock, epidote seams, feldspathic bands following each other in delicate laminations describing serpentine lines. In places the granite is striped by interrupted wedgelike seams of dioritic rock, or in the dioritic bands fragments of the granite rock are inclosed so that one cannot tell which of the rock masses is the accidental and which the principal. The theory of injection leaves one fully in despair and the assumption of the origin of this laminated and mottled agglomeration of different rock species by metamorphosis of sedimentary strata is just as unsatisfactory for the stunned, surprised observer; while close by again a regular dyke of basalt-like rock or of diorite penetrating sideways into the smallest accidental cracks of the sidewalls leaves the mind not a moment in doubt about the origin of these by igneous injection.

Thursday June 7 and Friday June 8. The section line between 22 and 15, and 21 and 16, in Town 48, R. 25 runs partly at the foot, partly over the crests of a series of knobs consisting of almost perpendicularly elevated rock beds dipping towards the north and striking in east and west direction. These knobs form several parallel rows but the continuity of the rows is much interrupted by intermediate depressions and the knobs of the parallel rows are rarely correspondingly situated, but the knob of one row is usually placed opposite a gape or depression between the knobs of the adjoining rows.

Along the north line of Sec. 22 the knobs consist of schistose rocks partly nearer to slate structure, partly obscurely stratified and approaching diorites. Some of the strata have the character of finely laminated novaculite. Others are rich in ferruginous matter with seams of calcareous hematite. Still other slaty strata are of a silky talcose appearance and gradual transitory varieties into a green fine grained hard dioritic schist, form a great proportion of these masses which amount to a thickness of several hundred feet. Towards the north true crystalline non-stratified diorite masses of blackish color are found intercalated between the slaty and schistose rocks.

At the northwestern section corner of 22 these knobs are interrupted by the valley of a creek which flows into Dead River. On the opposite side of this valley a very conspicuous knob rises on the northern section line of 21 in the angle formed by the creek changing its course from an easterly into a northerly direction. This hill is a compact dark coarse grained diorite with red feldspathic specks.

A chain of knobs consisting of the same sort of diorite is found continued to the northwest corner of Sec. 21. The north side of this chain is joined by slaty and schistose strata similar to those of the knobs along section line of 22. They occupy a depression of a few hundred steps width when further westward another parallel ridge of greater elevation rises on the north side of the first row, which consists of silky shining talcose and silicious slates with ferruginous seams and small bands of hematite.

The northern declivity of this row of knobs descends towards the main valley of Dead River. North of this row but further eastward in position and forming the west side of the tributary branch of Dead River mentioned before are a number of parallel east and west ridges gradually receding in a northwesterly direction from the east margin of Sec. 16 towards the central and west part of the section, which consist of schistose dioritic rock and silicious novaculite-like strata conformably interstratified with bands of granite of very variable thickness from a few inches to 10 and 20 feet thickness. The total thickness of the exhibited series containing granite bands is not less than two thousand feet.

The schistose rocks are of a finely striated laminar structure and also the granite exhibits a kind of striation in the direction of the strike which is west as usual and with a dip to the north in the schistose beds. Sometimes fragments of granite are observed but this may be only caused by lateral fissures in the schists filled with granite mass from the main seam.

The north portion of this granitic belt of parallel knobs is composed prevalently of the laminated silicio-dioritic rocks and the granite band are more sparingly interposed than in the southern row of knobs. Traveling northward one intersects these knobs diagonally and finally descends into the valley of the creek which has few rock exposures excepting an isolated knob of granite which rises not far from the north east corner of the section 16 and which seen from a distance emerges from the timbered level land surrounding the creek, like the shining timbers and roofs of a newly built farmhouse.

The abandoned Furnace Collinsville is situated on the embankments of Dead River a little south of the centre of the south half of Sec. 9, T. 48, R. 25. The river forms rapids at the spot and both sides of its embankments are formed by rock cliffs. The strike of the strata east and west, dip north. The river has almost the same direction at the spot and intersects them very obliquely.

On the south side of the outcrop a thick mass of non-stratified very hard dark colored diorite forms the embankment. Next to it comes a band of schistose greenish colored rock 3 or 4 feet in thickness. North of it joins a mass of red granite. Then follows again a very thick seam of greenish schistose and slaty rock into which the main body of the river has carved its bed. This seam and the schistose seam on the south side of the granite run together some 30 or 40 feet lower down the stream and a cross vein intersecting the wedged-in granite mass connects the two schistose bands already before they totally come together.

On the north side of the schistose river channel again granite appears. Then a band of schist and granite again, when the drift masses forming the top of the bluffs cover up the further continuation of rocks.

Diagram

The road northward from the Collinsville furnace ascends over sand covered hills without any outcrops. After circuitous bends and after crossing the valleys of several creek branches near the northern terminus of Sec. 9 the granite comes out in a high range of knobs which continues in a chain of gradually less elevated knobs eastward to the mouth of Dead River.

The high granite knob under consideration with a general strike from east to west which is also indicated by the linear striation of the rock mass in that direction (gneissoid arrangement of the constituent minerals) is on the north side overlaid by a massive dark diorite 50 feet in thickness which again is followed by granite. The dip of the rocks is evidently to the north. A seam of talcose slate rock crosses the granite at that locality in a northwest direction and meets the diorite band under an acute angle.

Further north all the way to the lake shore the surface is dotted with knobs and intervening ravines and nearer the shore the knobs become lower, more sporadically rising from a swampy level shore land. The knobs consist of a reddish granite of quite uniform character and nearly every knob is intersected by bands of diorite or schistose rock or both. The diorite and schistose bands are generally not parallel but intersect each other and the direction of any of the two kinds of dykes is frequently changed by bends or geniculations.

An abundance of smaller quartz veins is also observed but their direction is not regular. They represent merely subordinate accidental fissures and cracks in the rock mass. I followed the road across those knobs diagonally through the southeast quarter of Section 4 from whence the road winds itself around the foot of the granite knobs through the south half of Sec. 3 to its southeast corner, where in the granite some very fine dykes of diorite are laid open for observation by some old quarries near the roadside leading towards the Powder Mills.

Sunday June 10. Ascended the hills by following Jackson Street south of Northwestern Hotel which street is about coincident with the east and west section line between the sections 25 and 26. The high hill which is located in the southeast corner of Sec. 22 is formed by a green diorite identical with the diorites of the cliffs at the mouth of Whetstone Creek. Towards the south side of this knob is formed by a slatelike finely laminated sub-talcose quartz rock (novaculite) to which further southward follow greenish grey slate rocks of silky shining character, and next to them are more argillaceous but hard slate rocks of dull green or blue color. The thickness of these slaty bands is about 300 feet wide clearly observable. Further south in the depression between the high knob and the next rock cliffs heavy drift deposits prevent observation.

The rock ridge on the south side of this depression consists of an obscurely stratified or non-stratified greenish diorite frequently exhibiting in its mass signs of convolution and pervaded by cellulose quartz veins, epidotic and calc spar seams with nests of chloritic rock and sometimes micaceous iron ore.

Diagram

South of this a rock ridge follows which is composed of a very fine grained black diorite, very hard with flinty conchoidal fracture, densely disseminated with grains of iron pyrites.

South of this the parallel rock ridges extend to the central east and west line of Sec. 27 retaining the same general character of the dioritic schistose rocks as seen on the mouth of Whetstone Creek. Sometimes the diorite is more compact and non-stratified. In other parts it has more the appearance of a metamorphosed slate rock. In one of the knobs north of the Catholic graveyard, on the southern escarpment a fissure between the perpendicularly elevated schists is completely filled with sand-rock of the Potsdam age. The elevation of this knob above the brownstone quarries east is not less than 100 feet, perhaps more which shows to what height the sandstone deposits once reached. All the hitherto described strata as far as observable dip northwards and have a uniform strike from east to west.

Friday July 6. Went with some students from Bethlehem, Pa. to the Picknik Islands. The largest and most easterly situated, consisting of a massive coarsely crystalline diorite rock pervaded with reticulated thin seams of epidote and frequently containing segregated seams of flesh red feldspar and quartz bands is intersected from east to west by a dyke of about 4 feet width.

