

Notebook No. 207 - LEVERETT

COUNTY

Alger: 3, 14-15, 63

Chippewa: 54, 55, 56, 57

Chippewa Co. - Drummond Island: 55, 56

Delta: 49-50, 51, 62

Dickinson: 61-62

Mackinac: 54, 55, 56, 57

Marquette: 1-14, 15-49, 50, 51, 52-53, 54, 57-61, 62, 63-64

Menominee: 50, 51, 52, 53-54

Schoolcraft: 45

I N D E X  
t o  
N O T E B O O K N O . 2 0 7

(October 6 to October 28, 1905)

- October 6. Marquette to Sands and back. Deep wells near Sands.
- October 7. Marquette to Yalmer and east over the calciferous escarpment and north to Sand River and Gordon.
- October 8. Sunday. Striae in Marquette (views), Presque Isle.
- October 9. Drive Marquette to Harvey, Silver Creek, Sands, Swanzy, Little Lake and Carlshend.
- October 10. Carlshend to Trenary and back and north to Skandia and Marquette. Altitudes.
- October 11. Walk from Marquette up D.S.S. and A. railroad track and along moraine to Van Iderstein siding and back via Forestville to Marquette.
- October 12. Walk southwest from Marquette to see Taylor's high shore line in Section 30, and on to Morgan Furnace and back via Mud Lake. Striae south part of Marquette, also southwest part of city.
- October 13. Drive, Marquette to Saux Head and back.
- October 14. Rail, Marquette to Eagle Mills and southeast to Pelesier Lake and back to Marquette. Altitudes on L.S. and I. railroad.
- October 15. Sunday.
- October 16. Drive with Geo. P. Cummings to Forestville and up Dead River, south to Ishpeming and back through Negaunee and Eagle Mills to Marquette. Striae.
- October 17. Marquette, Eagle Mills northwest to Baldwin Plains and then south to Negaunee and back to Marquette.
- October 18. Notes around Marquette and the Penitentiary.
- October 19. Drive northwest past Forestville to Rainy Creek and granite ledges and back.
- October 20. Marquette, at U. S. Land Office.
- October 21. Striae near Marquette Hotel and near Hewitt Avenue. Notes on Land Survey plats. Waterworks supply at Marquette.
- October 22. Striae, Front and Ohio Streets, S15<sup>0</sup>W. Trip northwest from Presque Isle and back on foot. Sunday.

- October 23. Beaches south of Marquette, on Poor Farm.
- October 24. Marquette, at U. S. Land Survey Office.
- October 25. Marquette to Negaunee and return, by rail. At U. S. Land Survey Office. Notes on land Survey plats.
- October 26. At U. S. Land Survey Office in Marquette. Notes on Land Survey plats.
- October 27. Notes from County Clerk, Mark Elliott.
- October 28. Marquette to Negaunee, Swanzey, Princeton mine. Camp in northeast part of Dickinson County.

October 6, 1905, 7:30 a.m.

Aneroid 29.820 at Lake Superior level = 602 feet A.T.; 29.740 at top of Parquette sandstone at quarry in south part of city = 675-680 feet A.T. bench mark on bridge 10 rods west is 671 feet.

We take new road toward Sands, following up the D.S.S. and A. track for a couple of miles. Aneroid 29.550 at a summit on east side of creek reading 855 feet by U.S.G.S. levels; 29.640 at Carp River bridge = 782 feet at 8:00 a.m. Water level is 774 feet A.T. by U.S.G.S. levels. This is in southwest part Section 34, T.48N., R.25W. Aneroid 29.335 at 1,066-foot U.S.G.S. mark on road near center Section 3, T.47N., R.25W; 29.170 at top of a rock ridge = 1,200 feet to 1210 feet at 8:30 a.m. Mr. Gordon's aneroid reads 1,195 feet here. There is a slate rock at top of mountain which has a ragged, rough surface. This is not more than 40 rods from the wagon road. Aneroid 29.300 at a U.S.G.S. mark, 1,081 feet, in road 40 rods south of top of this rock hill; 29.290 = 1,090 feet on a plain south of the rock ledges 60 rods south of top of high rock hill. The drift here is full of boulders and cobblestones and is gullied considerably but seems to have been built up to this general level. South of it is a rock range 1,100-1,150 feet A.T. Aneroid 29.280 at summit where road turns south in a cut 15-20 feet. A U.S.G.S. level near here, 8 feet lower, is marked 1,092. This is in southwest corner of NW $\frac{1}{4}$  of SE $\frac{1}{4}$  Section 3, T.47N., R.25W. Aneroid 29.250 = 1,130 feet at a summit in SE $\frac{1}{4}$  of SW $\frac{1}{4}$  Section 3 where road changes from a southwest to a southward course. Aneroid 29.270 on plain a few rods south near section corner. There are rock hills east of road for a short distance into Section 10.

We pass a hill on west side of road that is 1,175 feet  $\pm$ , aneroid 29.190 at top. I find no rock on its slope or crest, but am told there is some near west edge. Aneroid 29.260 on road east side of this hill = 1,115 feet A.T.

This hill is 40-50 rods long and very steep on east side. It is less steep to the west and drops off in lower knolls southwest to Pelesier Lake in Section 9 which is about 100 rods southwest from its south end and lies west of it also. Aneroid 29.250 on a sand plain at south end of Pelesier Lake in NE $\frac{1}{4}$  of NE $\frac{1}{4}$  Section 16 = 1,125 feet A.T. This is the level of Pelesier Lake.

Rock hills occur in north part of NW $\frac{1}{4}$  Section 16 and run north into Section 9, reading 1,400 feet A.T. There are hills of drift in SW $\frac{1}{4}$  Section 16 and the SW $\frac{1}{4}$  of SE $\frac{1}{4}$  Section 16 that rise about to 1,280 feet A.T., aneroid 29.070. This is on a sharp ridge, narrow as an esker, but associated with others in a plexus that is probably morainic. There are several sharp spurs running north from this high tract, each as sharp as an esker, but the tract at south end of the spurs is gently undulating and stands 1,250 to 1,265 feet A.T. Mr. Gordon makes the highest points 1,290 feet where I read 1,280 feet.

Between these drift hills and the rock hills to the north is a plain standing about 1,170 feet A.T., aneroid 29.200. It is 1/4-1/2 mile wide and runs northwest along the course of the wagon road in Section 8. On this plain and on the moraine south of it there are cobblestones, but boulders are rare. This plain rises like a bluff 20-30 feet above the plain that lies south of Pelesier Lake in northeast part of Section 16. There is a wide stretch of plains to the east from here at about the altitude of Pelesier Lake.

Aneroid 29.190 at foot of rock ledges in north part of NW $\frac{1}{4}$  Section 16; 29.060 at top = 1,300 feet A.T. Hills 60 rods northwest are 50-75 feet higher with bare rock at top. The rock is granite. There are high ranges of hills southwest and west from here for several miles standing about 1,300

feet A.T. The bluff in west part of Section 17 is a rock bluff. Mr. Pelesier says he has seen no bare ledges in Sections 20, 21 and 28.

Ed Frazier made a well at an old camp in NW $\frac{1}{4}$  Section 21 to depth of 190 feet and struck only gravel and sand. It is on a hill 1,280 feet  $\pm$  A.T.

John Gillett made a well in NE $\frac{1}{4}$  Section 20, 75 feet through sand and got no water.

Aneroid 29,070 at residence in southwest part of Section 16 on the moraine. An open well here has water standing within 10 feet of top of well. It is shallow and fed by surface supplies.

There are boulders on the knolls in this vicinity. The moraine covers the northeast quarter of Section 20 and a little of the NW $\frac{1}{4}$ . The southwest half of Section 20 is on a plain. There is a narrow remnant of the original outwash apron on the edge of the moraine standing about 1,290 feet A.T., aneroid 29,070. There has been erosion of this plain and a branch lower plain, aneroid 29,100, extends west to hills in Section 19--the range that runs northeast through Section 18 and west edge of Section 17.

At the crossroads in west part of Section 19 another drop of 15-20 feet is made to a plain that extends to the base of the rock hills in northwest part of Section 19. We take a road south on the first plain below outwash apron and find it has basins in it 15-25 feet deep. Near Gention switch the C. and N. W. rises to the outwash apron and so does this wagon road, aneroid 29,070 = 1,235 feet.

Near the township line a swale heads in the outwash apron and leads south along east side of C. and N. W. railroad. Its bed is cobbly and gravelly while the surface of the outwash apron is a sandy gravel. This swale is 1/4 mile wide. It runs southeast to the lake in Section 8, T.46N., R.25W. West of this lake are rock hills 75-100 feet high with granite-like that to the north of the moraine. This rock continues southeast along the

C. and N. W. railroad past Sands Station low bosses being present on the east side of track.

Aneroid 29.110 at Station at 12:30 p.m. = 1,202 feet. The rock extends no further south than here at Sands on the east side of Escanaba River but follows down the west side the river several miles. There is granite in southwest corner of T.46N., R.24W, Sections 31 and 32. From a rock hill 60 rods northwest from the station a view to the north, west and south is obtained that shows the high country with rock hills. To the east and southeast a moraine is visible for several miles. It trends a little more east of south than the C. and N. W. railroad. It is only about a mile east of Sands Station but is 2 or 3 miles east of Plains Station. It is timbered with hardwood as far north as the Sands settlement in Sections 34 and 35, T.47N., R.25W. The moraine has a general relief of 25-50 feet on its outer border above the edge of the outwash apron.

I can see distant hills east of the C. and N. W. track. They are very prominent and seem to be isolated. The distance to them seems likely to be 15 miles or more. There are also high points west of the railroad about as far south. From here these high points look to be isolated hills.

The rock bosses around Sands Station are rubbed very smooth at surface by glacial action but I cannot find striae. The ridges show, in places, folds that are quite intricate on surfaces only 3 or 4 yards square.

Aneroid 29.050, 1,202 feet, at Sands Station at 2:50 p.m. where it read 29.110 at 12:30 p.m.; 29.030 at middle of line Sections 11 and 14 on a strong part of the moraine = 1,220 feet. The border is 3/4 mile southwest from here and I cannot see to the northeast edge. There are swells 10-30 feet high and the surface is all wavy. Granite boulders are numerous and generally are rounded. These are 1 to 6 feet  $\pm$  in diameter. The surface

is a sandy loam but the road gradings show clay of reddish color under it at 2-4 feet deep. The soil is very productive and several square miles of the moraine are under cultivation. It is not timbered with hardwood clear to the outer border, there being a little jack pine on the edge for 1/4-1/2 mile from the outwash apron. The outwash apron is nearly all timbered with jack pine from Section 19, T.47N., R.25W., south to the vicinity of Little Lake, in T.45N., R.24W. From the moraine in north part of Section 11 the calciferous escarpment east of Yalmer and Skandia is in plain view. It seems to take a turn to the east within a mile north from a line running east from here or on the north edge of T.46N., R.23W.

Some deep wells 100 feet or more in depth have been made. Barney Goodman has one 135 feet deep--probably in Section 14.

There is a very broken country in sections 1 and 12, T.46N., R.25W., with knolls and ridges 50-75 feet or more above sags among them. They have a lighter sand than the sandy, gravelly loam that caps the clay in sections 11 and 14. The altitude of the highest points on this broken tract is not much greater, if any, than the knolls in sections 11 and 14. The highest points on the moraine seem to be only 30-40 feet higher than Sands Station, or 1,230 to 1,240 feet A.T.

James Kindlin has a well in Section 35, T.47N., R.25W., (southwest corner) 184 feet deep. It was mainly sand. There was a little slaty material near the bottom. There is 20 feet of water--made in 1903. S. C. Miller, near center of SW $\frac{1}{4}$  Section 35, has a well 205 feet with a hard crust near bottom (at 186 feet). It was mainly sand. There is only 14 feet of water. Made in 1904. Both wells have 3-inch casing. The ground is 15 feet higher at Miller's than at Kindlin's. Aneroid 29.000 at Miller's = 1,200 feet  $\pm$ ; 29.020 at Kindlin's at 3:20 p.m. = 1,185 feet.

Aneroid 29.140 on a lower sand plain in Section 27 at 3:40 p.m. = 1,065 feet  $\pm$ ; 29.150 at edge of bouldery tract (4:20 p.m.) probably near southwest corner Section 14 where road turns more to the east. Altitude 1,055-1060 feet. There is a very steep descent of over 100 feet through this bouldery tract. Aneroid 29.270 at foot of steep descent; 29.370 at a stream 1/2 mile farther, perhaps near center of Section 14; 29.500 at a stream tributary to Silver Creek near corners sections 11, 12, 13 and 14 = 715 feet  $\pm$ ; 29.560 at Silver Creek in Section 12. There is a lowland 1/4 mile  $\pm$  wide extending up this creek across Section 12. It heads abruptly at the southwest as if the lake had an arm running up there. The head is about the same as the reading in southwest corner of section, 29.500 or 715 feet A.T.

Aneroid 29.600 at Harvey Station = 625-630 A.T. at 5:15 p.m. (same as Chocolay Station). There is more or less bouldery material on the hills all the way from Section 14, T.47N., R.25W., down to Harvey. The drift is loose-textured at top, generally sand without much loam, yet the soil seems a little richer than it is on the jack pine plains and the stump land.

The outwash apron between the moraines in the central part of T.47N., R.25W., was timbered largely with pine of good size for lumbering, only a little of it being jack pine--but in the outwash apron outside the western moraine there is little besides jack pine.

October 7, 1905, 7:00 a.m.

Aneroid 29.400 at Lake Superior here = 602 feet in Marquette; 29.350 = 625 feet at 8:00 a.m. at Harvey Station, or a barometric weather change of 0.020 inch in an hour. Wind from south blowing a gale. Aneroid 29.350 at Chocolay River at Mangum at 8:10 a.m.; 29.345 at Mangum Station at 8:15 a.m. = 630 feet. This is near Mile Post 13.

Out 1/4 mile south has a few feet of bouldery till of red color capping a

fine sand. The till thickens southward. Cuts 1/2 mile south, just north of wagon road, are 15-20 feet and nearly all till. There is sand, however, in the ravines. Aneroid 29.290 at mile post 14 a few rods north of wagon road at 8:25 a.m. = 685 feet ±; 29.280 on plain 1/4 mile farther south where road curves toward the southeast. Reddish, sandy till here. A cut 1/4 mile farther is nearly all sand but has a few boulders in it.

Aneroid 29.250 = 710 feet ± at Mile Post 15 (12 from Lawson) at 8:35 a.m. Surface is very flat for 1 1/2 miles farther southeast along railroad; soil is a gravelly sand and boulders are not rare. Aneroid 29.220 = 745 feet ± at Mile Post 16 (11 from Lawson) at 8:50 a.m.; 29.185 at Mile Post 17 (10 from Lawson) at 9:10 a.m. The sand ridge thought to be a beach is about 1/3 mile southeast or about halfway to Yalmer Station. Aneroid 29.170 = 791 feet ± on the beach at 9:20 a.m. I follow it northeast far enough to determine that it leads in that direction. It leads nearer north than a due northeast course. Mr. Gordon followed it southwest to where it crosses the road west of Yalmer about 1/3 mile (600 paces). It is a cobble beach with a large amount of Potsdam sandstone pebbles in it. Width is 10-15 rods; height, 6-10 feet. There is a cedar swamp each side.

Aneroid 29.150 at Yalmer at 9:40 a.m. = 809 feet. There is a cut 1/4 mile long 1/4-1/2 mile southeast of Yalmer mainly in a red till. The top of the cut is about 30 feet above Yalmer Station and the track, 15-20 feet at Mile Post 18 (9 from Lawson). Aneroid 29.125 at Mile Post 18 at 10:00 a.m. = 840 feet. The north slope has a cobble deposit 2-5 feet deep on it resting on the red till. It is well-rounded like beach material but I am not certain that it is a shore for there is no cut bank on the till ridge but simply this skin coating of waterworn stuff. This runs east 1/2 mile and there breaks up into low knolls of sandy gravel that run north across the road into southwest part of Section 4.

There are numerous sandstone blocks also, but not any outcrops. The altitude remains pretty constant at about 20 feet higher than Yalmer, or 830 feet  $\pm$  the whole length of line of sections 4 and 9, T.46N., R.23W., and surface is flat. The road bears southeast through a cedar swamp in Section 10. Aneroid 29.130 at northwest corner Section 10 at 10:30 a.m.; = 850 feet. The swamp is narrow and the road soon rises near a series of terraces (are they the Algonquin shore lines?) reaching an altitude of 75 feet above Yalmer (Yalmer is 808 feet) before going 1/2 mile from northwest corner of Section 10 at what may prove to be the Upper Algonquin beach, aneroid 29.050 = 883 feet. It is a narrow terrace cut into the high tract lying southeast from it.

Aneroid 28.900 at top of steep hill near center of Section 10 = 1,025 feet  $\pm$ . There is a flat here about 60 rods wide. Aneroid 28.875 at southeast edge of this flat; 28.850 at top of hill 40 rods farther southeast, probably near center of SE $\frac{1}{4}$  Section 10, at 11:00 a.m. = 1,075 feet  $\pm$ . About 1/4 mile farther, after crossing a small cedar swamp, the calciferous formation appears. The falls of Laughing Fish Creek are apparently over the calciferous escarpment. They are near line of Sections 9 and 16, T.46N., R.22W. This tableland has a very flat surface. The corner of sections 10, 11, 14 and 15 is 40-50 rods southeast from where we strike the calciferous blocks of yellowish calcareous rock.

Aneroid 28.825 at a ridge running west-northwest and east-southeast across line of Sections 11 and 14 near middle. This is steep sided like a drumlin on each side. It is 1/2 mile long and about 1/8 mile wide in widest part, and tapers at each end. Aneroid 28.870 at corner sections 11, 12, 13 and 14 at 11:30 a.m.; 28.900 at a farmhouse in southeast part of Section 12, at 11:50 a.m.; 28.885 at 12:15 noon; 29.030 at north edge of hardwood timber near line of sections 1 and 12. The calciferous bluff runs eastward from here.

Aneroid 29.070 in swamp about the town corners at 1:00 p.m.---possibly 1/2

mile south of corners. Aneroid 29,080 at a stream near town corners. There is a rapid descent westward down this stream, a fall of about 100 feet being made in a mile. There are rock-strewn bluffs, and probably sandstone occurs at slight depth. We follow this down to where it turns north and take an old logging road down the valley. The stream has very little swamp along it in T.47N., R.23W., but the bluffs are strewn with sandstone blocks. There is sandstone near surface clear to the D.S.S. and A. tracks in the district west of Sand River as well as east. There is an outcrop on north side of the track near the bend in Section 10 near Mile Post 14.

The sand in sections 10 and 11 extends scarcely 1/8 mile south of the railroad track. South of this, for a mile or more, is a tamarac swamp with blocks of rock at surface. Aneroid 29,300 at north edge of this swamp in Section 10 at 4:15 p.m. This is probably 625 feet A.T.

Aneroid 29,310 at Gordon Station at 5:15 p.m. The well here is 40 feet deep and water does not rise much in pipe. It was driven through sand the whole depth.

October 8, 1905: Marquette, Michigan.

A fine exposure of striated surface at corner of Ridge and North Fifth Streets bearing about 28-29 degrees west of south; altitude 775 feet  $\pm$ ; magnetic bearing Var. 2 degrees east. Also a little farther west on Ridge Street are exposures.

There is a fine roche moutonnee surface of which Mr. Whitman takes a view --facing in the direction of ice movement. The roll of maps is in line with the striae about S35°W. Mr. Whitman is standing on the striated ledge. This is in the NW $\frac{1}{2}$  NW $\frac{1}{4}$  Section 23, T.48N., R.25W. Altitude about 800 feet A.T. Rock is the Huronian slate--with 25' focus for one view. A closer view is taken with only 6-foot focus that brings out glacial grooves nicely. The roll of maps is in line with the grooves. Facing south-southwest is another view.

A third view shows the different rate of weathering of a rock surface. The camera case is just beyond some granite pebbles that stand as pedestals an inch high. The seams are 1/2 inch or more high. This weathered rock is an amphibolite diabase dyke, not so highly metamorphosed as the smooth part. The smooth unweathered rock is a greenstone schist (see specimens).

Facing southwest in line of striae: The granite-like inclusions that stand in relief were mixed in the molten lava, without becoming melted. There is a faulted granite pebble in the upper part of the view, farthest from the instrument. The slip is  $2\frac{1}{2}$  inches. A granite pebble to the left of it shows a furrow around its north end. There is a protected ridge at the southwest end

of the pebble. Direction of ice movement, S28°W magnetic. The dike is younger than the greenstone schist for it has fragments of the schist imbedded in it. The dike is about 4 feet wide and runs the whole length of the exposure--18 paces or about 60 feet. Mr. Gordon says the weathering of the diabase dike is due to its scaling easily parallel to its exposed surface.

I go out to Presque Isle and find near its north end a gravel ridge running east-west that stands about 720 feet A.T. by U.S. topographic map. It is fully 15 feet high and steep-sided on both sides, and its base is above 700-foot contour. North of it is a sharp ridge with bouldery till on it, having fully as great an altitude; and still farther, just south of the north end of driveway is a sharp knoll of bouldery drift 725-730 feet A.T., aneroid 29.285 at top. Aneroid 29.325 at highest point on the driveway north of this hill. We go west to a still higher ridge south of this driveway, aneroid 29.275 at top. Aneroid 29.415 at Lake Superior level.

October 9, 1905, 8:00 a.m.

Aneroid 29,450 at lake level at Harvey Post Office. We go south in sections 7 and 18. There is a flat tract on Silver Creek about 100 rods wide, standing in Section 7, only 20-25 feet above Lake Superior. One on Cherry Creek in Section 18 is fully 50 feet above the lake, aneroid 29,385. This flat is  $\frac{1}{3}$  mile  $\pm$  in width. There are undulating sandy tracts between these creeks and between Cherry Creek and Cedar Creek. Aneroid 29,340 on bluff south of Cherry Creek in Section 18, at Michael Hennessy's. The well here is 65 feet.

There is a flat southeast of Cedar Creek that is much wider and it swings around to the northwest under the range of high morainic hills in Sections 19 and 24, 23 and 14. Its altitude in north part of Section 19 is about 700 feet, aneroid 29,340. Aneroid 29,350 at Massey's Creek near center of Section 19. The high moraine covers the south 40's in Section 19.

Aneroid 29,280 at a house in Section 24 ( $Ne\frac{1}{4}$  of  $SE\frac{1}{4}$ ) on edge of moraine. There is a flat  $\frac{1}{8}$  mile or more wide along Massey's Creek here but it scarcely reaches the north-south quarter line of Section 24.\* We wind up a ravine southward through Section 25. Boulders are very numerous from 975-foot altitude up to the edge of the outwash apron where the aneroid reads 1,050 feet; aneroid 28,950 at 9:30 a.m. There is a plain here  $\frac{1}{2}$  mile wide southwest of which is the high moraine noted October 6, on which the Sands settlement is located. There are boulders for a short distance and a rise to 1,070 feet before the sandy plain is struck. Aneroid 28,920 at foot of high moraine; 28,850 = 1,140 feet on crest of moraine about 100 rods from south end of line sections 35 and 36. There is very rough moraine in Section 1 and neighboring parts of sections

\*The drift here is a loamy sand. There is much higher land south of this road than north in Section 24.

6, 31, and 36.

Aneroid 28.790 = 1,200 feet at S. C. Miller's well at 10:00 a.m. This is 205 feet including the point; 191 feet to water from top of well. The point was drawn down into sand. There was a crust at 186 feet. The pipe is 3-inch. Mr. Miller has a shallow well 18 feet deep. There is a lot of loamy, gravelly material with reddish tinge, though some layers of white sand occur.

Aneroid 28.750 at edge of outwash apron north of Sands Station at 10:45 a.m. = 1,240 feet; 28.790 at Sands Station at 11:00 a.m. = 1,202 feet. We drive southeast along the railway and pass ponds east of the railway  $\frac{1}{4}$ - $\frac{1}{2}$  mile in Section 35, T.46N., R.25W. They are in basins 30 feet or more in depth. In east part of Section 34 there is a swale about 60 rods wide and 20 feet deep running southwest to the Escanaba River which is about a mile distant. Aneroid 28.810 in sag = 1,160 feet  $\pm$ .

Since leaving Sands Station I have seen no rock hills on this side the river rising above the plain. Aneroid 28.800 at Plains Station. About a mile south of Plains the railroad cuts the east end of a sandstone hill with Potsdam sandstone in horizontal beds. Aneroid 28.780 at top of hill. East of this hill is a pond in a ravine. It was enlarged by the railroad embankment. Aneroid 28.855 at level of pond at 12:15 p.m. = 1,100 feet  $\pm$ . There is a terrace  $\frac{1}{3}$  mile  $\pm$  wide bordering this ravine on which aneroid read 28.825 = 1,120 feet  $\pm$ ; railroad is 1,094 feet. This is a line of glacial discharge from a moraine a mile or more northeast from the railroad. The moraine we see is within Chocolay River drainage. Between here and Swanzy is a pitted plain with basins 25-30 feet deep. Aneroid 28.800 at Swanzy at 12:35 p.m. = 1,145 feet  $\pm$ . The pine plains extend west from here four miles to the Escanaba River and south to Little Lake and northeast about  $2\frac{1}{2}$  miles to lakes in West Branch Township.

Aneroid 28.780 at 2:45 p.m. = 1,139 feet; 28.780 at Little Lake Station = 1,123 feet. There are rock hills 60-75 feet both on east end and south side of

Little Lake with sand plain around them. Aneroid 28.750 at edge of moraine northeast of Little Lake 2 miles = 1,170 feet  $\pm$ ; 28.710 = 1,200 feet  $\pm$  at hill back of C. A. Carlson's in Section 9 about 80 rods southeast of center. Aneroid 28.740 at Carlshend at 5:30 p.m. The plains east and north of Little Lake run out to the center of Section 9 and northeast corner of Section 16, and west edge of sections 15 and 22. Farther north the border runs through south and west parts of Section 5 and across northeast corner of Section 6, into Section 31. The moraine is very sharp on its border and in places farther back. A very high point is found in the north part of Section 14 that can be seen from Presque Isle. There is another high rolling tract in Section 22, south of the Munising railroad. This railroad has a gravel pit on its north end, in south part Section 21, 40-50 feet high and the ridge becomes at least 100 feet above the gravel plain about  $\frac{1}{4}$ - $\frac{1}{2}$  mile south of the railroad, or about 1,250 feet A.T. It is apparently a gravelly sand. At its southeast end, probably near corners sections 22, 23, 26 and 27, are sharp knolls 50-100 feet above the plain west of there. We find a smoother tract from Chocolay River east to Carlshend than west of the river.

There is said to be a large swamp near Cyr which shuts off the moraine in that direction. There may be a moraine running east-southeast near corner sections 20, 21, 28 and 29. It is undulating immediately south of Carlshend with swells 10-20 feet high and this is probably the inner edge of the moraine.

Rock is struck at slight depth in the vicinity of Carlshend: One well 80 rods west boring to it at about 10 feet. In the village, wells are 10-13 feet without striking it. Rock outcrops on the slope northwest from Carlshend Station within  $\frac{1}{2}$  mile.

October 10, 1905, 7:00 a.m.

Aneroid 28.680 at Carlshend Station; 28.680 at a sandstone outcrop on the state road about a mile east of station and 1/4 mile east of schoolhouse. This is striated S4°W magnetic or about S6°W corrected. It is a reddish sandstone. The grooves are heavy.

There are several ridges of drumlinoidal form about 2 miles east of Carlshend. They are 20 feet  $\pm$  high and trend north-south. The length is 1/4 mile or more and width about 1/3 as much as length. They have a reddish loamy sandy material where cut by the road. A flat tract is entered east of these ridges on which the aneroid reads 28.750 at a red schoolhouse at corner of sections 10, 11, 14 and 15, T.45N., R.23W., = 1,100 feet  $\pm$ .

There is a nearly plane tract in Section 14 that descends eastward. Aneroid 28.800 = 1,060 feet  $\pm$  near corner sections 13, 14, 23 and 24. There are small knolls in the vicinity of the county line in sections 24 and 25 and Sections 19 and 30.

Aneroid 28.850 at Mr. A. G. Huber's in the NW $\frac{1}{4}$  of Section 30, T.45N., R.22W., = 1,040-1,050 feet. A knoll here is 15-20 feet high and there are numerous knolls to the east in the next clearing in Section 30 on east side of a creek that flows northeast. There is said to be considerable swampy land south of here along Warner Creek. Section 29 is reported to be broken but Whitefish River traverses it.

Aneroid 28.875 at river on the state road at 9:00 a.m. The calciferous formation is exposed in the bed of this stream = 1,020 feet  $\pm$ . There are only low swells 5-15 feet high in northeast side of river for a couple of miles along this state road. Some of these are gravelly sand and esker-like.

Wells in T.44N., R.22W., in north part have rock at 12 feet  $\pm$ --if on flat land. The knolls are only 10-20 feet high. This northwest part is more knolly than the remainder.

Aneroid 28.865 at Whitefish River in Section 29, T.45N., R.22W., at 10:30 a.m. = 1,020 feet  $\pm$ . I am told by woodsman that the rolling land in Section 29 continues on south side of Scotts Creek in Section 28. There are sharp knolls north of the creek in central part of Section 21 and SW $\frac{1}{4}$  Section 22. There is a large amount of swamp in Sections 15, 16, 17, and 20. Aneroid 28.780 at red schoolhouse in northwest corner Section 14 at 11:10 a.m. where it read 28.750 about 8:30 a.m. = 1,100 feet  $\pm$ .

Aneroid 28.750 at Carlshend at 11:45 a.m. = 1,148 feet; 28.690 at Carlshend at 1:00 p.m. = 1,148 feet; 28.725 at Chocolay River on railroad track west of Carlshend = 1,092 feet by profile; 28.510 on hill in north part Section 14, T.45N., R.24W., at 2:00 p.m. = 1,300 feet  $\pm$ ; 28.650 at Carlshend at 2:30 p.m. = 1,148 feet. This hill in Section 14 is probably 145-150 feet above Carlshend Station or nearly 1,300 feet A.T.