The rock mass of the dyke is very compact of delicately laminated gneissoid structure resembling a well stratified sedimentary seam but in structure and composition representing a fine grained granite rock. The dyke is evidently intrusive as the dyke mass fills out all accidental irregularities of the fissure in the diorite, dividing sometimes into several branches which wedge out or abruptly abut against the surrounding diorite.

Diagram

From the Picknik Islands I landed at the shore close by and walked in a south and somewhat westerly direction through the sandy flats bordering the lake. In the southwest quarter of Sec. 13, T. 48, R. 25 a small protrusion of rock is visible over which a wagon road leads. The rock is partly a very coarse grained hornblende rock containing pyrites and some mica and very little feldspar or is a fine grained compact diorite rock, in places mottled and striped by segregations of red feldspar, of epidote, ectr. Also bands of gneissoid fine grained granite are connected with the dioritic rock masses which have a strike to the west and retain a conformable position to each other.

By following the road in southwest direction we ascend the drift terrace bordering the flats on the west side and now after its ascension we notice in a short distance to the west a number of parallel knobs striking east and west which consist of a very thick series of dioritic schists, thin bedded slaty, or more massive and divided by rhomboidal cleavage cracks.

The most northerly portion of the outcrops is almost exclusively dioritic schist, the knobs next south of them inclose several bands of laminated granite rock within the schists. Also quartz bands are frequent. Near the section line between sections 14 and 23, on Section 14, one of the parallel knobs distant about 150 steps north of the section line is composed of granite altogether conformably interstratified between schistose rocks, which on the south side change into a coarsely crystalline diorite with reddish feldspar. The strata all regularly dip to the north under an angle of about 70°. Going from the granite knobs southward across the formation we enter dioritic schists of great thickness well laminated in even beds with rhomboidal cleavage or sometimes interposed by belts of massive diorite,

On the space between Ohio and Michigan streets the outcrops of the strata are of considerable extent and on Michigan Street a coarsely crystalline blackish diorite forms a long string of protrusions. From the centre of the street north of this diorite the schistose strata contain concretionary seams of marble-like ferruginous calcspar and sometimes nests of hematite with calcareous intermixture. Likewise are in this horizon common, silky shining talcose slates much corrugated and bent by the uplift and separating in wedge-like fragments, as the case generally is in all the outcrops of the softer thinly laminated slate rock of this district.

Saturday July 7. Cloudy and rainy in the forenoon. At noon a severe hailstorm. Towards evening went along the road to lighthouse point. The bluffs near the Grace furnace are composed of slaty rocks of various characters, and the strata are in places considerably twisted and corrugated by the uplift into their highly inclined position, dipping north. The slates are of quite various kinds.

A thick seam near the furnace building is of a white color finely laminated quartzose slate with silky shining talcose intermixture through the whole laminated mass. It is a closely approximated rock to novaculite. Other slates are of a dark greenish grayish or reddish color of more argillaceous nature but likewise the surface of the delicately laminated rock has a smooth shining surface with delicate striation in the direction of the uplift of the strata, so to say slickenfaces of every lamina composing the rock.

There are also seams of quartz in cellulose masses impregnated with micaceous hematite ore of more compact milky quartz intercalated between the slate, either as lenticular masses conformable with the strata or as dyke masses. The visible thickness of these slates is evidently over one hundred feet but there is no good opportunity to measure its thickness.

Further along the road and evidently above the slates unto the sawmill of the Marquette Lumber Co. more compact greenish colored schistose dioritic rocks are exposed, having the same strike and dip with the slates. The rock has been considerably twisted and corrugated by the uplift and numerous hair-fine and other coarser seams pervading the mass in every direction are filled with white calcareous spar or with other minerals. The distinction between the schistose fine laminated beds and the more massive rocks approaching diorite with only obscure stratification are merging gradually into each other.

Quartz veins of silky whiteness intersect the rock very frequently and near the sawmill is a band of a bright green aphanite intersecting the schistose rock in such a way that in one place it might be taken for a regular bed of the series of strata but further along this band bends and cuts across the stratification in the form of a dyke, and in some places it is plainly observable how the aphanite mass fills out an irregular fissure with angular projections and is an intrusive mass not belonging to the stratified series. The aphanite is frequently covered by a coating of calc-spar or of feldspathic mineral on the outer surface of the veins or the vein matter and inclosing rock mass are intimately united without such intervention.

North of these schists follows the series which composes lighthouse point and the quarries west of it. Essentially the entire series has the same chemical composition. The difference is in the more schistose slatelike or more massive condition of the rock in its fine grained obscurely crystalline condition or a distinctly obvious coarsely crystalline structure allowing the discrimination of the hornblende and the feldspar composing it.

The schistose beds are interchanging with apparently non-stratified crystalline diorite masses which sometimes inclose detached large fragments of the schistose rocks within themselves so that a presumption of their fire-fluid intrusive nature is very natural. The transition however between metamorphic schistose rocks and such supposed lava masses is so gradual in certain instances that I hesitate to take the massive diorites of Lighthouse Point as intrusive without expressing my doubts in regard to it.

A band of a quartzite or granite like hard rock separating in very regular smooth faced rhomboidal blocks and slabs and of a whitish light grey color is conformably interstratified between the schistose rocks of the point occupying the side north of the lighthouse building. The microscopical structure of this rock is finely laminated in the direction of the strike after the mode of gneissoid rocks and its composition seems to be principally a feldspathic plasma with quartz intercalated in layers of granites and likewise with streaks of hornblende granules in less abundance. It is difficult to draw a sharp line of distinction between some of the fine grained granites of the vicinity and that rock which has not the appearance of being intrusive but is a member of the stratified rock series in a highly metamorphosed condition.

Sunday July 8. Bright day. In the afternoon traveled out Ridge Street which on Oak Street or at the point where Arch Street angles into Ridge Street has risen into a very prominent knob. The southside of the street is on the edge of the declivity of the hill and is formed by argillaceous slate with some rare compact schists. In the centre of the street is a broad belt of much corrugated and finely laminated novaculite which is joined on the northside by a thick mass of crystalline compact diorite to which again a belt of novaculite follows. The development of knobs on the same line in Michigan and Ohio Streets up to the east and west section line is very conspicuous on Ohio Street and Michigan Street a string of knobs continues unto the lake bluffs.

On the east side of 7th street near the section line between 14 and 23 are large surfaces of the schistose rocks denuded. They inclose at the road ditch cut across the beds some narrow bands which approach granitic structure. The knob on the corner of the graveyard between Sec. 22 and 23 consists of well stratified compact dioritic schists with rhombic cleavage and of some intercalated masses of a crystalline diorite west from there in the south part of Sec. 15. Knobs of rock continue unto the bed of the creek which is a branch of Dead River, but north and northwest from the corner of cemetery the land gradually sinks into a drift covered terrace land with scarcely any outcrop of rock and towards the Dead River valley a drift bluff demarcates this higher inclined plains from the lower lake bottoms and swampy or sandy plains bordering it.

On the side toward the Dead River tributary creek however the rock outcrops continue as far north as into the north half of Sec. 15. The creek cuts for some distance right across the series of strata and is bordered on both sides by perpendicular rock walls but the elevation of the surface is not near as great as it is in the knobs nearer to the section line between 15 and 22.

Monday July 9. Part of the observations of this days explorations are embodied in Sunday's report and will not be repeated here. From section line on west end of graveyard on railroad track 640 steps to east fence of Tannery. From there to crossing of Whetstone Creek 596 steps. From there to section line passing Rubleins Brewery 710 steps, total of the mile 1946 steps.

An outcrop of slate rock is visible on the north side of railroad track only about 100 steps from section line between 21 and 22. This outcrop with little interruption continues to Harlows line and on further into the west half of Sec. 21 where the creek winds itself around the foot of the schistose or slaty knobs. The course of the creek on the map is perfectly false. There is no arm running parallel with the railroad on its south side. There is undulating land sloping gradually towards the railroad. The main stream of the creek is the arm which passes Rubleins Brewery and takes up a tributary branch from Harlows mine. It heads to the south near the centre of the northwest quarter of section 21 and crosses small distance from there the railroad line.

About a half a mile further the creek running into Dead River crosses the Railroad but the swamp lands delineated on the map as surrounding it are not very well indicated on the map. There is no marked swamp of any larger extent but only low land overgrown with cedar etc., and the rock forms near the railroad a narrow abruptly sided valley instead of as the map makes one to suppose to expand into a flat swamp belt.

The side track of the road for the ore transportation to Bancrofts and Collins furnace is 460 steps west of the 3 mile post. At the same spot the branch of creek flowing into Dead River crosses the road. At this spot also the track of the old railroad crosses the new road. An outcrop of slate rock which is a direct continuation of the slates at Harlows mine is noticeable. At this juncture of the old and new lines south side of slate rock joined by a massive diorite.

Following from here the wagon road to Bancrofts and Collins furnaces we have to transgress on the section line between 17 and 20 an inconspicuous swell formed by a protrusion of a massive diorite. Thence the road descends into the valley of the creek entering Dead River about $\frac{1}{4}$ of a mile west of Collinsville furnace. Near the houses on the spot where the roads to Bancrofts and to Collinsville divide, outcrops of diorites and dioritic schists interstratified with granitic masses of greenish color strike across the valley in an east and west direction or nearly so and with northern dip (west southwest to east northeast).

Short distance ahead from there on the Collinsville road an outcrop of dioritic schists with bands of a fine grained laminated or striated granite forms a considerable knob on the southside. The schist is joined by a massive crystalline diorite which gradually changes itself into the gran masses of granite mentioned previously in the outcrop near the houses.

After passing this knob the road descends over a drift covered declivity towards the river whose embankments and bed are formed by granite of red color with intercalated seams of schistose and dioritic rock and in places intersected by cross dykes of a compact dark colored diorite.

From Collinsville I followed the road towards the Powder mill which is nearly coincident with the section line between 9 and 16. Inspected the granite knob in the fork of the two creeks uniting in the southeast quarter of Sec. 9. The granite of red color and of micaceous laminated structure is intersected in conformable direction with its strike by a dark green crystalline diorite with red feldspathic specks from 3 to 4 feet in thickness.

Also laminated in structure and containing occasional fissures in the granite rock or inclosing detached fragments of the granite an entirely similar but broader belt of diorite I found next day in the vicinity of Hancock's furnace. This granite knob is the northern termination of a series of outcrops bordering the bed of the creek which has its headwaters in Sec. 29 and 30 of T. 42, R. 25.

The strata are in almost vertical position striking east and west with northern dip and forking on both sides of the creek cutting across them almost perpendicular walls. These outcrops continue as far south as to the head of the creek on the section line between 16 and 21. The outcrops representing the thickness of about 4,000 feet of strata are composed of granite at first and to the south of dioritic schists with belts of massive crystalline diorites and numerous intercalated bands of granitic nature all of which are in conformable parallel position. These are intersected in irregular transverse directions by larger or smaller differently bent or rectified dykes of a compact blackish diorite rock which is evidently intrusive and younger than any of the other mentioned rock beds.

A fine section of the rock series traversed by a dyke of this kind is observable near the quarterpost of the line between Sec. 15 and 16 (north of it). I have given a sketch of it on a separate sheet of paper and specimens of rock are preserved from the locality.

Diagram

Wednesday 11. Followed the western prolongation of Washington Street of Marquette. The distance from north and south line between Sec. 21 and 22 is 600 steps to the principal outcrop of slate rock on the road side, from there to the bridge across Harlows mining location it is 210 steps. The slate outcrops continue westward across the creek (Whetstone Creek), which arches from here to the south and crosses the railroad track about a $\frac{1}{2}$ of a mile west of the north and south line through the centre of Sec. 21.

The road (Washington Street) turns on the other side of Harlows bridge north and shortly after bends west again following the foot of the slate knob and compact black diorite masses placed in the watershed between Dead River Creek and Whetstone Creek. Small distance north of the road passes also the old track of the Megawnee railroad stretching west through the swampy valley of the Dead River creek which it crosses about on the north and south line between sec. 20 and 21. The position of the creek and swamp on the map is incorrect.

Diagram

Followed the Collinsville furnace road to its division then took the branch leading to Hancock's furnace. That road for a short while follows the creek presenting on both sides outcrops of dioritic schists and alternately belts of granitic rock. Then it crosses the creek and strikes northwest over a plateau-like granite spur between the creek and the mainstream of Dead River. The declivity of that plateau which is partly covered by drift presents on its margins toward the creek large denudations of the granite with dioritic dykes.

On the left hand side of that road granite ridges of about 120 feet elevation above the plateau rise from the top of which a splendid view is to be had over all the surrounding country.

Near the coal kilns close to Bancrofts furnace on the south side of the river the granite striated in east and west direction incloses belts of a similarly striated dark crystalline diorite rock, and both of these conformable rocks, the dark rock however being perhaps an intrusive parallel band with the granite as it sometimes incloses fragments of the granites and enters fissures in the granite, are diagonally intersected by a 10 feet wide dyke of a dark very compact diorite. Several other such dykes are observed in the vicinity and frequently an irregular ramification of these dykes can be noticed.

The general strike of the granite is east southeast and west northwest. On the northwest side across the bridge of Dead River the granite is largely exposed and contains a thick belt of the dark crystalline and conformably striated diorite rock with dots of red feldspar and irregular veins of white quartz and of epidote.

Ascending on the northern bluffs of Dead River a drift plateau of about 100 feet elevation above the river bed is reached and transgressing it about $\frac{1}{4}$ mile northeastward we are at the foot of high granite knobs at the foot of which 2 small lakes expand. The knobs may be 200 feet higher than the plateau. A splendid view over the surrounding country is offered on their summit. And the whole interval between the Dead River and the parallel river running a mile or more north of it is filled by an uninterrupted granite body cut up into innumerable chaotic knobs of which the highest are the knobs close to the two lakes.

This body of granite knobs continues in a east southeast direction to the granite knob short distance west of the Powder Mill and to the similar knobs found in the northeast corner of section 10 close to the lakelike ramification of Dead River mouth. The large body of the flesh colored granite contains very few dykes or diorite and schistose belts but at the lower eastern terminus of the ridges dykes and schistose or dioritic parallel bands are very numerous. A cross section from Dead River to the river bed on the north would have about the following contour lines.

Diagram

After ascension of the high granite ridges which in the direction towards the east become lower. We descend again to the drift belt above the Dead River and walked down on it to Collinsville furnace. From there followed the road on southside of river towards the Powder Mill. Short distance after crossing the creek coming from the south we followed a road through pine plains passing the race ground and Trench's farm on its west line. The ground begins to rise into gentle drift hills near the east and west line crossing the centre of Sec. 15, and from there a road leads almost due south over a gradually ascending hill to Washington Street 400 steps west of the corner of cemetery lot.

About in the continuation of the diorite knob on Section corner of cemetery lot the road passes the summit of the elevation and a denudation of diorite and schistose rock is found there extending over a limited space. The remainder of the surface is drift covered and in the somewhat depressed interval between cemetery and the road mentioned a few outcrops of Potsdam sandstone can be noticed but the testpits for quarrying it did not open useful beds of it, but clearly demonstrate the presence of the strata.

Thursday June 12. Examined the topography of the south half of Sec. 15, T. 48, R. 25.

On the western brow of the knobs facing the swampy depression which forms the watershed between Whetstone Creek and Dead River the silicious slate or novaculite presents itself in exactly the same manner as seen on the summit of Ridge Street. North a belt of novaculite with considerably corrugated laminated slate structure. Next south to it a thick belt of massive crystalline diorite and then again a belt of novaculite. And still further south dioritic schists which also form the rocks joining the novaculite belt on the north portion of the outcrop. Examined again the fine outcrop with basaltic dyke and granite belts on Dead River tributary.

Friday 13. Ascended Mount Mesnard following the north and south section line between Sec. 34 and 35. The foot of the high hill is like the promontorial surface extending to the lake shore, formed of boulder drift enclosing large blocks of Potsdam sandstone. The hill top is formed by a series of quartzite beds of several 100 feet thickness (not less than 400 or 500 feet), strike east and west, dip north.