Mr. James Gaines outlined the course of the range of hills southeast of Little Lake to Section 20, T.44N., R.23W., the extent of the jack pine plains west and southwest from Little Lake, the extent of the Cyr swamp and of the Helena swamp, through which the C. and N. W. Railroad passes. These swamps are underlaid by sand and seem closely related to the sand of the outwash apron. There is a spur of hills running west across the railroad in north part of T.44N., R.24W., that needs examination before an interpretation can well be made concerning the relation of the swamps to the outwash aprons.

I go north from Carlshend through a nearly plane tract past the township line. Aneroid 28.680 at township line = 1,120 feet; 28.710  $1\frac{1}{2}$  miles north at brow of escarpment = 1,100 feet  $\pm$ . Limestone is exposed in a ravine a short distance south of here near a church. Aneroid 28.850 at foot of escarpment = 960 feet; 28.810 on a ridge  $1/2$  mile southwest of Skandia Station = 1,000 feet  $\pm$ ; 28.930 at Johansen's store west of Skandia at 3:25 p.m. = 875-900 feet. Drift knolls in field southwest are 60 to 70 feet higher, and knolls north

1/4 mile are 50 feet higher. The rock is struck at 20 feet  $\pm$  on the flats among the hills but the hills seem to be drift knolls.

Aneroid 28.980 at Little Lake wagon road two miles west. There are high points about  $1\frac{1}{2}$  miles south and southwest from here, apparently on a level with the calciferous escarpment south of Skandia, but they may be too far west to catch it. Section 15 and the part of Section 14 west of Chocolay River are remarkably flat. Aneroid 29.025 at stream near north end of line sections 14 and 15.

The hummocky land is in Sections 2 and 3 and north part of sections 10 and 11 that I noted a few days ago and supposed to be in south part of sections 10 and 11. There is a large amount of silt and sand in Section 33 and very rough surface. The moraine continues north on west side of Big Creek through sections 28 and 29. Aneroid 29.200 at Big Creek in Section 28 at 4:45 p.m. This has a well-defined terrace 40 feet above the stream. Aneroid 29.250 at Cedar Creek in Section 17 = 630 feet  $\pm$ . Most of the space between Cedar and Cherry creeks is flat sand but there is a narrow ridge on the southeast bluff of Cherry Creek.

The profile of Munising Railroad shows following altitudes:

	<u>A.T.</u>
Little Lake at C. and N.W. Railroad	520 = 1,122'
100 chains east at M.P. 36-37	545 = 1,147'
(flat for 12 chains west)	
Highest point (east surface) in cut by gravel pit, Sec. 15	548 = 1,150'
Muck at M.P. 35-36	surface: 522 = 1,124'
	bottom: 500
Ridge east side of this muck bed	538 = 1,140'
	543 = 1,145'
M.P. 34-35, valley of Chocolay River	490 = 1,092'
Ridge 20 chains west of M.P. 33-34	Natural surface: 520 = 1,122'
M.P. 33-34	Track: 499 = 1,101'
M.P. 32-33	Natural surface: 552 = 1,154'
Carlshend, 5 chains east of M.P. 32-33	Natural surface: 546 = 1,148'
M.P. 31-32	534 = 1,136'
M.P. 31-30	498 = 1,100'
13 chains east (summit)	Natural surface: 509 = 1,111'
M.P. 30-29	499 = 1,101'
Ridge 5 chains west	Natural surface: 509 = 1,111'
Ridge 12 chains east	Natural surface: 511 = 1,113'

M.P. 28-29	491 = 1,093'
M.P. 27-28	461 = 1,063'
M.P. 26-27	444 = 1,046'
Stream at 20 chains west of M.P. 25-26	429 = 1,031'
M.P. 25-26	437 = 1,039'
M.P. 24-25	469 = 1,071'
Summit 20 chains east of M.P. 24-25	483 = 1,085'

The drainage from the pond a mile northwest of Swanzy is both to Chocoday River and Escanaba River--i.e. to Lake Superior and Lake Michigan. This channel in which the pond lies was probably a line of discharge for water from back of the moraine that runs along the northeast border of the outwash apron. The altitude of the pond is probably 1,070 feet A.T. or more. The plain or main bed of channel is 1,094 feet where crossed by C. and N.W. Railroad.

October 11, 1905, 8:00 a.m.

Aneroid 29.035 = 774 feet at junction of Dead River Branch of D.S.S. and A. Railroad with the main line near center of NW $\frac{1}{4}$  Section 22, T.48N., R.25W., = 774 feet by U.S.G.S. levels. Railroad reaches 800 feet at the bridge over a wagon road running to a dwelling south of the Upper Peninsula Boring Company plant at west side of NW $\frac{1}{4}$  Section 22. Altitude 871 feet at north-south road in Section 21. There are striae on ledges in this section west of the north-south road bearing S58 $\frac{1}{2}$ W magnetic or S60 $\frac{1}{2}$ W corrected. Altitude about 1,000 feet A.T. Aneroid 28.800 = 973 feet at summit in east-west wagon road southwest of this ledge 80 rods.

Road intersection middle of north side NE $\frac{1}{4}$  Section 29 is 1,065 feet A.T., aneroid 28.700. West from here is a sandy tract bordered on the north by a low ridge of bouldery drift--probably a moraine. Aneroid 28.640 on the moraine just south of a private road running east-west to a dwelling about 100 rods west. This ridge is probably 80 rods south of center of Section 20 and runs northwest 1/2 mile or more. North of this road there is a notch cut into the

northeast face of this morainic ridge. Aneroid 28.680 at foot of cut bluff = 1,025 feet  $\pm$ . A few rods northwest the moraine is notched at a still higher level, aneroid 28.650 = 1,050 feet  $\pm$ . The moraine runs northwest to a flat-topped tract of a few acres, aneroid 28.615 at 9:30 a.m. At the northwest this ridge runs into a rock ledge of schist. Striae in it have a bearing  $S57\frac{1}{2}^{\circ}W$  magnetic or about  $S59\frac{1}{2}^{\circ}W$  corrected. There are lines  $S45^{\circ}W$  that may be striae. Aneroid 28.625 at ledge at 10:00 a.m. This is south of the D.S.S. and A. Railroad in northwest part of Section 20. Aneroid 28.650 at railroad where a private road crosses just west of a rock cut, altitude 1,056 feet. There is a fine exposure of striae here bearing  $S51^{\circ}W$  to  $S54^{\circ}W$  magnetic or  $S53^{\circ}W$  to  $S56\frac{1}{2}^{\circ}W$  corrected. These are on south side of the track. Prevailing course is  $S54^{\circ}W$  magnetic. The altitude is 1,065-1,070 feet A.T. East of this is a cut in drift, 25 feet, of sandy character and only a few small stones--8 to 10 inches. This is probably the moraine. The moraine crosses an east-west wagon road just east of an old brickyard in northeast part Section 19 and its outer face probably comes to corners of Sections 17, 18, 19 and 20. I find there is  $1/2$  acre or so of the moraine in Section 19. Aneroid 28.630 on the moraine in Section 18. It runs northwest to Dead River and causes the northwest course of the stream in Section 18. There is a flat along the river where aneroid reads 28.710. The river is 30 feet lower at the bend in southwest part Section 18.

We find moraine on west side of river running west to Van Iderstine's crossing. Aneroid 28.640 at crossing = 1,082 feet A.T. at 11:40 a.m. There is a greenstone schist just north of here in the railroad cuts but we find no striae though it is glaciated and has a very smooth surface. There is much higher country to the west from here, reaching 1,200 feet or more.

We take road toward Forestville, making a rapid descent through a ravine in which there are no rock exposures till we pass the first crossing of a small

creek, altitude 876 feet. Granite outcrops occur at about 875 feet. The Munising Railroad has a cut 25-30 feet deep in high part of bluff north of this stream that is entirely sand and gravel, but granite outcrops below the track.

The second crossing of creek is 847 feet, and third 830 feet. The railroad cut referred to is between these two wagon road crossings. There is a terrace at 860 feet. Aneroid 28.845 on this terrace. Forestville Station is on this flat. The flat is probably the Lake Algonquin bed. There is a bluff back of it just west of the station. There is a bare rock hill 1/2 mile east of the station on north side of track, rising 100 feet  $\pm$  above it. The old lake plain runs in back of it on the west side. There is an extensive high sand plain on north side of Dead River.

Aneroid 28.940 at a road intersection on brow of high bluff about a mile east of Forestville village site. The village has been abandoned since furnace was taken out. Just east of here the wagon road descends to a lower flat, aneroid 29.000. The higher bluff runs north here away from Dead River.

Aneroid 29.050 = 681.5 feet on bridge of Dead River at Electric Light Station. The river here is tumbling over granite ledges. The terrace here is about 710 feet. There is a bluff about 60 feet high that runs out 1/4 mile east of the station of Electric Light plant. There are slight notches in its face where it runs south at higher levels than 710 feet A.T. The best one is about 740 feet. Aneroid 29.090 = 652 feet at a bridge 3/4 mile east of station where road turns southeast. There is a burned flat at the Fair Grounds northwest of Marquette at 653 ?

October 12, 1905, 7:00 a.m.

Aneroid 29.285 at the P. O. bench mark in Marquette = 674 feet A.T. We find striae on the south side of a small stream in southwest part of Marquette

north of the sanitorium bearing S37°W. It is a little farther west than 7th Street, but may be 7th Street. Altitude is about 710 feet. Rock is greenstone schist. There is a conglomerate inclusion in it near the striae.

We take the county road southwest to top of steep hill and find a beach here at 830 feet. The residence of Mrs. Anderson is on it. South of her residence 20 rods and about 40 rods west-northwest of the sanitorium tank is a rock ridge on west side of a ravine on which there are numerous striated places S40 to S47½°W--mainly about 47½--magnetic, altitude 845 feet. Rock is greenstone schist. The sanitorium tank is on a hill, 920 feet, and is cut into it at about 860 feet--a possible level of Lake Algonquin. The 830-foot beach is probably part of this series. We follow the ridge of rock west and find striae with bearing S34°W about 80 rods west-northwest of sanitorium tank. They are heavy grooves. Aneroid 29.030 at a cut cliff or old shore on north side of a rock hill 100-120 rods west-northwest from the sanitorium tank on south side of county road. This hill rises to fully 900 feet A.T. Striated surface on flat surface near its east end with bearing S36½W magnetic. Others about 25 feet east bear S50°W on a steep upslope. A view to the southeast shows the hills east of Penitentiary to rise about to 850 feet.

Aneroid 29.025 at base of the cut cliff on north side; 29.015 at base on south side. The jagged appearance of this ridge on the south side is in striking contrast to the smooth surface on the north. This knob and the one that the sanitorium tank is in are on the section line of sections 22 and 27.

There is a glacial ridge at 880 feet running west-northwest from middle of line of sections 22 and 27 to a creek near line of sections 21 and 22, 120 rods north of corner sections 21, 22, 27 and 28. It is 30-40 rods wide and has a gravelly, bouldery drift. The beach at 860 feet is traceable though not very distinct along its north side. In one place a bar is built across a sag just north of this wagon road. There is a swale along the south side of this ridge

nearly 1/4 mile wide and southwest of this arrange of hills (rocky knobs) that form the divide north of a small stream that runs east through south part of Marquette, entering the lake near the furnace.

We go into Section 30 to see the features considered a lake beach by Taylor. There is a gravelly drift here with nearly plane surface traversed by a low rocky ridge 1,195-1,205 feet. The southwest edge of this plain is 1,209 feet at base of a rock hill in what Taylor noted as the lagoon which is 3-4 feet lower than the ground a few rods northeast of the cliff. There are boulders on this gravelly tract and it seems to lack the definite ridging that a beach should have. There are sharper ridges about 1/2 mile northeast at altitude 1,140-1,150 feet that are more like beaches, but even there I doubt if there has been lake action. On the low rock ridge on this gravelly plain is a faint showing of striae bearing S45 $\frac{1}{2}$ °W.

The road turns from south-southwest to a westerly course at the place Taylor put a beach and rises to 1,279 feet at a place where rock ledges appear close to the road on each side, perhaps 1/4 mile from the supposed beach. There are till ridges on the rise toward this place with boulders and loamy material. This is 40 rods east of township line. The altitude at town line is 1,284 feet. There is a cliff south of road here 50-60 feet higher. West of this rock ridge in southwest part of Section 25 on north side of road is a gravel plain about 1,280 feet A.T. It seems to be present also south of the road. There is a rock ridge north of the gravel plain in Section 25, 1,325-1,350 feet A.T. Striae 80 rods south of sanitorium tank in Marquette bear S18°W.

The drift with nearly plane surface that stands 1,280-1,300 feet A.T. in sections 25 and 36, T.48N., R.26W., is reported by Mr. Whitman, the topographer on Marquette quadrangle, to cover most of sections 31 and 32, T.48N., R.25W., and sections 5 and 6, T.47N., R.25W., north of Carp River. There is a small rock hill rising above it in northeast part of Section 31 and a horseshoe-shaped

ridge concave westward in Section 5 west of center. There is also a rock ridge along line of sections 1 and 36. The plain is only 1,260 feet near Little Carp River where we went onto it in Section 31, but gets above 1,300-foot contour in sections 5 and 6 on the bend of Carp River.

There is a rock ridge covering much of the NE $\frac{1}{4}$  Section 32 and nearly all of Section 33 except the south 40's and running out to Carp River near center of Section 34. North of this is a tract of thick drift, gently undulating, with a moderate number of boulders. This belt of drift continues east across the Poor Farm in Section 26 and north edge of Section 35 on north base of Mt. Menard and forms the drift bluff in south part of Marquette that faces the lake. This belt is probably a continuation of the morainic tract across sections 18 and 20, T.48N., R.25W. and south into Section 29 to rock ridges in southeast part of the section. It probably swings around the east end of Mt. Menard and runs south back of the penitentiary.

October 13, 1905, 7:30 a.m.

We go north from Marquette on Third Street. Aneroid 29.170 on the 630-foot beach at north side of Normal grounds.

Dead River is 630 feet at Powder Works. There is a magnificent glaciated surface at west end of Powder Works dam north of this bridge, bearing 58°-9°W. Several square rods are exposed. The longest is 9 picks long. The river here falls nearly to lake level over the ledges. The water level under the dam is 620 feet. The rock is partly greenstone and partly granite, great masses of granite being included in the greenstones.

About 1/4 mile west from here is a rock boss of greenstone rising 30 feet or more above the sand plain. It is very abrupt on the north side and yet is heavily glaciated. The striae bear S27°W magnetic. Is it possible that the heavy glaciation at the Dead River rapids is due to ice moving north over the rapids? They seem too heavy for winter ice. From here northwest there are a

few rock bosses, but most of the land is a sandy plain 650-700 feet A.T.

The road for 1/4 mile or more near corner sections 3, 4, 9 and 10 is near a bluff that is about 710 feet and trends northwest-southeast. A large amount of small timber occurs south of a stream in Section 4 in which no large stumps are present, but on the north side are good-sized pine stumps with a small growth of poplar, white birch, etc. The stream is 655 feet. The plain north is 675 feet  $\pm$  and has basins. It is strewn with boulders and so is the plain south of the creek.

We follow a new railroad track for about 1/2 mile west and then turn away to the north, rising to a higher plain. Aneroid 29.050 at 8:40 a.m.; 29.020 at west end of a rock boss a little farther; 29.045 at altitude 750 on road 1/4 mile farther north. There are marshes of 20 feet higher a few rods east and a swamp 15-20 feet lower a few rods northwest from this bench mark. The ground among the rock bosses is thickly strewn with boulders. Soil is a loamy, reddish-colored sand. We come to base of a high knob 1/4 mile farther northwest with U. S. 757 at base at edge of a swamp. This is granite. This reaches 850 feet. The road crosses it in a low pass 786 feet. About 1/4 mile west is a hill fully 950 feet, called Sugar Loaf Mountain.

I find striae just east of road at altitude 840 feet, bearing S15°W. We go north to a point 910 feet A.T., aneroid 28.860. This commands a view of granite ranges to the west. There is rock close to the shore in NW $\frac{1}{4}$  Section 29 north of the bay at Whetmore's Landing. Southeast from this bay is a strip of low land about 1/4 mile wide between the shore and these granite knobs which are near line of sections 29 and 32. Little Presque Isle is an island of rock. A low point of land runs out to it 1/2-3/4 mile long.

Aneroid 29.000 = 786 feet at road summit west of Sugar Loaf knob. The ledges extend down to the north about to the 750-foot, possibly to 760-foot and

below this is a boulder-strewn slope. The slope is rapid down to 740 or less. This proves to be only a narrow ravine with granite walls within a few rods back on either side. There is a lot of water-worn material from about 710 feet down to the lake.

Where the road ascends hill north of Whetmore's Landing, a striated outcrop appears at 700-710 feet A.T. on west side of road, bearing S12°W magnetic. Aneroid 29.050 at summit in road = 750 feet. The road soon drops to the 630-foot beach about 80 rods south of Pickerel Lake outlet.

There are sandy plains north of the stream in sections 13, 18, 24, and 19, standing 620-625 feet. We come to a rock bluff near corner sections 11, 12, 13, and 14, at a distance of less than 1/4 mile back from the lake shore. From here north the wagon road is along the base of the bluff that stands back of the 630-foot beach. This bluff is generally 20-30 feet high and has a red, thin-bedded sandstone, apparently Potsdam. This extends nearly to the mouth of Little Garlic River. North of Little Garlic River is a range of hills running out to Thoney's Point. There is a low plain northwest of it in Section 27, T.50N., R.26W. Another range of hills sets in near Blemhuber farm that runs out to Kamp Kildare Point. There are high lands on west side of Saux Head Lake in Section 20, said to be entirely of drift. High knobs occur on the east side close to the shore from mouth of Garlic River southeast to Kamp Kildare less than 1/2 mile wide and 50 to 200 feet above lake level.

There seems to be a drift ridge from Saux Head Lake north-northwest that causes the peculiar drainage. Wilson Creek runs southeast on its back side from Section 13, T.50N., R.27W., to its junction with the Garlic in Section 29, T.50N., R.26W. From the knobs east of Saux Head Lake I can see its course for several miles. It probably runs west through southwest part of T.51N., R.27W. There is hardwood on it and on the plain between it and the lake from about Section 7, T.50N., R.26W., northward to Section 20, T.51N., R.26W., (I am told).

I can see it as far as Section 33, T.51N., R.26W. The highest points on this drift ridge are scarcely 200 feet above Lake Superior, for I can see over top of most of the ridge from on a hill 780 feet A.T. on east end Saux Head Lake.

Aneroid 29.240 at lake level at 1:45 p.m.; 29.025 = 780 feet on ridge west of Saux Head Lake. This has a coarse gravel at top with a few cobblestones in it. I see no boulders either on the crest or slope. West of this is a terrace about 750 feet A.T. The high part is very narrow, scarcely 30 rods wide here on top, but widens northward.

I go west to the new railroad grade where it crosses Wilson Creek in west part Section 20 and find no boulders on east side of creek. West of the creek the rock is at surface at certain points and the drift appears to be generally thinner than east of the creek. I follow down the railroad grade to a mill at center of Section 29--Birch Station. There is a drift hill, chiefly sandy gravel, standing on the point between Wilson Creek and a small stream that comes in from the south from Section 32. But I am told that rock sets in back of it at about 1/2 mile from the mill or in southwest part of Section 29.

There is a sandy plain along the railroad grade to Garlic Creek near corner sections 28, 29, 32 and 33. The northeast part of Section 33 and southwest part of Section 34 are swamp and it seems to extend into north edge of sections 3 and 4 of the township south (T.49N., R.26W.). The rock hills that I crossed in the northeast part of Section 34, T.50N., R.26W., do not connect with high land to the south. There is a high, rocky range from near the corners of T.50N., Ranges 26 and 27 West and T.49N., Ranges 26 and 27 West, westward for several miles, I am told by an old surveyor, Mr. Cummings. He says there is heavy drift north of this rock ridge in the southern half of T.50N., R.27W., and it runs from there north of west through the central part of T.50N., R.28W., and north part of T.50N., R.29W. There are tablelands with pine on its south part and great gullies and broken surface in passing northward from these plains going on topography similar to that in the southwest part of T.47N., R.24W., where the moraine is so

strong. He says drift deposits are thick in the west part of T.49N., R.26W., and from there southeast into the drainage basin of Rainy Creek and down that creek to where I found heavy drift southwest of Forestville. This belt seems likely to have its continuation in the one in south part of T.50N., R.27W., but the high rock knobs near corners of Townships 50 and 49 North, Ranges 26 and 27 West make an interruption.

October 14, 1905.

We take train from Marquette to Eagle Mills at 6:50 a.m. Aneroid 29.030 at the road crossing on moraine in northwest part Section 20 = 1,056 feet. Heavier drift east from here than west--several cuts in sections 20 and 21 are 20-25 feet in drift (sandy). Aneroid 28.950 at Mile Post 159. Heavier drift southwest from here with cuts 15-20 feet. Boulders are numerous. This is near center Section 19. Aneroid 28.890 where rock ledges set in; 28.850 at top of steep grade 1/4 mile northeast of crossing of Munising Railroad; 28.800 at Bagdad. High rock cliffs on west side of track here rising about to 1,350 feet. Aneroid 28.780 on a gravel plain south of these ledges; 28.780 at Eagle Mills at 7:15 a.m.; 28.670 = 1,380 feet on bluff of gravelly drift 1/8 mile north of station; 28.650 = 1,400 feet at highest point in field 1/4 mile north of Eagle Mills Station. This is at the edge of an outwash apron that slopes westward. The ice probably occupied the lower tracts east and southeast of Eagle Mills and pushed a small tongue westward. There are large boulders on the face of the bluff-like face back of this outwash apron toward Eagle Mills.

There is a moraine with high knolls about 1/2-3/4 mile north-northeast from Eagle Mills on the east side of this outwash apron, but at Eagle Mills there is nothing but the bouldery face up to the high outwash apron.

We return to Eagle Mills (aneroid 28.770 at 7:40 a.m.) and take wagon road east to forks and then an old poorly traveled road farther east into Section 36.

At the forks we are on the brow of the bluff of the Little Carp River and the aneroid reads 28,740. The lower plain is 50-60 feet below. This higher plain through which the poor road runs becomes undulating and has small boulders just east from the forks. Aneroid 28,715 at swells 1/2 mile east of forks. We here drop to a lower plain, aneroid 28,770. There are numerous large boulders on the slope as if at an ice border.

We come to a better travelled road near the old Morgan charcoal kilns. This leads south-southeast along the base of a low bluff 20 feet higher than this plain. Aneroid 28,750 on brow of bluff = 1,258 by U.S.G.S. levels. There is a plain back of this to the southwest. Small boulders occur on both of these plains. The higher plain has a red slate and jaspilite outcropping near an Indian's residence. The border of the lower plain is pretty constant at 1,260 feet, as shown by numerous U.S.G.S. levels along its west border.

Aneroid 28,790 at Carp River = 1,249 feet at road crossing in Section 6. There is much higher land south of the river in Section 6, there being a rapid rise to about 1,330 or 1,340 feet. The road down the river on south side skirts along this bluff to a stream in south part of Section 6. It there enters a plain about 1,250 feet A.T. that extends to the north end of the hill in sections 8 and 9, dropping to about 1,230 feet. This plain is nearly 100 feet higher than the one east of the hill on border of Pelesier Lake. Aneroid 28,780 on the 1,230-foot plain; 28,880 on the plain south of Pelesier Lake = 1,130 feet  $\pm$ . The aneroid reads 28,920 at U.S.G.S. altitude 1,092 feet in south part of Section 3 so the plain around Pelesier Lake is about 1,130 feet A.T., and the plain west of the rock hills in Section 8 about 1,230 feet. It is probable that water from the 1,230-foot plain went southwest and eventually reached Escanaba River, but I did not trace its course as a mist and fog made it impossible to see any distance. I, therefore, returned to Marquette.

On the south side of Carp River near corners of sections 3 and 4, 33 and 34 there is drift banked up against the rock hills in considerable amount at about

900-925 feet. North of Carp River, in the south part of Section 34, is a bank of drift rising to 850-860 feet, or about 75 feet above the river where the wagon road crosses. It lies between the wagon road and railroad. This is very nearly at the level of an old beach. A very high rock ridge extends into the west part of Section 34 north of the river. The gap between its east end and the west end of Mount Mesnard is less than 1/2 mile. The north slope of Mount Mesnard is coated heavily with drift in the north tier of 40's in Section 35, and the heavy drift covers the part of Section 26 southeast of Carp River. There is a lot of drift banked up back of the penitentiary in sections 35 and 36 east and south of Mount Mesnard.

Mr. Whitman, the topographer, says a drift belt extends southwest between rock hills across the northwest part of Section 2, T.47N., R.25W., to the wagon road in south part of Section 3. Another drift belt between rock hills runs south from the penitentiary through the west part of Section 1, T.47N., R.25W. The rock hills east of this drift belt are much lower than those west, reaching scarcely 900 feet, while those west reach 1,200 feet. This eastern group of rock hills barely enters the west edge of T.47N., R.24W., in Section 6.

I interview R. C. Young, Engineer of the Lake Superior and Ishpeming Railroad, concerning the character of country along new line of railroad from Saux Head Lake northwest. The only place rock is found is in sections 19 and 20 along Wilsons Creek and it is thin-bedded red sandstone. There is a rock bluff at the west end of Lake Independence running north past the terminus of the new line in Section 16, T.51N., R.27W. The railroad is along the base of this bluff from the northwest part of Section 22 northward. The swamp that I crossed October 13 in sections 33 and 34, T.50N., R.26W., slopes eastward and drains into Little Garlic River from near the bank of Garlic River in northwest part of Section 33. It is 631 feet A.T. at the west and 624 feet at the east end, while Little Garlic River, where crossed by this railroad in northeast part of Section 3, T.49N., R.26W., is 617 feet.

The railroad rises rapidly in running northwest from the mill near Saux Head Lake. The altitude at the mill is 617 feet, while at the north line of Section 19 it is 698 feet and Wilsons Creek is 688 feet. It is 720 feet at range line between sections 13 and 13 and reaches a summit 746 feet in the NE $\frac{1}{4}$  of NW $\frac{1}{4}$  of Section 13, T.50N., R.27W. The altitude at line of sections 11 and 12 is 733 feet and at Yellow Dog River, 667 feet (water level), while the track just north is 681 feet and at line of Sections 25 and 36, T.51N., R.27W. is 683 feet. Lake Independence is about 625 feet with the dam, and an old beach north of it is 635 feet  $\pm$ .

Mr. Young states that a large tract of wet hardwood land is present on east side of the Yellow Dog River in T.51N., R.26W. It is stony but not in ledges, so far as he has noted. Some blocks of rock are several feet in diameter.

He thinks there is a low outcrop of rock on Big Bay Point, but most of the land north of Lake Independence is sandy.

The Land Survey plats show a low rock cliff from Yellow Dog Point southeast to Granite Point. South of Granite Point in Section 34, T.51N., and Section 5, T.50N., R.26W., is a cliff of red, thin-bedded sandstone 40 feet high.

October 16, 1905, Marquette, Michigan.

Drive with Geo. P. Cummings. We drive northwest toward Forestville; 653 feet at northwest corner of Fairground; 660 feet at foot of ridge; 670 on top. This is a sandy ridge. This is a wind drifted ridge. A plain west of it is 660 feet and has a pebbly sand. This extends west to corner sections 9, 10, 15 and 16. There is a rise here onto a bouldery tract, 677 feet A.T., but the soil is sandy loam. The little stream 1/8 mile west is 645 feet.

This wavy surface, Mr. Cummings says, covers all of Section 16 except the south edge where there is a range of low rocky hills. This wavy tract reaches to the base of the high tract south of the electric light plant. This is 760-770 feet; aneroid 29.360 at top. There is a little notch at 730 and another at 710. The flat bordering Dead River is 683 feet here where it opens out into the plain, aneroid 29.440. The bridge at Electric Light Station is 670 feet.

There is a slight beach at 710 feet and a better defined one at 730 feet on north side of river. Aneroid 29.390 on the 730-foot beach; 29.350 on the high plain on north side of Dead River = 770 feet  $\pm$ .

The delta at Forestville is about 870 feet. The 860-foot contour is a few feet lower than the railroad station and the gravel reaches about 5-6 feet higher.

Aneroid 29.040 at Van Iderstine's crossing = 1,082 feet A.T. at 9:00 a.m. in southwest part Section 12, T.48N., R.26W.; 28.970 on high tract 50-60 rods west, near the corner sections 11, 12, 13 and 14 = 1,150 feet. There is an undulating boulder-strewn tract here that seems to be a continuation of the moraine. There is a gradual westward rise.

Aneroid 28.890 near quarter post of sections 11 and 14 = 1,230 feet  $\pm$ . We come to rock ledges in northwest part of Section 14 and northeast of Section 15 at about 1,300 feet. Aneroid 28.800 at base of ledges; 28.765 at top of ledges = 1,335 feet  $\pm$ . This is where the Houghton Survey makes altitude about 1,432 feet. This ledge is narrow and is surrounded by a flat 35 feet lower, or 1,300 feet A.T. There are points of rock that reach 1,350 feet.

We drive north  $1/2$  mile to Dr. Drake's summer cottage in east part of Section 10, making a descent of fully 100 feet from the plain, aneroid 28.920 = 1,200 feet  $\pm$ . There is heavy drift on the slope and an undulating surface like that northeast from Van Iderstine's siding. This undulating drift covers sections 10 and 15 north of Dead River, so Mr. Cummings states. In Section 9 is a high range of rock hills north of the dam in Section 9, reaching 1,500

feet  $\pm$ . It extends west into Section 3 a little distance. Mr. Cummings states that there is thick drift north of this ridge around the headwaters of Rainy Creek (see notes October 19). The rock range runs westward several miles on the north side of Dead River. Aneroid 28.850 at Dead River above dam = 1,304 feet at 10:40 a.m. There is 96 feet fall in about 500 feet below the dam, not including dam which is about 12 feet. Mr. Cummings has the level at home. It is 690 feet above Lake Superior at top of the falls.