The quartzite is partly ripple marked of white or reddish color. On the north margin of the outcrop some novaculite like slaty beds can be observed. On the southern side of the hill some slate and schistose beds are found intercalated but at that spot and more westward on the hills I did not observe any of the silicious marble strata which on the east end of Mount Mesnard form the highest crest.

Saturday July 14. Afternoon followed the shore to Harvey's furnace. The space inclosed between the Marquette rolling mill and the mouth of Carp River faces the narrow shore belt in a bluff from 60 to 80 feet high composed of drift. The drift occupies all the lower hill land in front of Mount Mesnard which at its base is likewise surrounded by a mantle of drift. The drift reaches up to the highest summit in some places. A deep ravine separates the main body of drift hills from the higher quartzite chain. The ravine intersects the northeast quarter of Sec. 35 diagonally from the northwest to southeast.

From Carp River Furnace to the mouth of creek entering the lake in the northeast quarter of Sec. 36, the space between the Carp River valley and the shore is composed of drift material but may be underlaid by sandrock. The mentioned little creek is on its south side washing the foot of quartzites. A continuation of the same quartzite hills strikes the shore 360 steps further southward on the road following the shore line. Here it forms (the vertical layers of quartzite) a small spur and a rocky small island which in the bed of the lake exhibit in a finely denuded outcrop the inconformable abutment of the Potsdam sandstone against the quartzites. The Potsdam sandstone continues to be exposed on the shore unto about 150 steps southward of point. From the mentioned quartzite point to the foot of the quartzite hills striking the road further south the distance is a little more than 900 steps. Here is the south line of T. 48.

In Town 47 the rock bluffs continue in a directly southern extension and in this direction. After passing the very thick belt of quartzite which has a strike 20 degree south of west and a southward dip, we come upon another spur of the high mountain range strata dipping and striking in the same direction as quartzites, which is composed of talcose silicious slates with bands of Quartzite and of marble. This rock series is at least 400 or 500 feet thick and exhibits a great variety of colors and minor differences in the rock character. Several thick bands of red quartzite are found interlaminated southward, and then a very powerful series of silicious limestone with intermediate slaty bands is exposed. The northern half of this exposure still has a southern dip, the southern half a dip northward.

And the centre portion of the limestone mass is wonderfully twisted and corrugated into serpentine flexions in the synclinal trough. On proceeding south across the outcrops we find again slaterock and quartzite dipping north, a repetition of the before mentioned strata in inverted order, and at once come upon a fault which is also plainly marked in the configuration of the hill as a dip indentation divides the crest in two where the fault is.

The strata of slate rock and quartzite dipping north are found in anticlinal contiguity with slaty rocks of a different character with a micaceo-talcoso slate minutely corrugated in its beds weathering white with silky splendor. Dip southward under an angle of about 60 degrees. South of the slate is a dyke-like heavy band of compact green colored diorite, which is followed by chloritic diorite schists of distinctly laminated structure with intercalated bands of granitic rock. The dip of these beds is somewhat variable. They have suffered many contortions and are in places nearly perpendicular, in other places dipping under an angle of not more than 50 degrees to the south. The exposure of schists south of the diorite belt is 125 steps long across the inclined beds.

Monday July 16. Afternoon ascended the hills at the Marble quarries in T. 47, R. 25, Sec. 1 or about at the division line of this township and Marquette Township. The highest point of the ridge which nearest the shore may have an elevation of 300 feet is formed by a heavy mass of quartzite about 250 or 300 feet thick, partly well stratified and ripple marked, partly forming an obscurely stratified compact mass. Bands of ferruginous color, conglomeratic seams are frequently noticed and the surface of the rock is found remarkably well polished by glacier action. The striae have a direction from north northeast to south southwest. The strike of the quartzite in this highest terminal hill is east and west, dip north. This quartzite forms the south portion of the synclinal section through the marble quarries described already in the former report.

North of the quartzite a thick series of slaterock of various character follows upon which then the marble with its corrugated and contorted beds follows. On the south side of the quartzites a belt of talcoso-silicious slate of minutely corrugated structure and of micaceous splendor can be traced for nearly $\frac{1}{2}$ a mile westward, joining the quartzite in an anticlinal position. The quartzite hills of this east and west chain are highest near the Carp River valley. Towards the Chocolate River the land sinks rapidly unto a rolling plateau intersected by ravines which is 100 to 150 feet lower than the high crest which occupies not over a half a mile in transversal width.

Tuesday July 17. Followed the creek entering the lake near the centre of Sec. 36. The space is first formed by lower hills intersected by many ravines. The south side of the creek near its mouth is bordered by quartzites which are quarried, the other land surrounding the creek is all covered by boulder drift. Near the town line the higher range ascends briskly into large knobs of quartzite striking east and west and with frequently changing dip, either northward or southward. Some portions of the quartzites are massive with obscure stratification, others are well stratified and exhibiting ripple marks. The quartzite forms a mass of at least 200 to 300 feet thickness. The quartzite is overlaid by a series of slates of quartzose or talcoso or more argillaceous character which likewise have a thickness of several 100 feet and inclose bands of quartzite and higher in the series appear powerful masses of silicious marble of very much contorted and irregularly bent stratification.

Diagram

The marble is interstratified with novaculite-like shales and with talcoso-dioritic schistose rock seams.

Diagram

Tuesday July 31. From Camp River lower lake terrace and border of river 350 steps to foot of terrace, about 30 feet higher than the former.

4 pages of German

Friday Aug. 3. Southeast corner of T. 48, R. 25 parallel with the foot of hills across the strike of formation through shales to centre of limestone outcrop 110 steps, all south dip. Now dip north in going further in south southwest direction same distance of 110 steps, shales and limestone. Then high quartzite hill, strata almost perpendicular, only slightly northward dip. Vertical elevation of knob at the brink of the hill about 120 feet from lake terrace. Quartzite also about 110 steps across. Dip at the southern end of outcrop decidedly north.

Corrugated talcose slate follow next conformable with the quartzite but evidently an anticlinal arch because 20 or 30 steps further the same corrugated talcose slates dip south; are overlaid regularly by a band of diorite and then by heavy masses of dioritic schists with granite bands and massive diorite-like but stratified layers.

Diagram

is conglomerate and quartzite of ferruginous character very nicely drift polished and the beds convoluted.

Monday Aug. 6. On road a little north of section line between 21 and 26 to Sec. corner on Cook's land. 352 steps before reaching the corner the knobs south of the road are more prominent. From road to high knob on north and south section line 350 steps.

13 pages of German with several diagrams

Thursday Aug. 9 T. Morgan Furnace. the east and west line south of Sec 26, 1627 feet east of quarter post, consequently the creek cannot be correctly marked on the map. The furnace stands right south of it on other side of creek only about 2 to 300 steps from it. Hills of marble and talcose calcareous slate east and west strike, dip south, tops about 100 to 120 feet above the river bed.

We hunted for the line which we had lost a few days ago and found among the totally burned stump land a few trees indicating the direction. By pacing we ascertained the position of the section corner to be a short distance almost to the north from the coal kilns. The hill land is there forming a broad terrace which is drift covered but on the edge of the valley exhibits considerable outcrops of the marble. We then followed the north and south line in south direction ascending over the coal kilns unto a wide terrace land about 60 to 70 feet above the creek, as is the terrace on which the section corner lays.

Friday Aug. 10. Out on railroad to 3 mile post the north and south section line crosses the road 67 steps this side of the 3 mile post. From sec. line to where the road crosses the creek 486 steps. 650 steps to crossing of old railroad. At that spot a small slate knob close on north side of road, west side of creek.

1 page of German

Fassbinders farm west } of Northeast quarter section (19).

Hills along Dead River to Stones Mill on the west declivity very steep. Top part all drift, foot portion diorite. At Stones Mill the formation strikes west northwest, dips southward. River breaks through the rock parallel with its strike. Rock diorite inclosing granitic bands somewhat dove-tailed into the diorite.

Diagram

Stones Mill. A diorite dyke intersecting the schistose and granitic strata. Granite fragments inclosed in the dyke mass. A fire which burned the mill melted the dioritic schists of the outcropping rock and even the surface of the granite. The river forms a sort of low falls hemmed in between perpendicular walls.