Aneroid 28.730 on tableland south of Dead River in southwest part of Section 8. This had a heavy pine timber. Aneroid 28.765 on a terrace a little farther west; 28.740 on a higher plain in Section 7 at 11:00 a.m. = 1,410 to 1,425 feet. We enter a sandy plain soon and are in it to where we get dinner in northeast corner Section 10, T.48N., R.27W. Aneroid 28.770 at Finlander residence at 11:45 a.m. = 1,380-1,390 feet. Little Dead River has a terrace about 40 feet above the stream and this residence is on it. The plain is 90 feet  $\pm$  above the stream where we crossed near line sections 2 and 11. There is much higher land in Section 14 with rock on it, and this runs east across sections 13 and 18 into section 17 south of the hoist where an old road runs to the hoist from the south. East of this road also there is high rocky land. There is a rock hill on the east edge of Section 11.

Aneroid 28.790 at 1:00 p.m. where we had dinner = 1,580 feet  $\pm$ ; 28.680 on drift hills 1/4 mile southwest of dwelling = 1,480 feet. There are a few boulders here. Hills to the north in Section 3 have some rock on them and there is a range of rock hills along south side of Little Dead River. There is an extensive sand plain on north side Little Dead River extending to within a mile of the road that runs west along south side of the river. There is a narrow strip of drift knolls scarcely a mile wide on south side of Dead River from Section 10 to Section 6, T.48N., R.27W., interrupted in places by swamps (see map).

We go southwest to the intersection of a road coming in from the north near corner of sections 8 and 9, 16 and 17. We go southeast into the high land

south of Little Dead River, and find drift knolls for about 1/2 mile after crossing Little Dead River in NW $\frac{1}{4}$  Section 16.

We come to a striated ledge in south part of Section 16 bearing S19°W (magnetic). Exposure is on west side of road. Aneroid 28.715 at exposure. This is about 1/4 mile north of some charcoal kilns. About 60 rods south of kilns on east side of the road is a fine exposure of striated ledge: bearing S31°W (Magnetic). Aneroid 28.670 at ledge at 2:20 p.m.

About 40 rods southwest of a residence in Section 21 (south part) is another striated ledge at right (west) side of road, bearing S50°W. Aneroid 28.680 at exposure at 2:30 p.m. = 1,475 feet  $\pm$ . This is on the crest of a high range of Serpentine rock that lies north of Carp River. This range 15-20 rods west from here is 60 feet higher or 1,535 feet  $\pm$ . This is 80 rods east-northeast of section corners of 20, 21, 28 and 29. The section corner is on south side of this range. Aneroid 28.780 at a swamp in east part of Section 29 near Carp River = 1,330 feet  $\pm$ . A gold mine was worked in this section in a vein of quartz in the serpentine rock. It is at the west end of this swamp. About \$600,000 worth of gold was taken from it (Cummings). The glacial deposits among the rock hills between Little Dead and Carp rivers are bouldery and have a rich soil.

In southwest part of Section 28 are two striated exposures on northeast side of road a few rods apart, one 20 feet higher than the other. The higher one bears S50°W and the lower one S40°W. Aneroid 28.770 at the lower or eastern exposure.

Aneroid 28.770 at Carp River near entrance to Deer Lake. The great oxbow west from Deer Lake carries the stream around the west end of a high rock ridge that runs east past Deer and Teal lakes. There is a parallel range north of Carp River after it turns east. At a schoolhouse south of Deer Lake is a striated ledge bearing S61°W. Aneroid 28.730 at ledge. Near a water trough on road on hill east of Carp River are striated ledges with bearing S50°W. This is about a mile north of Ishpeming. Aneroid 28.700 at lower ones. Others occur up to near

top of the ledge 50 feet higher. There is a gravelly tract south of the road by this watering trough at a level 20-30 feet above it. Aneroid 28.670 at top of gravel. It is flat-surfaced and extends south past Ishpeming and runs southwest and west among hills and east to Teal Lake.

Aneroid 28.670 in north part of city = 1,440 feet A.T.; 28.700 at D.S.S. and A. depot, 1,413 feet A.T. at 3:30 p.m. A swamp 8-10 feet lower is now in business part of city. It runs northwest nearly to Deer Lake along Carp River. A channel has been blasted through rock at the north end to drain the swamp and give Ishpeming an outlet for sewage.

There is a heavily glaciated surface in a sag between hills in east part of Ishpeming, south side of wagon road where it is close to the L. S. and I. Railroad. Aneroid 28.670-685 at the striae. The bearing is about S70°W, but striae curve a little around the hill. There is also some cross striation amounting to 10 or 15°. East from here on the west edge of Negaunee the road rises to a pass between rock hills in which the drift is hummocky. Aneroid 28.610 at summit in road. South from here a mile or more is a hill probably 150-200 feet above this level, or 1,650-1,700 feet A.T. Aneroid 28.670 at L. S. and I. Railroad crossing a short distance west of this wagon road summit. Low drift (knolls) occur all along this depression to the built part of terrace. They are boulder strewn and probably mark a moraine, while the flats in and around Ishpeming are in an outwash apron.

Aneroid 28.760 at D.S.S. and A. Station in Negaunee at 4:00 p.m.; 28.785 at C. and N. W. depot. There is a sharp gravelly knoll, 40 feet or more high, just east of the business part of town between the wagon road and the D.S.S. and A. Railroad. It has rock at its east end. The gravel is in the lee of the rock boss and tails out to a low point at the west.

The ground becomes flat in the north and east parts of Negaunee, aneroid 28.750. It runs northwest past the Haas mine shaft to east end of Teal Lake.

It is probably an outwash from a moraine just east of it about 1/2 mile east from the Kasas mine. The surface is undulating and boulder strewn from here east to a swamp near the east city limit about 1 1/2 miles west of Eagle Hills. This runs to Eagle Hills with uniform level, aneroid 28.800 at Eagle Hills at 4:45 p.m. = 1,230 feet  $\pm$ . Little Carp River is 1,212 feet where wagon road crosses it and a low plain bordering it is 1,245-1,250 feet. There are boulders on the face of the low bluff below this plain east from here. There is a dolomitic limestone exposed south of Little Carp River west of here on south side of the wagon road. From here to Marquette we are on the road already traveled.

H. L. McGillis, resident engineer on L.S. and I., tells me that the new railroad under construction to Big Bay from Marquette strikes bouldery material from Section 19 northwest nearly to the Yellow Dog River.

October 17, 1905. 6:50 a.m.

Aneroid 29.560 at D.S.S. and A. Railroad Station in Marquette. I take train to Eagle Hills. Aneroid 29.350 in cut in first morainic ridge at Mile Post 157; 29.145 = 1,056 feet at road crossing in northwest part of Section 20, T.48N., R.25W. The cuts in Section 19 are bouldery drift about to center of section, but beyond these rock is at surface on the ridges.

Aneroid 28.910 on the railroad 1/4 north of Bagdad; 28.380 at Bagdad at base of a high rock hill. The little lake in south part of Section 24 is surrounded by rock hills. South of these hills about a mile from Bagdad is a flat gravel tract, aneroid 28.850, that extends to Eagle hills. Aneroid 28.850 at Eagle Hills at 7:15 a.m.; 28.700 on high plain north = 1,400 feet  $\pm$ .

I make trip on foot west and south to Negaunee. There are low swells along the east border of this tableland for nearly a mile north, or to an

old tramway that leads northward toward the hoist. North of this tramway, in the central part of section 27, rock hills set in. There are extensive flats southwest of these hills in sections 27 and 28 and 21 that have a sandy soil and I see no boulders until I reach section 20 at a slough by Mr. Jacobson's place. From here west across sections 20 and 19 boulders abound on the borders of sloughs around the base of hills. There are ~~sandy~~<sup>scarcely</sup> any drift knolls, however from here to Negaunee. The soil is, in places, somewhat clayey on borders of swamps, while the sloughs have a black mucky soil. The boulders continue numerous to the north side of the range of hills that runs along north side of Teal Lake and there are low swells along the base of the hills. South of this rocky range is an elevated gravel plain noted yesterday as running east from Teal Lake. This extends to the thickly built part of Negaunee but there, low gravelly swells occur and much of the surface is lower than on the gravel plain north of the city.

Aneroid 28.570 at D.S.S. & A. depot in Negaunee at 10:45 a.m. I take train to Marquette. Aneroid 28.690 at Carp River and at Eagle Mills. It seems probable that the morainic tract that lies on east edge of the high plain north of Eagle Mills finds continuation northwest on the north side of the range of rock hills toward the hoist where I found drift knolls and bouldery material yesterday and perhaps the ice overtopped the range of rock hills so as to send an outwash to the southwest into sections 21, 27, and 28.

The gravel plain at east end of Teal Lake seems to be between two ill defined ice borders, not prolonged enough halts to form a good moraine. Indeed there seems to be no good development of morainic topography between the belt south of Dead River and the city of Ishpeming. There are, however, bouldery flats north of Ishpeming that are in contrast with the gravel plains at Ishpeming and the sandy outwash apron south of the Dead River moraine, so it cannot all be classed as gravel plain among the rock hills. The soil is more productive on the

bouldery tracts than on the gravel plains.

There is an undulating slope east of the Negaunee gravel plain extending down to the swamp on Carp River in section 33 that may correlate with the morainic or high tract north of Eagle Mills and mark west end of a small lobe. The steep grade on the D.S.S. & A. sets in northeast of Bagdad at 1,204 feet A.T. and runs into Marquette.

October 18, 1905. 7:45 a.m.

Aneroid 29.210 = 674 feet at Marquette post office bench mark. Worked on foot around city on old beaches. Aneroid 29.120 = 750 feet at old shore just west of intersection of Ridge Street and Fourth. It passes to south side of Ridge but keeps north of Bluff Street from Fourth to Seventh. It then runs west along Bluff nearly to Seymour Avenue. It seems to run across Washington Street east of Seymour but the U.S.G.S. levels at intersection of Seymour and Washington read 733 feet. Aneroid 29.110, 751 feet, is reached on Washington just north of some coal sheds about 15 rods west of Seymour Avenue. Aneroid 29.090 at 8:30 a.m.; 29.085 = 830 feet  $\pm$  at north end of Lincoln Avenue about 1,800 feet north of Washington Street. There is a wave cut bank here. Back of this, to the northwest, are bare rock ledges up to 865 feet, aneroid 28.960 at 8:40 a.m. There is nothing higher for a long distance northwest and for about a mile west and nearly a mile southwest and south.

There is an island of only a few acres above the 830-foot beach on west side of the Park Cemetery. From its north side a little sandy bar runs east into the Park and a similar bar runs east from the south side along the south line of the park. Aneroid 29.020 on 830-foot beach at 9:00 a.m. where it read 29.000 about 20 minutes ago.

Aneroid 29.110 = 756 feet at Washington and Lincoln at 9:05 a.m. There is a sandy ridge running southeast from the coal sheds south of Washington Street which is cut by the D.S.S. & A. railroad east of their scale barn and west of

the F. W. Reed Lumber Co. yards. Where cut by the railroad it has sand and gravel at top, but the lower part has thin beds of reddish color that are a loamy sand. This ridge leads toward the Catholic Hospital. There is a ravine along its southwest side and south of this ravine rock is near the surface. The ridge is gravelly at top and contains a few cobblestones. It may be glacial but modified by lake action. It crosses 7th Street north of Fisher. Aneroid 29.150 = 716 feet at intersection of Fisher Street with Seventh at 9:25 a.m. The ridge reaches 740 feet at intersection of Fifth and Fisher streets at northeast corner of Hospital grounds. The ridge runs out eastward along south side of Fisher Street nearly to the lake and holds the drainage on its south border. The south end of Fourth Street is on the ridge but it is only 730 feet there and drops rapidly eastward. Aneroid 29.170 = 706 feet at intersection of Fisher and Fourth streets at 9:45 a.m.; 29.215 = 672 feet at intersection of Champion and Blemhuber streets near section line. I find that what seems to be a shore line a few rods northwest of here is 690 feet A.T. Back of this is a sandy filling up to 725-730 feet, above which is rock. The 690-foot shore runs west about 1/8 of a mile on south side of Blemhuber Street and then turns south and runs to the creek at the sandstone quarry from which it runs east along south bluff to the lake shore.

Aneroid 29.230 = 671 feet where I leave Division Street at 10:15 a.m. and go south across Poor Farm and continue to the bold rock ledges on north side of Mt. Mesnard. Aneroid 28.900 = 975 feet  $\pm$  at base of ledges at 10:40 a.m.; 29.800 = 1,055 feet at highest point on the east bold face; 28.730 = 1,127 feet at top of Mt. Mesnard at 10:50 a.m. From here I look across Carp River valley to a bold range of rock hills. The heavy drift is banked against the north base of these hills about to a point due south of Mt. Mesnard, or perhaps 1/8 mile farther west.

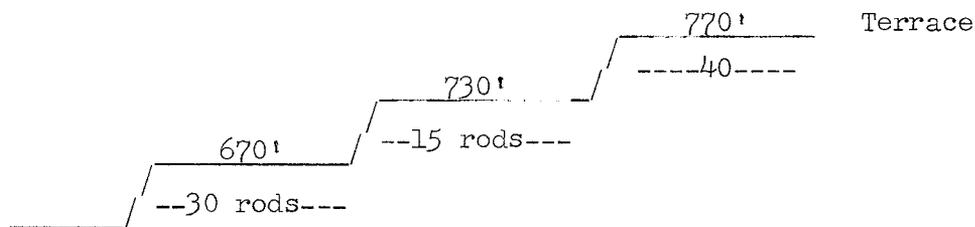
Aneroid 28.740 = 1,127 feet at top of Mt. Mesnard at 11:10 a.m.; 28.910 = 975 feet  $\pm$  at top of heavy drift deposits on north slope. I walk around the east

end of the mountain and find a steep slope down to 28.980 = 900 feet  $\pm$  A.T.; 28.990 at a line north-south cut through the timber. Time: 11:35 a.m. This may be 1/4 section line. Fifty paces east the land is flat, aneroid 29.005, for another 50 paces to a low rock boss 15 feet  $\pm$ . East of this is a sag about 40 paces wide, aneroid 29.055 in bottom, and then a sharp knob east of it, 70 feet  $\pm$  high. This knob runs east more than 1/8 of a mile and its ledges extend down with bare face on north to where aneroid reads 29.140 at the east end of the knob. There is a small terrace north of it with this height and it swings around the east end. A ravine cuts it off just east of the knob, however. Aneroid 29.210 in col in ravine. East of this is a sharp ascent to a narrow, gravelly ridge. Aneroid 29.160 at top = 770 feet. Its southwest end is not over 20 rods east from the knob. It runs northeast 1/8 mile or more and widens a little to the northeast but is only 6-20 rods wide. It looks a little like a large spit but it may be glacial. Aneroid 29.330 at its east base. This bluff is very abrupt. Aneroid 29.350 at Lake Superior level = 602 feet.