16 pages of German

Thursday Aug. 16 Distance cemetery fence to the west fence of first house 500 steps. From there to the ravine crossing the Tannery property 240 steps. From there to end of board sidewalk 225 steps. At 275 steps the summit is reached on street and it goes down hill from there. The half mile line must be crossing the street here with the fence of the slaughterhouse property. 140 steps from there to the road near Powder house. The hillside shows everywhere outcrops of Potsdam sandstone.

3 pages of German.

Lake in section 19 : A small creek enters it coming from the direction in which the old road is situated.

Diagram

About 300 steps east of it is the 5 mile post of the railroad. On both sides there, rocks. On the north side a small brook runs between the road and the rocks. 88 steps east from there is a post whose significance I do not know. On both sides of road rocks continue, road occupying a depression about 200 steps wide. Rivulet parallel with it on north side. 400 steps from 5 mile post small cut of road through rock, and on south side a plateau-like level strip of land. Also on the north side after the cut of 40 steps continue rather low and the rivulet has crossed before the cut to the south side of the road where it descends in an eastward direction. At 518 steps the rivulet crosses the road again and runs thence northward. From 500 to 625 and onward road cuts through a low gravel hill. (There a side road southeasterly).

1 page of German

On creek a post signed 80 rods north and about 30 rods east on an old road. On top of hill range not many steps from the railroad and its crossing of the creek a post is set telling 40 rods S.E. of section line. From there course of hill crest northwest. Road between in northwest direction. Crest 465 steps to hill top which is just in west line with the cemetery section line and strikes Fassbinders corner.

2 pages of German

Schwerning's land northwest quarter of southwest quarter of Sec. 20. And the northeast quarter of southwest quarter of Sec. 20. Follow section line of 20 to corner between 23 and 30, then south 245 steps from corner. Brisk descent into valley. Strike the old road at the creek 525 steps from corner.

2 pages of German

Monday 20. Along railroad past Bancrofts Station to crossing of creek to rocks extending northwest at Fassbinders. From there supposing to have passed the north and south section line a small distance we went south over diorite rocks on the railroad level and descended into a creek bed distant some hundred paces south of railroad. On its south side a large diorite knob which we ascended.

On the land of Tony (Tory) or near its western boundaries followed the subdivision east and west line from its supposed corner about 300 steps which led us through our ravine at 150 and at the 300 we were on the crest of a hill which allows direct on (follows direction of) the railroad with lower hills and numerous ravines before in the interval further west this crest seems to rise into a higher hill. Whether this is the before mentioned Iron Cliff Hill I have not yet ascertained.

We went from this line south into a ravine with creek running east and west approximately. Distance from line not more than 150 or 200 steps. Then I went south ascending a hill crest and descended into another east and west ravine. Ascended again a much higher ridge. All over this space diorite. A specimen from first crossed hill.

I struck the line on top of the high Iron Cliff Hill 674 steps from section corner. At 234 steps from corner met a creek running north and south, the land dipping slowly from the corner towards this creek. Creek running northward from creek. Steep ascent on a moderate hill. At 400 steps another north and south ravine, thence more rapid rise unto our high position at 674 steps.

From there past quarter section post 400 steps slowly descending but remaining on ridge on the northside steep descent into a ravine which at the quarterpost takes from an original east and west direction a direction northward and seems to strike towards the new railroad line. From quarter post to the crossing of the line with the road 464 steps all through swamp.

About 250 steps north from $\frac{1}{2}$ post after passing that distance through a swamp of a ravine running north we strike across the edge of a diorite knob. From there the course of the ravine is continued 15 degrees east of north. The swamp extends around the diorite hill also in an east direction.

Diagram

By 374 Steps crossing a creek running east. Thence ascension of a steep diorite knob. 500 steps at its summit. 114 steps further descending slowly we come across a road running down eastward clearing. High level undulating land. Followed now road northwestward. Thence north a high

About 100 steps east of where we are descent of surface in that direction. After 300 steps (about) we strike the railroad. In a gravel cut 57 steps west of the brickyard switch, here also the ravines begin which form the creek passing by the brickyard. Brickyard switch may be safely considered as situated on the quarter section line of the section.

Wednesday Aug. 22. From section corner south of town line, northwest corner of Sec. 30, T. 48, R. 25, 100 steps to foot of hill, to top 170 steps. A ravine crossing our way on the south and running to our left northward at the side of the hill on which we stand.

Diagram

At 342 steps an another diorite knob, little higher than the former. Ravines directed towards the north side. At 570 steps on top of highest diorite ridge with the lake on foot of southside. West from our standpoint another similar knob separated from this by an excavation. The rock walls toward the lake are almost perpendicular.

8 pages of German.

Friday Aug. 24. Railroad on Bruce's Station 662 feet elevation. Bancroft at bridge 399.7 over the old railroad. Megaunsee 767.60. Cleveland Mine store 847.8. Morgan 677.3. Ishpeming 842.3. Lake Angeline water 839.7. Saginaw 839.2 Township line where road crosses it 469.2. From section line near schoolhouse of Morgan 500 to 600 to foot of high rock knobs. First marble hill across creek is here already west of us.

At south line quarter post a small quartzite knob in west northwest direction. Small distance off from quartzite a low ridgelike elevation composed of ferruginous slates similar to the slates belonging to the marble series. From quartzite hill looking along the line southward which is indicated by a clearing the level plateau land continues apparently to Carp River. In east or southeast direction the quartzite continues in larger separate knobs. Quartzite dip south at about 45 degrees. From corner which is at the upper end of the ravine we cross the same eastward over the slanting side of hills ascending higher on southside. By 300 steps we are in another ravine running northeast.

10 pages of German

Monday Aug. 27. 100 steps west of little creek on railroad. Small cut through a diorite hill. Hills continue on both sides westward. Line northward passes massive diorite hills of the fine grained kind mottled with tortuous seams.

Diagram

The quarterpost is beyond the hills on the declivity of one of the numerous ravines running toward the creek. We descend through these ravines. The diorite rock crops out at various places but the shape of the hills is rounded, gently slanting.

Near the great bend of Dead River a small knob of diorite striking from southeast to northwest crops out. The principal mass is crystalline granite-like diorite with intermediate bands of a slaty rockmass.

Follow the embankments of river upwards. For a short distance the bluffs fall (form) close into the bed of river then the bluffs retrace and the river makes a bend towards the section line running through a wide level valley. The bluffs strike northwest onto a high rock bluff. 3 creeks interrupt our course. The last one flows at the foot of the south side of the diorite bluff.

Diagram

Tuesday Aug. 28. Specimens near section corner between 12, 13, 11 and 14. The line we followed from the corner situated at the foot of the knobs west of Stones Mills is running over a plateau passing coal kilns near which we meet with a stream running eastward from high granite and slate hills before us over which the line runs. Following an east and west valley we suppose to have the line a little distance to the north of us running over the hill, but no traces of blazes could be found. A little less than a quarter of a mile beyond the supposed corner we have descended into a valley where the former mentioned creek is met with running at that place northward. The entire country is cut up into numerous hills and the line seems to run near the watershed of the creeks of which one side leads the waters into Dead River near Bancrofts furnace, as the creek on which we are.

The other creeks originating north of the line enter Dead River above the big bend. Granite and slate outcrops on both sides of the creek ~~where~~ we are taking dinner strike east and west.

On north and south line 255 steps from quarter post to brisk declivity to river. At 407 steps another large very abrupt declivity to the water running in rapids. Granite rock at this place.

3 pages of German

Diorite striking with the surrounding schists at Stones Mill. Intersected in zigzag line by a vein of granite. Needle turning rapidly in circular revolutions.

Diagram

On island below Stones Mill where the river flows from west southwest to east northeast large exposures of schists with granitic bands. Schists prevailing largely. Some granite bands parallel with schist send out lateral ramifications into the schists diagonally. Specimens from a large dyke 50 feet wide striking across formation north and south. Rivers course for about $\frac{1}{2}$ of a mile from above to below the rock island from west southwest to east northeast.

Diagram

Granite close to furnace between river and building in irregular streaks between schists. East of furnace large massive outcrops of granite. Strike east and west. A dyke of considerable thickness (25 feet about) crosses it in east northeast and west southwest direction inclosing angular side veins of granite.