I cross Carp River at the kilns and ascend a terrace or perhaps a delta of Carp River northeast of the Penitentiary. It stands about 675-680 feet A.T., aneroid 29.260. There are only a few acres at this level, the penitentiary grounds being on a lower flat. It is difficult to explain the preservation of this small piece of the old fluvial plain, though there may perhaps have been an oxbow curve of the river where the penitentiary stands that removed the filling. A little reddish till appears at the north end of this terrace or delta near the base. The Mesnard quartzite is exposed at the south end of this terrace on the lower plain at northeast corner of penitentiary. Striae on it bear S20°W with a slight departure each side, the range being from about S18 to 24°W.

South of Penitentiary grounds is a narrow ridge or spit standing about 715 feet A.T., aneroid 29.215. It runs east 30 rods  $\pm$  from the east end of a ridge

of greater height, aneroid 29.150 = 770 feet at top. There is a ravine back of this as well as the lower part and it looks to be a spit. There is a slight flat on its crest at about 730 feet. The diagram shows a profile along the



crest. A terrace appears at its west end that stands about 770 feet A.T. This is in all probability a delta of Carp River. It is 1/4-1/3 mile southwest of the penitentiary grounds and is about 1/8 mile wide on this side the river. It is the same height as the ridge I was on on northwest side of river. There is a still higher delta about 1/2 mile farther west which Mr. Whetmore makes just above 840 feet A.T. There are no higher ones in view up the river, though on north side, on southwest side of Mt. Mesnard, this one catches 860 feet. Aneroid 29.240 on a lower terrace southwest of the penitentiary grounds. This slopes rapidly northward to the bluff of Carp River, aneroid 29.260 = 663 feet by U.S.G.S. levels. Aneroid 29.270 at north side of penitentiary grounds; 29.245 on high terrace northeast of penitentiary = 680 feet. This seems likely to be a delta of Carp River connected with the 690-foot beach and is to be correlated with the terrace at 29.240 that lies southwest of the penitentiary grounds. Aneroid 29.285 = 620 feet at entrance to the penitentiary grounds by lake shore.

I return to Marquette and take up tracing of shore lines in north part of city. There is a sandy ridge crossing Arch Street in an east-southeast - west-southwest course between Third and Fourth streets. Aneroid 29.250 on ridge; 29.250 on Ridge Street west of Fourth = 740 feet A.T. This is height of shore line. There is high land north along Fifth Street to Hewitt Avenue, standing generally a little above 740-foot contour. The beach bears west from

north side of Hewitt Avenue and then northwest, as indicated by the 740-foot contour, on the Lake Chart, until it reaches the north side of cemetery park. Farther west it breaks up into several ridges and a spur runs north and then doubles back southwest and keeps this course to the Presque Isle Spur of D.S.S. & A. Railroad. It crosses this spur at the corners about 5/8 mile north of the main line of the railroad and from there runs west past an old house and enters a thicket through which I trace it westward along base of some rock ledges to a small creek. It makes a swing around to the north to the road 1/4 mile east of electric light station, but I cannot locate it definitely.

I find a beach at 690 feet, running toward the same point and lying 1/8 mile  $\pm$  north and east of the 740-foot line. I return along this beach to Marquette. It passes just south of the fairgrounds and a short distance west and south of the Normal School grounds. I did not map its course in detail, but it runs very close to the 680-foot contour.

October 19, 1905. Marquette, Michigan.

I drive northwest to Forestville along route previously traveled. The 630-foot shore fades out before reaching the electric line that runs to the fairgrounds and a plain rises from 628 to 660 feet along the road that runs west past the north side of the fairgrounds. West of it is a sand ridge that runs a little farther north than this road and reaches 676 feet at crest on road. It has a plain back of it. This is small, however, and I soon enter a bouldery, undulating tract that sets in at about 670 feet and rises to the beach at 690 feet. This, farther east, extends up past the 740-foot beach that I traced last night to the base of the rock ledges at 770-800 feet. The boulders are in a sandy material as well as on the surface.

After crossing Dead River I find that the 740-foot beach is well marked, being cut into the 780-foot tableland (i.e., 780 feet at brow of bluff at east

end). There is a gradual westward rise, the reading being 786 feet by U.S.G.S. levels a few rods west. There is a basin with small lake lying north of a sand ridge which fronts on the river. The L.S. & I. Railroad runs across the lake. It is about 780 feet, while the ridge south of it is 810-820 feet (aneroid 29.340 on highest part of the ridge). This lake is southeast of a high rock knob. The plain is about 820 feet south of this knob, but rises rapidly westward and reaches 865-870 feet at Forestville Station. It is higher next to the river bluff then back from it to the north.

Aneroid 29.310 at Forestville Station = 865 feet at 8:40 a.m. I take road toward the Holyoke Mine and soon rise about 100 feet to a high tableland with sandy soil. Aneroid 29.190 at top of steep part of hill = 962 feet. There is a gradual ascent to 980 feet. The surface is very flat, like a river delta, for 1/8 mile or more. A rise through gravelly, cobbly land then sets in and the surface is undulating. Boulders soon set in. Aneroid 29.115 at U.S.G.S. 1,035, where I notice first boulders. This is probably moraine.

Aneroid 29.040 at U.S.G.S. 1,100 at 9:00 a.m. Surface still gently undulating--swells scarcely 10 feet high. I reach a flat tableland at 1,120 feet. It has a gravelly soil but seems to be free from boulders. It may be a border drainage. It is 1/4 mile or more in width. West of it is a bluff-like bank rising to 1,136 feet U.S.G.S. (aneroid 28.995) which has a plain west of it. The soil is a pebbly sand. I see no boulders. There are slight inequalities, shallow sags, and low banks 5-6 feet  $\pm$ . The plain rises gradually westward, reaching 1,145 feet U.S.G.S. levels a short distance east of forks of road, probably at Fossbend's in northeast part of Section 2, T 48 N, R 26 W. The lefthand road runs to a small lake less than 1/4 mile south of the forks. Aneroid 29.010 at lake; 28.985 at forks of road.

About 1/2 mile west I come to prominent rock knobs at an old camp. One on north side of the road is over 100 feet high and has a bare surface = 28.965,

975 feet along the base. There are summer cottages both east and west of these knobs.

There is a flat tract of sandy gravel for 1/2 mile west to a small creek draining north, standing about 1,150 feet A.T. North of the road, however, I can see knobs of rock, and upon crossing the creek I enter a stony tract standing 1,150-1,175 feet thickly strewn with boulders and having a few rock outcrops. These are at about the level of the plain.

I soon cross another stream and then work up a ravine westward. I ascend to the north bluff and find high rocky knobs, aneroid 28.670 = 1,440 feet  $\pm$  on highest one. From here west for more than two miles there are hills, and the highest ones 1 $\frac{1}{2}$ -2 miles west are fully 1,500 feet A.T. About 3/4 mile south-southwest are higher hills than the ones I am on. There is a terrace in this depression up which the road passes that has gravel and cobble, aneroid 28.815 = 1,300 feet  $\pm$ .

There is a fine exposure of striae on the south slope of this ridge with slightly divergent lines, the range being from S15°W to S20°W. Aneroid 28.720 to 28.730 at the exposure. The ice must have formed them on a downward slope in the lee of a ridge 30 feet higher. Aneroid 28.815 at bottom of rock exposure and level of drift filling.

Aneroid 28.920 at creek 1/2 mile east on return trip, at 11:05 a.m. = 1,200 feet  $\pm$ ; 28.945 at east creek at 11:30 a.m.; 28.920 on its east bluff where I stop for dinner at 11:45 a.m. Rock ledges come in from the west to the bluff of this creek 1/4 mile north of where this wagon road crosses and it is less than 1/2 mile northeast to ledges east of the creek. Aneroid 28.925 at creek by road at 12:30 p.m.; 28.900 at top of bluff; 28.730 on knob about 3/4 mile east of this creek. There are high knobs for a mile or more north from here and there a low and comparatively smooth country sets in that extends to the lake. There is a level tract from the base of this knob south

for scarcely a mile. High ranges of hills there set in. The range I am on runs east to the lake shore.

Aneroid 28.870 at foot of knobs at 1:00 p.m.; 28.870 at forks of road in northeast part of section 2 = 1,150 feet  $\pm$ . I drive southwest to the west end of the little lake. There are rock ledges here 15 feet above the general level of the plain and rock is exposed beyond the southwest arm of this lake in a ridge which has greater height than this low boss. Aneroid 28.900 at 1,118 U.S.G.S. at 1:50 p.m. This high plain seems to extend north into section 36 to a sharp granite knob elongated east-west, which rises 100 feet or more above it. Possibly this knob is in section 31.

Aneroid 29.015 on the 980-foot terrace. I descend from this plain to the 870-foot one by a road making a little detour to the north, and pass some rock ledges on south side of this road. Aneroid 29.150 at Forestville Station, 870 feet, at 2:05 p.m. I take a road leading northwest from Forestville. It skirts along the foot of the bluff at about 870 feet for a mile or more. It then passes up on the slope and comes to a terrace at 920 feet.

There are occasional low rock bosses at various heights up to over 1,000 feet A.T. There is considerable level land at about 1,000 feet, possibly 980 feet A.T., for the aneroid is changing to lower barometer. I return to Forestville and take the road south to Washington Street and cross ridges with rock near the surface. There are a few drift hummocks west of the road.

There is a spring west of Marquette, in north part of NW $\frac{1}{4}$  Section 21, called Lake Superior Mineral Spring, and the water, Polaris Water. It is sold at 10 cents a gallon and is used in the city especially when the public supply is contaminated with creosote.

October 20, 1905.

I spent entire day at U. S. Land Office on maps.

October 21, 1905.

I find striae on rocks east of Marquette Hotel, on south side of ore dock, bearing from north-south to  $S10^{\circ}W$ . They run from near the water's edge up to a height of 28 feet. About  $1/8$  mile south, on south side of a small stream, are rocks projecting into the lake and these are heavily striated north-south and carry lines at other angles to  $S50^{\circ}W$ , but the main striation is north-south. Possibly the scratches are due to winter ice grounded on the rocks and moving south along the shore. The southwest bearing ones, in most cases, are later than the north-south ones, and seem very likely to be due to winter ice. They are weaker and show gouging more than the north-south striae, being plain for a few inches and then entirely disappearing for a few inches, to reappear again strong as ever. Back of these rocks, at a level 40 feet  $\pm$  above the lake, I find striae bearing  $S10^{\circ}-12^{\circ}W$ .

There are striae with similar bearing,  $S10^{\circ}-15^{\circ}W$ , in rocks a few rods northeast of the Hotel Marquette, between Front Street and the railroad tracks at a height of 60 feet or more above the lake.

Partridge Island reaches 818 feet A.T. by Lake Survey contouring. This survey makes Presque Isle less than 682 feet, whereas it really reaches 725-730 feet. By this chart the contour for 682 feet runs east along face of bluff in north part of Marquette to Ridge Street between Spruce and Cedar, and then swings around to the north, passing near intersection of Arch and Cedar streets and runs westward, crossing Spruce Street just north of Michigan and Pine Street, south of Hewitt Avenue (a section line).

I find striae bearing north-south on north side of the cliff east of Pine and south of Hewitt Avenue at altitude 690 feet A.T. The 690-foot beach shows nicely on south side of Hewitt Avenue between Pine and High streets. It crosses near the intersection of these streets and runs west on north side of Hewitt Avenue a short distance, and then takes a northward course along east side of ledges past Prospect Street and then swings westward around these ledges, along

Crescent Street past Front Street and doubles back southwest nearly to Prospect and keeps south of Crescent past Third Street.

I worked today at U. S. Land Office, transferring data to my maps. In the Land Office Plat for T 43 N, R 15 W, a bluff 70 feet high is noted in northeast part Section 18 and northwest of Section 17. It runs northeast into south part of SW $\frac{1}{4}$  Section 8 and then turns south, passing 60 rods east of center of Section 17 and continues 80 rods into Section 20 or nearly to center of NW $\frac{1}{4}$  of NE $\frac{1}{4}$ . It there turns abruptly west to the NE $\frac{1}{4}$  of NE $\frac{1}{4}$  Section 19. Then it runs south to northeast corner of SE $\frac{1}{4}$  Section 19 and from there east-southeast to northeast corner Section 29, then south-southeast to line of sections 28 and 33 about 30 rods east of quarter post. This is probably either a moraine or a high outwash apron. The high tract of which this is the east border has a sandy soil of first and second rate quality and is timbered with hemlock, beech, maple and pine, or a mixed timber.

In sections 5, 6, 8 and 9 of this township there is open marsh with groves of pine, as in townships farther north. There is also open marsh with groves of pine and spruce from near the north branch of Manistique River east into the next township. There was good white pine in a belt along this stream out to a distance of  $1/4$ - $3/4$  mile east of it, clear through this township.

In T 45 N, R 15 W there is open tamarac or grassy marsh with numerous small, sandy ridges timbered with white and yellow pine over the entire township except a narrow strip along a stream in sections 4, 5, 8 and 9 where there is hemlock and birch (marked brown on my map). There is a little dry land in east part of Section 1, on border of North Manistique River.

In T 47 N, R 15 W, basins are noted on line of sections 18 and 19 and knolls on line of sections 7 and 18 and line of sections 3 and 10.

The waterworks supply at Marquette is from Lake Superior north of the Lighthouse Point. There is a large pipe, 42 inches in diameter, and it extends

850 feet into the lake and terminates in 26 feet of water. There is a smaller (24-inch) pipe of the same length. This system was installed in 1891. There was an older system but it was abandoned. The consumption was 332 gallons per head per day in year ending March 1, 1905. Nearly every family uses it. The population is about 11,000 and probably 10,000 use it. The lowest consumption, in October, is about 2 million. The highest amount pumped is about 5 million gallons.

Analyses have been made monthly at Ann Arbor for the past 10 months, one sample being taken from the present intake and another from a test pipe 3,200 feet out. The latter gets a poorer class of water than that from near the shore.

There are about 20 miles of mains ranging from 4 inches to 20 inches. There are 1,720 service taps. Fire pressure is 100 to 125 pounds. Ordinary pressure is 90 pounds. Tin hydrants in streets, 172. Pumping is by direct pressure.

The tank on hill back of the Sanitorium is filled from city water by a pump at the Sanitorium. The hotel foundation is 205 feet above lake. The large residence on north side of Washington (Mr. T. Nester's) is also 205 feet. There is a tank on 3rd story of house and the water company filled this each night when Nester occupied it.

The rock surface drops off very abruptly in places so that wells have been put down 90 feet in some cases without reaching rock. Mr. Finney has one 90 feet on Bluff Street near the Clifton Hotel, about 110 feet above lake level, that does not reach rock.

A trunk sewer leads down Washington Street and another on Superior Street --each discharges into the lake. A sewer farther south near Hampton Street runs into the creek near the sandstone quarry. This is used by the Poor Farm and city water is pumped to the Poor Farm. This is at the southern limits and Fair Avenue is at the northern. The Penitentiary gets a supply from Carp River.

The sewage from north part of the city is brought around the east end of the ridge and discharged into Marquette Harbor south of Lighthouse Point. There are very few cesspools in the city, as nearly everyone connects with the sewer.

Rates for 4-room house of 4 people get a rate of \$4.20, or 70 per cent of \$6.00. For house of 6 or 8 rooms the minimum is 70 per cent of \$16.00. Hotels and laundries, etc., have meters, and there may be meters put in throughout the city--65 are now in use to test the amount used in order to fix a fair rate.

Bonded indebtedness, \$105,000. Interest paid is  $3\frac{1}{2}$  and 4 per cent. Operating expenses about \$18,000. Total cost of plant to date, including repairs and extensions, is about \$300,000. Original cost about \$125,000, with about 7 miles of mains.

October 22, 1905.

Faint striae preserved on west side of Front Street and south side of Ohio, S15<sup>o</sup>W. Altitude about 720 feet.

I go north on street car to L.S. & I. railroad and then follow the railroad track west. Aneroid 29.485 = 609 feet at crossing of spur of D.S.S. & A. railroad south of Dead River pond. I go northwest to a tract of sandy land in the northwest part of the chart of Marquette and Presque Isle harbors, passing rocky knobs on south side of a creek and one knob about 715 feet A.T. on the north slope of this sandy ridge.

The beach at 625-630 feet is strong, but those at 690 and 740 feet I can scarcely detect, though they seem to have had favorable conditions for development here. The road has a summit at 754 feet where it runs westward across this ridge. I go northwest up the slope to where rock ledges set in. Aneroid 29.280 = 780 feet; 29.310 at 754 feet. The slope is very gradual from 770 feet up to the rock ledges. It is also nearly flat for a short space between 755 and 760 feet

and there is a very gradual slope southeast below the 754-foot beach. I travel more than 1/8 mile on an old road along the crest before descending 10 feet from the 754-foot level.

The new branch of L.S. & I. railroad has excavated gravel on the south slope of this ridge at about 690 feet, aneroid 29.380. There are boulderets in it and numerous cobblestones. The gravel seems to have been used chiefly for a fill just west. I saw scarcely a stone on the crest or north slope. Aneroid 29.400 at U.S. 673 feet on railroad.

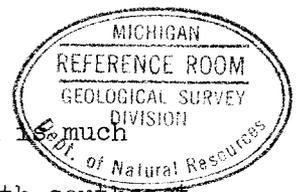
For 1/4 mile or more east from here the railroad has excavated a fine sandy gravel for ballast. The crest of the ridge, 20 rods north of the 673-foot line, is about 690 feet. Where the railroad crosses this crest 1/4 mile east, the altitude is 675 feet  $\pm$  and it cuts 15 feet to pass through it.

There are several basins near this line of railroad with gravelly sand around them. They may perhaps have been shut in by an interlacing of gravel bars for I presume this gravel is a lake deposit. South of the creek for 1/4 mile east from this railroad crossing, sand is conspicuous, but farther east rock is at surface. Partridge Island is bare rock to the top.

October 23, 1905.

I examine the morainic tract on Poor Farm for shore lines, but without good results. The altitude of one shore line, 740 feet, is reached about 20 rods east-southeast of the dwelling house, but there is a bouldery till here and this undulating bouldery till continues up past the 770-foot line, which is only 20 rods south. There is a flat west of the cemetery at 740 feet. About 1,000 feet south of the Poor House, a tableland, 800 feet A.T., is reached and there is considerable land 800-810 feet here and also west from here across a ravine.

The surface south of Poor House, at 830-840 feet, is coated with a sandy



gravel but boulders set in at depth of a foot or two. This tableland is much eroded here. Aneroid 28.970 on a higher tableland about 120 rods south-southeast of Poor House; 28.985 on 810-foot tableland; 28.760 at 741-foot level; 28.740 on flat terrace about midway between pest house and cemetery on north side of a creek = 883 feet. From the terrace east of the pest house I sighted with level to a broad terrace of same height on the bluff facing Lake Superior, above mouth of Carp River. This seems to be connected with a lake level somewhat prolonged.

I trace the beach of this lake stage northwest past the front of the Sanitorium. It there turns northwest and is interrupted by ravines until it passes the D.S.S. & A. tracks east of Mr. Nester's dwelling on Washington Street (see notes on waterworks supply). There the beach turns northeast toward Ridge Street and I trace it no farther this morning.

October 24, 1905. Marquette, Michigan.

I worked at U. S. Land Office, transferring the swamps, ridges, and some of the notes to my maps, from Land Survey plats.

Summer Island, in T 37 N, R 19 W, has a flat rock beach. There is a harbor on the northeast shore. Bluffs 20 and 30 feet high occur on it with northeast-southwest trend.

Little Summer Island has flat rock at southeast end. There is a stony beach except in a bay on east side where there is shallow water with grass and rushes.

The point of mainland in this township has a flat rock coast or stony beach all the way around except a little strip of sand beach on border of NW $\frac{1}{4}$  Section 10.

In T 42 N, R 19 W, a hill in Section 16 is said to be 400 feet above a little lake on line of sections 9 and 16 and the north part of this township is said to be 500-600 feet above Lake Michigan (probably less than 400 feet). There is rock in northwest part of Section 16, south of the little lake, but it is in a cliff below the high knob.

St. Martins Island, in T 36 N, R 20 W, is good farm land with rich sandy loam soil and beech, maple, birch, hemlock, and balsam timber. The beach has limestone ledges 15-20 feet high and the island is about 50 feet.

In T 38 N, R 21 W, there is a sandy and gravelly beach the entire shore. The land is but little above Lake Michigan and has only a few inches of sandy soil covering a flat limestone that slopes down beneath the lake. The south 40's in Section 6, southwest corner Section 5, and north part Section 7, are marked as swamp. The timber throughout the township is largely cedar.

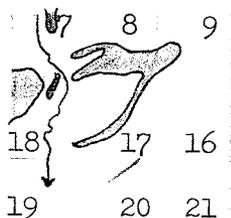
October 25, 1905.

8:00 a.m. Aneroid 29.770 at D.S.S. & A. station in Marquette. I take train to Negaunee via the southern track of the D.S.S. & A. Aneroid 29.670 at altitude 741 feet U.S.G.S. by Honolulu farm. Drift deposits are banked against the south side of the quartzite range so cuts 50 feet or more show no rock. The drift is sandy with a few boulders where below 900 feet A.T., but nearly free where above that level. There is flat topped drift at about 1,100 feet A.T. This is gravelly and has a few small boulders.

Aneroid 29.150 at 1,212 feet A.T. at Morgan; 29.060 = 1,280 feet at Eagle Mills at 8:25 a.m.; 28.940 = 1,400 feet at Negaunee Station at 8:35 a.m. I fail to get a team here on account of funeral, so return to Marquette and work at Land Office.

In T 43 N, R 23 W, the land is said to be generally level except in swamps where there are sharp knolls timbered with pine. The swamps have cedar and tamarac. The dry land outside the swamp ridges has considerable maple.

T 36 N, R 24 W is all cedar swamp except sandy ridges. See diagram.



In T 37 N, R 24 W, land is generally level with sandy soil outside the swamps. Swamps are extensive.

T 38 N, R 24 W is mapped as nearly all swamp. The dry land is level; soil sandy loam; timber, beech, maple, ironwood, hemlock, etc., and some good white pine.

In T 39 N, R 24 W, the dry land is rolling and is 2nd rate sandy loam timbered with maple, beech, birch, hemlock, basswood, etc. Swamps are mainly cedar.

In T 40 N, R 24 W, the dry land is mostly level and good soil for agriculture--a dark, sandy loam; swamps mostly cedar; timber on dry land mainly maple, beech, etc., but some white pine in eastern part.

In T 41 N, R 24 W, soil is sandy--2nd and 3rd rate--and surface nearly level, except in southwest part where there is undulating land and better soil. Beech, maple, etc., in southwest part, but in remainder, hemlock and birch on the level dry land and cedar, tamarac and spruce in swamps. Limestone is exposed in Ford River and tributaries in the southwest part of township.

T 42 N, R 24 W has a sandy and sandy loam soil, 2nd rate, with beech, maple, etc., on dry land. There is a larger amount of dry land than in townships south yet there are 3 large swamps (see map).

T 43 N, R 24 W is largely swampy land. The dry land is rolling, 2nd rate sandy loam soil, with beech and maple timber. Swamps are tamarac, cedar, spruce, and alder.

In T 44 N, R 24 W, the ridges are birch, maple, hemlock; the swamps cedar, tamarac and spruce. See Marquette County map and notebook 207 for townships from here north to the lake.

T 34 N, R 25 W, on west side Green Bay, is nearly all swamp--cedar, etc. There are small ridges with sandy soil and hemlock, beech, maple, and aspen timber.

T 35 N, R 25 W is also largely swamp, less than one-fourth of it being marked dry land. There are some oval hills with trend in some cases north-south and in others nearly parallel with shore of bay north-northeast - south-southwest. A few crooked ridges occur.

T 36 N, R 25 W is about 3/4 swamp. The ridges and dry areas are irregular in trend and outline. The timber seems to be largely pine and hemlock on the dry land and tamarac, alder, elm, and ash in some swamps east of Cedar River, but cedar, spruce, tamarac, in swamps west of river.

T 37 N, R 25 W is more than half swamp. The trend of swamps and ridges is generally northeast-southwest but they have sinuous borders. The soil is 2nd and 3rd rate sandy loam with hemlock, birch, maple, and beech. The swamps are cedar and tamarac.

In T 38 N, R 25 W, numerous small ridges (drumlins?) are noted where section lines cross them and they usually trend northeast-southwest (see Cleveland-Cliffs Company map for position of those noted).

In T 39 N, R 25 W, numerous small ridges (drumlins?) are noted which I mark on the Cleveland-Cliffs Company map.

In T 40 N, R 25 W, ridges are not noted except on the south border. The land is said to be "rolling" except in swamps, and good for agriculture. Timber--maple, elm, beech, yellow birch, linden, etc. Swamps in eastern portion are mainly cedar; those in western, tamarac. There is scattered good white pine.

In T 41 N, R 25 W, soil is sand and sandy loam. Timber is maple, yellow birch, beech, white pine, etc. Land level or gently undulating.

T 42 N, R 25 W has good soil (sandy loam, 1st and 2nd rate) in southwest and northeast parts, but the west and northwest are called inferior land. Maple, beech,

T 43 N, R 25 W has numerous knobs noted that may be rock. The dry land is generally rolling and good 1st and 2nd rate soil with maple, yellow birch, linden, ironwood, etc., except on northeast side of Escanaba River where there is a poorer soil with hemlock, spruce, yellow birch, etc. Knobs are colored red on Cleveland-Cliffs Company map.

T 44 N, R 25 W has a rolling broken surface except in swamps, and these have occasional sharp ridges. The soil is 2nd and 3rd rate--sandy. Timber, hemlock and some maple, yellow birch, and white pine.

T 33 N, R 26 W is on shore of Green Bay and is largely swamp but has ridges 1/8 to 1/2 mile wide. Those near bay trend about parallel with it, but in the west part they run nearly north-south. Soil on ridges sandy.

T 34 N, R 26 W is nearly all swamp but has ridges running north-northeast - south-southwest across it with 2nd rate soil and beech, maple, elm, etc. These may be morainic ridges.

T 35 N, R 26 W is similar to the township south with ridges trending north-northeast - south-southwest and more than half the surface swamp.

T 36 N, R 26 W has broad tracts of dry land on which soil has admixture of clay. Surface level or gently undulating. There is a tendency to northeast-southwest trend of swamps and ridges.

T 37 N, R 26 W similar to township south of it, and ridges and swamps trend northeast-southwest.

T 38 N, R 26 W has numerous oval hills (drumlins?) which I have copied on map of Cleveland-Cliffs Company. There are also two long ridges east of Powers. Land is gently undulating; soil a sandy loam. Timber, hemlock, maple, beech, elm, linden, etc. Nearly half the surface is marked as swamp, but these low tracts are likely to be the sags between drumlin ridges, and may have a heavier clay soil than the ridges. The ridges are classed as 2nd rate soil.

T 39 N, R 26 W shows the elliptical hills nicely and I copy them on

Cleveland-Cliffs Company map. Some are over a mile long and less than 1/8 mile wide. The soil is sandy loam, called 2nd rate. Timber is maple, hemlock, and a little white pine on dry land. The swamps have cedar, spruce, and tamarac.

T 40 N, R 26 W has elliptical hills finely developed (see map). The soil is classed as sandy loam, good for agricultural purposes. Timber, maple, hemlock, white pine of good quality. In swamps, cedar, spruce, and tamarac.

T 41 N, R 26 W also has elliptical hills as indicated on the Cleveland-Cliffs Company map. There are broad swamps in the central part that fork and run into the northwestern part and also extend southwest to corner of township (see map).

In T 42 N, R 26 W, the land is mostly rolling and has a sandy soil--2nd rate. There is but little swamp land, except in the southeast corner. Timber, maple, linden, (spruce, and cedar in swamps.)

In T 43 N, R 26 W, there is a rolling country with 2nd and 3rd rate soil. The timber is birch, linden, ironwood, etc., on dry land; cedar, spruce, and tamarac in swamps. The swamps are small except in southern part.

T 44 N, R 26 W is said to have gravelly and sandy land, good to second rate, with hemlock, maple, birch, white and yellow pine. In the northwest part swamps are extensive.

In T 45 N, R 26 W, land is said to be gravelly land, as if plains. Timber, maple, birch, white pine, etc. The townships north are in the rock hills.

I now take up the east end of Northern Peninsula.

T 41 N, R 1 E is mainly Cheneaux Islands, and has no swamp.

T 42 N, R 1 E has scarcely any swamp. A high ridge is noted on line of sections 29 and 30 and a maple ridge NE $\frac{1}{4}$  Section 16 and SE $\frac{1}{4}$  Section 9. Limestone at surface on line sections 3 and 10; 20 and 21; 21 and 28.

In T 43 N, R 1 E, limestone ledges are noted in Section 29 running northwest-southeast through center and in north part sections 33 and 34. Scarcely any land marked as swamp.

In T 44 N, R 1 E, the land is largely classed as swamp for several square miles in northwest part and along shore of Munuscong Bay in east part.

In T 45 N, R 1 E, there is a large amount of swamp in the south and east parts and in sections 8, 9, 10, 15 and 16. There is also much swamp in sections 1, 2, 11 and 12 but there is a ridge at the section corners.

In T 46 N, R 1 E, the clay land in sections 2, 3, 4, 8, 9, 10, 11, 15, and 16 is classed as swamp but, really, the only swamp is along the edge of St. Marys River in sections 12, 13, and 24.

In T 47 N, R 1 E, there is swamp on Sugar Island along line sections 11, 12, 13, and 14. The clay upland in sections 18, 19, 30, 31, and 32 is marked as swamp. There is also a strip of swamp along base of Nipissing beach.

T 41 N, R 2 E is on shore of Lake Huron and not marked swampy, except on north edge of Section 1.

In T 42 N, R 2 E, are several large swampy tracts (see map of Upper Peninsula Land Company).