Diagram

1 page of German

On high hill south of Dead River about in the centre of Section large granite knobs edging the plateau with a parallel dyke of black trap 20 feet thick. Specimens Dyke No. 3, contact with granite northwest quarter, 8 acres of northwest quarter of southeast 2, northeast quarter of southwest ($\frac{1}{4}$) of Sec. 17, 40 acres. From 40 acres corner north 412 steps brings us on the Bancroft road. 60 steps to the south southwest is a granite knob.

Friday Sept. Michigan Street on south side. Coarse grained black diorite about 75 feet. Then about a 100 of well stratified schists. On northside likewise similar schists at least 200 feet with thin occasional bands of ferruginous spar. Dip north. Diorite apparently parallel with schist. A seam of laminated granite within the schists about 6 feet thick, and about 20 feet north of crystalline diorite seam of black ferruginous rock with calcspar and quartz separated from schist by a smooth saulband (salband) surface, rather porous and nodular, in all 7 feet thick.

About 50 feet further north band of ferrugino-pyritous rock partly laminated, 8 ft. to 10 ft. Next north of it crystalline diorite with pyrites. Most massive and very tough but with intermediate well stratified schistose portions.

Saturday Sept. 1. Eastern continuation of line from corner of 40 acres post leaves by sighting south the hill No. 3, granite on the west side. Land inclined to east towards Collinsville creek.

N.B. Line traveled by Wagner 700 steps north from east and west line 40 acres corner, schoolhouse due west about 250 steps. At 800 steps on the bluffs of Dead River 12 feet above water running about east and west. At 1000 steps close to river the large granite knobs, from there east at about 150 steps distance west from there 250 paces struck creek. Dyke on granite from northeast to southwest. Bancroft Schoolhouse about 100 feet west of section line.

Paragraph in German

2 diagrams

Dyke cutting schists under angle of 45 degrees northeast to southwest, 12 feet wide.

Stones mill at the 2 feet wide dam, an Epidote vein with quartz crossing the schists in south southwest direction. From section corner north 220 steps at a precipitous bluff 15 feet high on a ravine running north. At 300 steps we leave the ravine which there bends northeast. At 425 steps we are in another small ravine likewise running northeast. A still larger ravine with creek is at 500 steps nearly east in direction. At 535 steps on the summit of a hill at its eastern terminus, then descent into another ravine eastward. All these ravines unite short distance eastward into one. The next ridge we now have to go over stretches far more out in an eastern direction.

N.B. At the entrance of this common ravine is a piece of fresh burnt timber which may guide ones eyes by looking for the place from the opposite side of river.

At 600 steps from corner we leave the timber and stand at the clearing which continues on a ridge northward, declining east and west. The high hill in the bend of the river lays from here east northeast.

Diagram

At 250 steps at the head of a ravine running north northeast line goes along the western edge of it on ridge. Close ahead is the quarter post, 50 steps. The high knob on the river by Bancrofts is from the quarterpost running easterly. Line continues from quarter post up and down across the head of numerous ravines directed to the main creek. 221 steps from quarter post brisk descent into the large creek. 346 steps from quarter post large granite rocks at the spot. Creek considerable in size.

Paragraph in German

Followed east line between sections 6 and 7 T.48, R.25 from corner over the plateau of the highlands. At 100 steps beyond quarter post we descend briskly from the high terrace unto a lower one. Line leads unto small knobs of granite with some schistose layers. On one of the knobs the high granite ridges are rising 250 or 300 steps north of the section line. All these lands are cleared and low asps grown up again. Nearly all traces of the linear survey are extinguished.

Tuesday Sept. 3. On New Vermont Street a small knob of diorite partly massive, partly distinctly laminated without a demarcation of one kind from another. Bands of quartzose ferruginous schists run parallel with it. A dyke of about 12 to 18 inches thickness crosses it in an irregular zigzag course. Dyke material black basalt-like.

Diagram

Messages of German.

Wednesday Sept. 5. On slate hill next to Washington Street, 40 acres west of cemetery a dyke cutting through slate in north northeast and south southwest direction. Some granitoid layers also intersected. Seams of Epidote within the dyke mass. On hill in Sec. 3, southeast $\frac{1}{4}$ of Southeast $\frac{1}{4}$ red granite and a at least 70 feet thick mass of dioritic rock joining it with a strike from northeast to southwest. On the other side of the diorite (south side). The granite has a little different appearance from the one on north side. 2 specimens on hill on line on northeast of northeast of S. 10. Diorite besides granite of which no specimens taken.

Hill 144 steps beyond quarter post granite and dioritic massive rock forming a rounded dome. Specimen marked 7 (or 1) from there. Further on the line we come over a large granite hill part of a cluster of knobs on which granite is frequently found pervaded by dykes parallel and intersecting. The rock in the central portions of the large dykes is coarsely crystalline.

220 steps from corner southwest on foot rise high granite knobs. On the opposite (of) the line

Saturday Sept. 8. To Riedingers slaughterhouse. A small granitic knob close to it intersected by a 15 feet wide dyke running north and south. Knob about 15 feet high. In north northeast direction from slaughterhouse are other larger knobs of the same low height which strike from east to west and are composed of a very thick mass of dioritic rock partly non-stratified partly with somewhat laminated seams of dioritic rock. On the north side, this diorite is joined by granite. Parallel from here the lake is visible in close vicinity.

From here west we find other granite knobs, at the quarter post directly in the strike of the former. A swamp south of quarterpost connected with the river by a slough. From there on line northward unto the river we come across numerous knobs of granite about 20 feet high. On one of them a seam of about 3 feet wide of a ferruginous sub-stratified rock with seams of talcose schists run apparently parallel with the granite on both sides (southwest to northeast). The granite is principally represented by a diorite-like rock which is pervaded by irregular seams of a red arsenite-like mineral, by epidote veins with quartz and chlorite. This granite composes several hills exclusively.

In others the usual form of red granite is seen. Towards the Powder mill along the river the granite outcrops continue and there the granite is of a schistose easy decaying nature of light whitish red color with greenish talcose slate seams pervading the mass and inducing its easy decay. The knobs along the river are scarcely noticeable from distance on account of their low elevation, not much distinct from the general level. Granite range highest in northwest $\frac{1}{4}$ of Sec. 10. At the south, schistose weathering granite. To this follows a 50 feet wide belt of black diorite rock which composes one of the larger knobs entirely. On the north side of this belt again granite. The hill marked with X is this diorite hill. From $\frac{1}{4}$ post 250 steps due north strike the road which then runs west.

Monday Sept. 10. 11 boxes specimens turned over to Spear.

After noon

Midday I went to Pardridge Island with sail boat. Landed first on island east of headland with a dyke of 3 feet intersecting the granite in north northeast direction which is highly magnetic. Other dykes of very great thickness and of very irregular course with a sort of laminated structure like the granite pervade the granite. They are of coarsely crystalline dioritic character and connect with the granite in serpentine bands such corrugated in their substance and enclosing loosened fragments of the granite.

The island I call Magnetic Island. It is about 75 feet high. The headland of the main shore is composed of similar rocks which reach an elevation of about 100 feet. We camped at the foot of the rocks. Granite in north east corner of Sec. 4 pervaded in east and west direction by several 3 to 5 feet thick veins of magnetic-talcose schists.

Pardridge Island on west side at our landing place a diorite dyke and along shore northward within a short space 3 others of about the same lithological character and from 6 to 8 feet wide. In one I see a granite layer parted and dip 7 rock run in the cracks separating the granite fragments corresponding to the fracture.

Diagram

Dyke on Pardridge Island which is identical with the magnetic dykes mentioned before is intersecting the granite and the same time the black basalt like dykes consequently is of younger date.

Diagram

It contains asbestos and calcosper with quartz and chlorite. From a large 50 feet wide dyke of dioritic rock. 1 specimen in contact with granite almost aphanitic is marked A. The specimen from centre of dyke coarsely crystalline is marked B.