In T 43 N, R 2 E, the swamp covers all the township below the Nipissing beach except small areas in sections 1, 2, 3, and 12 (see map of Upper Peninsula Land Company). There is very little swamp on Neebish or Sugar Islands and those are shown better on the chart of St. Marys River.

In T 41 N, R 3 E, no swamp is indicated.

In T 42 N, R 3 E, large swamps occur as indicated on map of Upper Peninsula Land Company. Nearly all the drainage basin of Carp River is swamp and it runs from there southeast to Caribou Lake.

In T 43 N, R 3 E, there is a high tract timbered with maple, beech, hemlock, etc., in the northern part, and another in the southeast part at Raber. Between them is a swamp in sections 18, 19, 30, 31, 29, 20, 21, and 16 (see map of Upper Peninsula Land Company).

In T 41 N, R <sup>5</sup> E, on Drummond Island, there is a swamp in west part Section 2 and east part Section 3.

In T 41 N, R 4 E, on Detour Peninsula and west end of Drummond Island, the land appears to be nearly free from swamps.

In T 42 N, R 4 E, there is a swamp in west part in sections 19, 30, 31, and 32.

In T 42 N, R 5 E, very little swamp is shown.

In T 43 N, R 5 E, are some islands, but they seem to be dry land.

In T 41 N, R 6 E, on Drummond Island, is a swamp in much of Section 6 with an arm along line of sections 7 and 8 to north end of a small lake. There is also a little swamp in northeast part.

In T 42 N, R 6 E, there is swamp in sections 33 and 34 and south sides of sections 35 and 36; also on a stream in sections 13, 12, 11, and 14.

In T 43 N, R 6 E, there is mainly naked limestone. The remainder of the island is classed as rolling and rocky.

In T 41 N, R 7 E, on Drummond Island, no swamp.

In T 42 N, R 7 E, considerable swamp in sections 6, 7, 8, 16, 17, 18, 19, 20, and 21, bordering a stream that drains west. There is a ridge in sections 6, 5, 4, 8, 9, 10, 16, 15, 21, 22, 27, 26, 34, 35, and 36, with rolling surface--maple and birch timber; rough, stony surface. Is it followed by a moraine? Professor Russell's report states that an undulating stony clay occurs on this island that suggests a moraine.

T 41 N, R 1 W is largely in Cheneaux Islands and shows the drumlin forms. No swamp.

T 42 N, R 1 W has swampy tracts, as shown on the Upper Peninsula Land Company map. The deep red color in sections 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, is swampy land.

In T 43 N, R 1 W, the large clay tract and nearly the whole northern 2/3 of township is called swamp, but really it is swampy only in strips such as that along Taylor's Creek. The deep red color on the map extends to the southern limits of what is marked as swamp.

In T 44 N, R 1 W, the deep red color extends to the northern limits of the swamp land.

In T 45 N, R 1 W, there is swamp among knolls in sections 1, 2, 11, and 12. There is a large swamp running from section 23 and northwest corner of Section 26 west-northwest through sections 21, 16, 17, 18, and 7, and north over east part of Section 8 and much of sections 9 and 4. Its east limits in this north fork are not given clearly. There is also a swamp in Section 36 and east part of Section 35.

T 46 N, R 1 W is marked as all swamp except the high knoll at corner of sections 29, 30, 31 and 32.

T 47 N, R 1 W is marked as swamp below the Nipissing beach from sections 28 and 29 north.

T 42 N, R 2 W is represented to be largely swamp except some limestone tracts. See map. The townships north from here are poorly differentiated.

In Townships 41, 42, and 43 North, R 3 W, I have the high tracts outlined on Upper Peninsula Land Company map.

T 44 N, R 3 W is classed as all swamp.

T 45 N, R 3 W has strips between tamarac swamps that are probably sandy. I give them a pencil color on the map from Tackaberry atlas.

In T 46 N, R 3 W is a wet tract between the red clay and the pine plains in sections 22, 23, 24, 26, 27, and 34, as indicated on the Tackaberry atlas map. This map also shows the position of the border of the pine plains.

October 27, 1905.

Mr. Mark Elliott, county clerk, says that in T 47 N, R 26 W, the hardwood and fertile soil extends from Negaunee south to the range of hills in sections 27, 28, 29, and 30, but south of this range is a sandy, gravelly soil. Sections 25 and 26 are barren soil and much of Section 24. The whole of T 46 N, R 26 W

has poor soil with some pine and dry land, but tamarac and cedar are wet land. The only hardwood he knows of in the township is in Section 4.

Most of T 45 N, R 26 W is land that has been lumbered for pine. There are only a few knobs in this township, and there is considerable flat land in the north half. In the southern half there is a strip of hardwood running east to west. It starts at Austin Mine and runs west beyond Bass Lake. (See Mr. Jackson at the Princeton Mine). This is more rolling than the pine land and may be a moraine.

There is a great belt of flat country southwest from Ishpeming, setting in south of the Saginaw and New England mines and running south beyond Escanaba River.

T 46 N, Ranges 27 and 28 West are largely a poor quality of soil, like T 46 N, R 26 W.

October 28, 1905. 6:50 a.m.

Aneroid 29.900 at depot of D.S.S. & A. Railroad in Marquette. I take train to Negaunee. Aneroid 29.230 = 1,280 feet at Eagle Mills; 29.100 at summit by cemetery in east part of Negaunee on east edge of gravel plain; 29.135 at Negaunee at 7:30 a.m.;

I go southeast about 2 miles on the road toward Palmer and find that the soil is a sandy and gravelly loam among the hills. There are few knolls of drift, but boulders are numerous. It seems likely that the ice border ran west from near Cascade Junction past Negaunee. There are very high hills, 1,600 feet ±, west of Goose Lake.

I interview Napoleon Marketty, a landholder at Negaunee, concerning the hardwood belt in T 45 N, R 26 W. It covers much of sections 22, 23, and 24 and southeast part of Section 13, northeast part of Section 26, and much of Section 25. There is considerable swampy land north of this hardwood belt in sections 14 and 15.

In sections 16 and 21 is pine land, and this runs southeast across north-east part Section 28 and north part Section 27 into Section 26. There is hardwood in sections 28, 29 and 30 and north from there in sections 17, 18, 19 and 20. Most of sections 31, 32, and 33 is pine. Section 34 is wet land.

Aneroid 29.100 at Negaunee at 9:15 a.m. = 1,365 feet, I take train on C. & N.W. to Swanzey. The swamp west of Partridge is tamarac and spruce. Low drift hummocks among low rock hills south of the swamp. High rock hills east. Goose Lake has high rock hills with hardwood timber north, south, and east of it. A few low drift hummocks along the south side of the narrow southeast arm but generally rock hills with but little drift. On the north side the hills have bare rock.

Aneroid 29.300 at edge of pine plains at outlet of Goose Lake = 1,185 feet; 29.280 on higher plain at Gentian = 1,230 feet  $\pm$ . The pine plains run southwest across the southeast part of T 47 N, R 26 W with only an occasional knob rising above their level. Aneroid 29.340 by Powell Lake, 10 feet  $\pm$  above water in Section 9, T 46 N, R 25 W = 1,150 feet; 29.350 at Sands Station = 1,202 feet; 29.420 at Swanzey Station at 9:45 a.m. = 1,140 feet  $\pm$ .

I take stage to the Swanzey Mine. Aneroid 29.475 at the slough 3 miles west of Swanzey = 1,090 feet  $\pm$ . This has a valley  $1/4$  mile  $\pm$  wide and 20-25 feet deep. West of this slough is an outcrop of granite a little lower than the sand plain. It is glaciated but I see no well defined striae. There is an appearance, however, of a southwest movement.

Aneroid 29.340 at Princeton Mine = 1,200 feet  $\pm$ . I am told there is 100-foot available fall on Escanaba River at and below the cataract in Section 11, T 45 N, R 26 W, within  $1/2$  mile. This is just below the "run around". This island enclosed by the run around is mainly all swamp.

B. A. Middlemiss of the Princeton Mine tells me there is jack pine over the northwest part of T 45 N, R 25 W--much of it level. Borings in southeast

part of T 45 N, R 25 W have 100-275 feet of drift. There is a little pine in sections 12 and 13, T 45 N, R 26 W. The hardwood (sentence not finished).

There is white limestone up the main Escanaba, mile above mouth of West Branch and about 2 miles up the West Branch from mouth.

Around the mines in sections 18, 19, and 20, T 45 N, R 25 W there is bouldery, gravelly drift in hummocks and also of considerable depth aside from hummocks. Rock is exposed at only a few places.

After dinner I start westward and find gravelly, bouldery drift for over a mile west of Princeton Mine and hardwood timber. There is a range of rock knobs north of the road and from this range north is pine timber. I enter a flat-surfaced pine tract in Section 13, T 45 N, R 26 W that lies between the hardwood and a tamarac swamp south of the "run around". It has gravelly soil. There is a little dry land 25-30 feet above the swamp, just east of Mud Lake with rock at surface (granite). Mud Lake has a flat pine tract north of it that is not swampy.

Aneroid 29.340 at Mud Lake at 1:30 p.m. West of the lake the road crosses a low gravelly, bouldery rise of ground which probably has a rock nucleus. West of this, past the forks of road, is a plain timbered with pine and having a sandy gravel soil. Aneroid 29.325 at forks of road 1 mile west of Mud Lake at 1:50 p.m.

I take the lefthand road leading southwest toward Maitland and Pike Lake. It rises to a higher plain (Aneroid 29.260-270) that is timbered with pine and has a gravelly soil. There are a few boulders where the road ascends to it but there seem to be none back from the north edge. There are a few basins, 10 feet or so in depth, and an occasional low swell of similar height. The plain seems to slope southwest, for in a mile farther, the aneroid reads 29.300. This suggests an ice border along its north edge. This edge trends northwest-southeast.

I enter a belt of hemlock timber north of Pike or Maitland Lake that has a gravelly, sandy soil but no boulders. It is cut up by sloughs 15-20 feet deep and a few rods wide otherwise, it has a plane surface. Aneroid 29.310 on the general level of this tract at 2:45 p.m.

At a camp in Section 29 at south side of section, known as Camp 1 of Stearns, just being built, boulders set in, and I am told they run northwest past Camp 11 and Camp 10. The Camp 11 is probably in Section 19. I follow the railroad track southwest, rising into a strong moraine as soon as I leave the camp. Aneroid 29.210 at a crest nearly a mile from the camp. This is a very bouldery ridge but lower ridges northeast of it are sandy and gravelly with no boulders. From this high ridge southwest along the railroad the ridges are sharp, like eskers, and contain numerous boulders. There is sand and gravel under the boulders. They seem to be thickest within 5 feet of surface. The ridges are winding and irregular and make a strongly morainic tract. Some ridges rise very abruptly 60-75 feet.

I cross a cedar swamp draining southeast. Aneroid 29.300. This probably leads into Bass Lake. It is 1/8 mile or less wide. West from here for 1/4 mile or more up to a small lake the stream is bordered closely by morainic hills. I continue west and ascend nearly 100 feet to a high plain that lies outside the moraine. It is timbered with small pine and poplar and is about 1/2 miles wide. Aneroid 29.200 at its east edge. I cross it westward and come to a high, bouldery ridge. Aneroid 29.100 on crest; 29.220 at base, east side. From this I can see the moraine sweeping around in a curving course north of here so that it soon bears westward. The plain seems to run west only 1/2 miles. West of this ridge is rolling land.

Aneroid 29.320 at Camp in Section 3, T 44 N, R 27 W, at 6:00 p.m. This is a sandy plain bordering the north branch of Escanaba River in this vicinity. Mr. White, the farmer, tells me that in T 45 N, R 26 W there is level hardwood in Section 18 with little or no swamp. In Section 17 there is pine. Section

19 is very hilly with morainic topography and this runs west into T 45 N, R 27 W. The moraine runs from sections 19 and 30 eastward through sections 29, 28, 27, and 26 and north part of sections 33, 34, and 35. There is swamp south of it in Section 34 and pine plains in sections 31, 32, and 33.

The outwash apron that I passed through is in north half of Section 26 and it extends northwest over most of Section 22, T 45 N, R 27 W, but is swampy in Section 22. The south half of Section 26 is morainic and Section 27 is all morainic except the northeast corner, so this outwash apron is very local. The high hill I noted elevation of is in NE $\frac{1}{4}$  Section 27. There is a very high point in west part of Section 14 and granite boulders are numerous there. There is another very high point in Section 4 of that township. Sections 3, 4, 9, 10, 11, and west part of sections 12 and 13 are morainic.

There is an extensive plain with swampy land in part, and part a sandy plain, covering the south half of sections 35 and 36 and SE $\frac{1}{4}$  Section 34, and running down the North Branch into T 44 N, R 26 W. There are large swamps in T 44 N, R 26 W, as indicated in the land survey plats. The island in sections 8 and 9 is largely low, level land timbered with pine, but the east end is higher.

In the southwest quarter of T 44 N, R 26 W there is ridgy land--probably morainic. A prominent ridge, higher than the tree tops, runs from Section 31 eastward to Section 34. In T 44 N, R 27 W, sections 1, 2, 11 and 12 are largely sandy plain.

A boring in Section 8, T 41 N, R 24 W, is 496 feet. It entered limestone at 8 feet. At 350 feet a reddish rock called granite was struck. It was probably sandstone for the remainder of the well is through sandstone. The water flows in weak stream. It is located in a swamp. It is a 4-inch well made in 1901-02.

Notes from back of Notebook No. 207

From Munising Railroad profile:

Dixon	814'
Au Train bridge	787'
Water	750'
Swamp about Mile Post 12	834'
Vail summit	934'
Mile Post 9, sag	917'
Stillman (on track)	930'
Munising Junction on D.S.S. & A.	804'
Munising, Railroad, under	782'
Hallston, about	704'
Highway northeast of Hallston	681'
Depot at Munising	627'
Swamp at Mile Post 1, about	613'
East Branch (see profile)	

Polaris water has been analyzed qualitatively and sodium bicarbonate found and some potash and a little sulphur. It is not highly mineralized. Another spring on Mr. Cox's farm is so highly mineralized it will kill trout.

Aneroid 29.265 = 720 feet; 29.210 at 773 on Presque Isle Spur.

674 at bench mark south side of Post Office; 678 at Fourth and Washington; 686 feet at Fifth and Washington streets; 692 feet at Sixth and Washington. The 690-foot beach runs near Washington Street from Seventh Street east to Front Street, crossing it between 5th and 6th streets.

In Section 30, T 48 N, R 26 W, on Negaunee road, beach at 590 feet above lake is 200 yards wide with longer behind upper along base of rocky knobs. A lower beach  $1\frac{1}{2}$  miles southeast with swamp back of it. One mile farther south is delta of north branch of Carp River. This is cleared and has farm house on

it. Level is nearly that of the highest beach. Near Eagle Mills a valley has gravel plains and terraces seen to good advantage  $1\frac{1}{2}$  miles east near abandoned iron furnace where road ascends to the high plain.

A very high plain  $1/4$  mile northwest of Eagle Mills station at altitude 110 feet above station, or 790 feet above the lake.

-o-o-o-o-o-o-o-o-o-o-o-o-o-