Ascended Sugar Loaf. Then to Sec. corner between 30 and 29 followed line west 740 steps from corner over granite knobs. Before the line leads over the low grounds of a valley but no flowing creek in it. From 740 to 900 again swamp. The quarter post stands again on a low granite knob. 66 steps from quarter post we cross a creek running northwest and southeast.

444 steps from quarter post we have the foot of the large hill to our left close by. At a $\frac{1}{4}$ of a mile we begin to ascend the hill. The corner is on top of it. From there we followed the line southward and came unto the top of a much higher hill at a distance of about 400 steps. This is decidedly the highest portion in the country. The knobs strike from southwest to northeast and the main body of the high ridge is nearly $\frac{1}{2}$ mile long. The height must be near 600 feet. Descending on the eastern slope we come $\frac{1}{8}$ mile from top to a creek running north northwest.

Friday. Followed from corner on road line south. At 400 steps across low swampy ground ascension of a low granite knoll. At 530 steps across and in a swamp. At 625 ascending another chain of knolls extending east towards the road and westward. 688 again at swamp. 820 at foot of granite knoll with basaltic diorite dyke. 876 descent. At 900 on another knoll and knolls visible all round in every direction.

A high hill in front which is probably the knoll near section corner. The line leads apparently through a valley between two other knolls to it and crosses the foot of one of them. The knolls at the supposed vicinity of quarterpost extend nearly half a mile westward and also eastward to Sugar Loaf which is situated about north-east. Line very obscure continually over granite knobs. The corner is not clearly preserved but I have little doubt of its correct recognition. It is on the lower part of the hill declivity towards a creek (dry) which evidently comes from the Hawkback Mountain northwest to southeast. Follow now the valley, knobs constantly continue on left side. On right side is a small isolated knob probably the one indicated on the map.

Diagram

Granite intersected by frequent basalt dykes of various thickness and direction. After less than a quarter of a miles walk the valley joins the valley of Campos Creek which is struck by the old wood road leading down from the section corner. Campos Creek runs from here nearly due east. High granite bluffs on both sides of the valley which is about $\frac{1}{4}$ of a mile wide.

The road (footpath) leads close along the perpendicular bluff on north side of creek. Then after a few 100 steps crosses the bluff. Continues for some distance eastward in all about $\frac{1}{2}$ mile close along the north side of creek. The road leads now to a farm and coal kilns both on south side of creek which keeps close to foot of granite knobs on northside. 6 coal kilns. East from them no more hills seen in that direction from the valley. But an outcrop of diorite close by. The most easterly one forms a low round knob surrounded by swamp. The diorite is joined by granite and both are intersected by one of the basalt like dykes. Specimens are preserved but it is difficult to distinguish between the diorite and the dyke stone.

At this knob the creek bends to the southeast and the road goes on its northern side. It crosses the creek close by the knob on dry level ground but through the bushes. On the left side at a distance low granite cliffs can be noticed. Road turns now northeast over a drift covered rounded elevation which continues to the shore and strikes there Harlows Road.

The cliffs along the shore are much lower than this drift plateau. Above them only as far as the outlines of the Sugar Loaf go, the shore mountains and cliffs are higher.

Tuesday Sept. Starting from margin of river bluff on section line near Collinsville north 443 steps we are at the beginning of an incline towards the creek intervening between this high drift plateau and the northerly situated rocky hill range. No trace of surveyors marks to be found except at the bluff from which we started.

At the supposed corner of the last 40 acres lot south of corner of Section we are at a creek running eastward. Right opposite the creek briskly ascends a granite knob about 60 feet high. The granite is adjoined by a thick belt of schistose dioritic rock. See specimens.

Diagram

On a hill forming a higher north range in which I suppose the corner situated, the granite is intersected by two kinds of dykes of which one seems to intersect the other. The larger dyke is about 7 feet wide. Contains a bluish green fine grained rock (brittle) and the dyke mass incloses fragments of growth. The other one which seems to be the older intersected dyke is of darker color and of very tough micaceous character only about 2 or 3 feet wide coarser crystalline grain than the other. Of both are specimens marked Northwest corner of Sec. 9, T. 48, R. 25. Also an asbestine schist is found in the vicinity of the latter mentioned dyke and seems to make part of it.

In southwest quarter of southeast quarter of Sec. 4, granite knobs forming the sides of Campo Creek valley. At their foot is a strip of level land not quite a quarter of a mile wide extending to the bed of creek. The granite is adjoined by large bulky domelike protrusion of dioritic rock of which specimen is preserved. Specimen of massive diorite north half of northeast quarter of Sec. 9 forms a very massive bulky round knob joined by granite and breaking through it separates frequently in hexagonal basalt-like columns. The portions in contact with granite are less crystalline in structure.

Wednesday Sept. 20. Swamp from little lake on Powder Mill Road extends in a continuous streak across the road to quarter post on the section line between 10 and 3. From quarter post to bridge 68 steps. The rocks are principally on the northside of the quarter post. 175 steps to edge of embankment of Gattle (Castle) lake line intersects the lake. We went to the opposite side of the lake to line which point may be about 400 steps from the quarter post, perhaps a little over. From there we went over the crest of granite knobs due west, crossing narrow dyke, several feet of micaceous tough diorite dyke drift running almost north and south.

Close west of it is another very massive dioritic protrusion through the granite 45 feet wide. southwest to northeast strike. Specimen of dyke and granite also specimen of dyke and granite specimen marked dyke second.

Other specimen of coarse grained dyke marked dyke third. The outside of it touching granite is amorphous. This dyke and knob is 200 steps west of the section line. At 253 steps strike the road leading southwest. All level. No more knobs in that direction. West direction crosses the road but strikes it again at 500 steps distance.

On this interval a few small rock outcrops seen to the southhand side, generally level ground. 720 steps from line we strike again a granite knob and from there westwards the low granite knobs continues until we meet the road again at 1057 steps.

At 220 from the 1000 on small granite knob a northern prolongation of a larger hill south. 166 steps from this last knob we are on another similar knob and descend again. North of us low lands. On south side the valley of a small creek seems to be. At 220 swamp. At 480 steps we are across swamp and at the north declivity of another granite knob not very high.

100 steps westerly from the supposed section line between 4 and 5 we have a large field of rocky knobs before us which extend for about half a mile further and also northward toward the bed of the creek. On hill crossed by the section line between 4 and 5 a large dyke 40 feet wide in granite. Outer portions aphanitic, inner portions finely crystalline with white feldspar crystals. See specimens of both kinds. Dyke runs southwest to northeast.

Another similarly heavy dyke but with somewhat different rock is seen running in nearly the same direction only separated by a band of granite about 20 or 25 feet thick. (German) Translation. We follow now the line that we started on in the beginning further westerly.

$\frac{1}{4}$ mile west of section line we are on a tolerably high knob totally composed of diorite of the kind represented by dyke 4 with white feldspar crystals. North and south is granite. On north side a valley or deep ravine separates those hills from the main high range of Bancrofts Hills.

Thursday Sept. 21. On high near railroad at Bruce Station well stratified drift sand beds. From Morgan Station on road to crossing on Sec. line between 25 and 26 of Morgan Township. From railroad the line passes the foot of a dioritic slate hill runs across a small ravine like valley with east and west direction which opens into a ditch formerly in direct connection with the lake but interrupted by railroad dam.

Going north a very high knob is crossed by the line which on the side is formed by slaty rock with frequent pea-like concretions. The top is a massive diorite rock. The hill extends nearly due east and west and is at least $\frac{1}{2}$ mile long. Sighting from here the line strikes short interval west of the upper Morgan kilns. About $\frac{1}{3}$ of the distance between kilns and furnace the high diorite knob is about 100 feet above the railroad. Specimens from slate and diorite.

1. German paragraph. See Translation Page 1, paragraph 1.

A blockhouse stands right on the line. From blockhouse we descend into a wide level marshy place. A small knob on the east side somewhere near the position of the supposed corner.

2. German paragraph See Translation Page 1, paragraph 2

200 steps before reaching the section line which is on a clearing of the edge of the high plateau we turn due west towards a high ridge. At 615 steps sighting south we see at the distance of about $\frac{1}{2}$ of a mile a diorite knob about 30 or 40 feet high. At 1750 steps from line we strike the first rock forming foot of high hill. Rock is granite. The high part of hill must be crossed by section line between 22 and 23. We found it afterwards verified. The direction of the range is from northwest to southeast. The elevation must be the greatest of all the hills in this and the other township. Marquette is due east from the hill. Granite specimen from dyke, Sec. 23, T. 48, R. 26. Dyke very much denuded into many side branches. Rock mass very light colored.

Saturday Sept. 22. Morgan Station. From place where section line crosses the railroad and lake to creek coming from a west northwest direction 293 steps. From there to smaller creek 425 steps along track of road.

Diagram

185 steps east of smaller creek the road makes a small cut through rocks. 100 steps west of this creek another cut. Looking towards Morgan schoolhouse, that building is only 6 or 8 degrees west of the line. Road from bend in straight direction northeast and southwest to station. From little creek to Station dwelling house 320 steps. The schoolhouse is from there in east southeast direction looking to Eagle Mills. The road runs 35 degrees west of south.

160 steps from Station house the road is close passing the south edge of the drift bluff towards Morgan valley, making then a cut through drift for about $\frac{1}{4}$ of a mile. At 975, passes from Station house, the coal tram road crosses railroad, end of drift cut. Tram road runs from railroad 60 degrees west of north. 392 steps from railroad a creek running 32 degrees west of south, swamp. 800 steps from railroad the tram road strikes the foot of hills. Hill range from there to Eagle Mills striking nearly due north and south.

From tram road to railroad track at Eagle mills on footpath running nearly north and south 1250 steps. The creek and lake remain east of that footpath and the mill is west of the lake. Lake on south side of road along railroad. 2200 steps from depot to Eagle Mill.

Eagle Mills north half of the southeast quarter of Sec. 34. The fence behind the mill is the centre line of Sec. 34. The east fence of the mill property close to Lake is on the north and south line. The quarterpost is in the little lake. The corner northward is this side the tram road in the level land.

German paragraph. See Translation page 1, paragraph 3.

Starting from tramroad about 120 steps east of creek on north northeast direction we strike the foot of diorite knobs at 425 steps. All the land from here to Morgan Station and over to Carp River an almost perfect level. From railroad over tram road to middle of bridge 747 steps. To the opposite embankment of ravine at old railroad track 785 steps. Direction from road to that place 57 degrees west of north. From tramroad bridge 150 steps towards furnace on old railroad when we are at the edge of the bluff on north side of us. To furnace 700 steps. Stable of Furnace on line east and west 1687 feet east of quarter section corner. From stable directly north we strike the bluffs and creek at the railroad at 800 steps right at the easterly small cut of the road.

Monday Sept. 24. A dyke 10 feet wide runs with the strike of the diorite formation (east and west). The rock is magnetic, the wall rock diorite sub-schistose. The hill is situated in the southeast corner of Sec. 24, T. 43, R. 26.

Schweitzers Mill. Creek for at least $\frac{1}{2}$ mile has an almost eastern course a little to the southward. Short distance above mill a pond and above that swamp valley, high diorite hills on both sides. $\frac{1}{4}$ of a mile east of mill we are at the foot of the high bluff to our left, more accurately at 700 steps. From here the creek bends more north of east. The creek runs from the mill pond about straight 10 degrees south of east to railroad dam.

From line where it crosses tramroad in west northwest direction about 600 steps to a farmhouse of Williams in Sec. 27. From there a road we follow north northeast direction for 28 steps. Thence due north at 110 steps crossing of a creek which is the same as found crossing the line. Creek runs eastward. At 288 steps on high of a drift hill. From there due north 424 steps across a high plateau when we strike a road running east northeast. From there 372 steps further we are at the edge of the plateau on the embankment of creek having an east direction. From thence 200 passes due east along edge of embankment then crossing a ravine the northern side of the creek is lined with rock bluffs.

The pond at Schweitzers Mill is about 100 steps westward crossed by the north and south section line. The mill stood 330 steps east of the section line. The high bluff of the second range is there direct north of us. We follow now the line northward from the crossing of line of the creek to hill top, 146 steps from there to rock bluffs on line only about 30 or 40 feet higher. 180 steps from creek. The rocks extend westward about 130 steps when a declivity towards a creek coming from a northern direction it reaches.

435 steps from creek on line we have descended into a depression covered with fine hardwood. At about 500 steps from creek we struck an east and west line on a clearing and there it is supposed the section corner was. 225 along this west line it runs over a diorite hill which is separated from the hills over which the north line runs by a small ravine.

Following east line for 252 steps we are in a low level space like the valley of a large creek. No creek seen yet. At 395 we pass along a side of hill on right side. On left side the creek is visible descending eastward. At 500 steps we are nearly on the high of dioritic schist hill, creek right below us on left hand.

240 steps from $\frac{1}{4}$ mile post we have descended into a ravine on its divide where on the northside a brisk descent is, on the southside the descent is slower. The coal kilns are seen in almost northerly direction. We now descend in a ravine running with the line and come to a small clearing where we suppose the quarter post to be. At 600 passes we are on the road coming from the kilns which we traveled over the day previous. The water of the ravine we came down runs from here down to Schweitzers Mill.

From road 600 steps east of corner traveling in northeast direction the kilns are struck at a distance of about 1000 steps. At adit of 300 steps. Sighting northwest the high granite rocks on the north side of the Dead River tributary are situated. About 100 steps east of this stand point a few small granite knobs. The road towards the kilns bends now north northwest.

250 steps due west of kilns a round isolated granite knob on south side of creek here a branch enters the creek from the south side.

Diagram

German paragraph

Schweitzers mill is situated in the south $\frac{1}{2}$ of N W $\frac{1}{4}$ of Sec. 26, T. 48, R. 26 and N.E. $\frac{1}{4}$ of S.E. $\frac{1}{4}$ of same section. All the connectioned (?) property. Mill spot situated 28 rod east of west section line and about the same distance on north line of south half. High bluff on little Carp is in N W. of S.E. $\frac{1}{4}$ of Sec. 26.

Wednesday Sept. 26. From schoolhouse of Morgan to line assuming the edge of bluff to be 100 steps north of corner went 400 steps further north on line. Then 500 steps east from there. At 375 steps we have ascended a foot hill and about 25 steps north of our course a quartz vein in diorite rock contains iron and copper pyrites, besides carbonate of iron, chlorite ectr.

After 500 steps east we turn north 100 steps to strike the foot of high hill, ascending now in the same direction 125 steps more we have nearly reached the top of part on the west slope of hill. From there 185 steps east bring us to the end of the high part of the knoll to our right. A ravine has been running parallel with our course and on the opposite side of ravine another high knoll extends still further east. The rock is diorite of massive fine grained character and light greenish, on south declivity of schistose slaty character.

110 steps further east brings us across the ravine unto the east end of the other knoll but its highest point lies to our right which we ascend now. From here the mountain continues until it strikes the Negaunee state road, but the ridge is about 100 feet lower than the part on which we previously traveled.

We now go north leaving the south margin of the rock ridge. We traverse a small swampy place and are at the foot of next hill. At 140 steps we cross its western end and are in a depression running westward. At 214 steps crossing undulating rock ridges all running east and west and intersected by cross ravines we are at the summit of the main ridge. At 382 steps, now then proceeding over a comparative gentle depression and then swell again. At 516 steps we begin to descend into a valley running northwestward. The bottom of valley is at 616 steps. A divide seems to exist there as in east direction the valley continues with an incline eastward.

At 664 steps we are again at the foot of a hill composed of slaty rock. See specimen. Southeast $\frac{1}{4}$ of northeast $\frac{1}{4}$ of Sec. 25, T. 48, R. 26. At 736 steps on brink of a deep valley at 785 steps reach bottom of valley. At 1000 steps we are at the foot of a high hill. The valley runs east and west. At our crossing point the decline of it is to the west. East of us is the lake which has its outlet eastward. The divide is on this valley. 1080 steps on top of almost perpendicular hill side. At 1128 steps on brink of other declivity.

We see from there the railroad right below us. The descent taking now a north-westerly direction to the end of the gorge, goes over no more hills. We descend into a valley which runs behind the gorge hills towards the lake on Little Carp River valley.

Diagram