

Notebook No. 205 - Leverett

COUNTY

Alger: 14-21, 52-57

Chippewa: 13, 26, 30, 31, 46-48

Luce: 1-14, 15, 21-23, 30-31, 48, 50-51

Mackinac: 24-30, 31-46, 48-50

Schoolcraft: 7, 51-52

I N D E X

N O T E B O O K N O . 2 0 5

(September 9 to September 21, 1905)

- Sept. 9. McMillan, Luce County, Michigan to Newberry.
- Sept. 10. Drive from Newberry with Davis and Tower to Halfway House.
- Sept. 11. Walked southwest into pine plains and back. Drive with Davis to McGarvey's homestead Section 11, T.48N., R.10W., and then walk northeast to Lighthouse at mouth of Two Hearted River.
- Sept. 12. Davis, Tower and I follow beach of Lake Superior west past Deer Park to Perry's Landing.
- Sept. 13. Walk Perry's Landing to Grand Marais. Drive south to highest beach of Lake Algonquin.
- Sept. 14. Drive from Grand Marais southeast to Island Lake and walk to Newberry with Davis and Tower.
- Sept. 15. Newberry to Soo Junction and Mendrie by rail. Walk to Fitch and Osborne quarry and caves. By rail to Trout Lake and Gilchrist and return to Lewis.
- Sept. 16. Walk Lewis to Trout Lake. By rail Trout Lake to St. Ignace. Drive to Rabbits' Back peak.
- Sept. 17. Drive northwest from St. Ignace to Gros Cap and back. Afternoon at court house with county surveyor, C. M. Whiteside. St. Ignace waterworks supply (p. 69 of notebook).
- Sept. 18. By rail St. Ignace to Allenville. Stage via Brevoort Lake and Pt. aux Chenes to Brevoort and Pt. Epoufette. Well data.
- Sept. 19. Pt. Epoufette to Rex and a quarry in Section 6, T.44N., R.3W. Striae at quarry, bearing S50°E to S20°E, altitude 900 feet ±.
- Sept. 20. Walk from quarry northwest to Newberry. Flowing well. Take train Newberry to Munising.
- Sept. 21. Notes around Munising and drive northwest to Train Point and back.

September 9, 1905, 5:20 p.m.

McMillan, Michigan. Aneroid 29.560 at station on South Shore Railroad = 734 feet at south edge of a swamp. (See notes October 1916 and letter from Road Surveyor.)

The Coopersage Company have a well 60 feet \pm deep on slope south of here with head about -16 feet. Aneroid 29.530 at well = 750 feet.

The schoolhouse well on the terrace is 30 feet deep. That has considerable water. Driven well, $1\frac{1}{4}$ -inch. The wells go through clay to a sand.

A well at Hank Hank's at about same level and nearer brow of terrace is only 50 feet. Aneroid 29.510 = 780 feet.

Aneroid 29.505 at schoolhouse at 3:35 p.m. There are numerous boulders on the terrace near schoolhouse. Aneroid 29.500 at south edge, 40 rods south of schoolhouse = 790 feet.

Aneroid 29.785 at top of bank or edge of a higher terrace. It has strips of clay in the sand where road rises to it. There are low sandy ridges scattered over this terrace. There is a beach at south side of this terrace, aneroid 29.440 = 340 feet \pm . It has a fine field of corn on it-- the best I have seen in the Upper Peninsula. It is about to the roasting ear stage now.

There is a plane strip between this beach and the high land that sets in just south, rising to 364 feet. Aneroid 29.320 at top of hill = 965 feet at 3:50 p.m. There are boulders on surface here; each side of the road are points 40-50 feet or more higher that are bouldery and morainic. I am not able to make out a definite beach above the one at base of this bluff which is about 364 feet A.T.

Aneroid 29.400, 875-880 feet, a few rods north of center of Section 9 on a ridge that looks a little like a beach fronting south. It is not, however, a clearly defined shore. The drift is all rather sandy here and the

surface uneven. Aneroid 29.410 at crossroads in Section 9--center of section--at 4:10 p.m. = 871 feet. For 3/4 mile east there is very little change in altitude but there, a descent of 30 feet or more is made in a short distance. Aneroid 29.445 at foot of descent = 840 feet. A narrow ridge is then crossed that seems to start near this road and run southwest. Aneroid 29.435 at top. It is a gravelly sand and, being at the level of the beach that I crossed south of McMillan, suggests a shore line at 840 feet. The aneroid drops to 29.460 just east of this ridge. The ridge is 20-30 rods wide. This is probably near center of Section 10. Aneroid 29.470 in sag on north side of a lake near line Sections 10 and 11. The lake is perhaps 20 feet lower or a little less than 800 feet A.T.

Aneroid 29.450 = 800 feet on plain 1/4 mile farther east. There are only occasional boulders along this road thus far. There is a deep basin with marsh in it on north side of road in Section 12 and the lake south of road discharges through it. Aneroid 29.435 at outlet at 4:40 p.m.

East of this outlet is a bouldery and gravelly tract with numerous limestone blocks. Aneroid 29.450 = 800 feet on the ridges. These have perhaps been worked upon by lake waves but the basin and ridge topography is, of course, glacial. I pass through a huckleberry marsh near line Sections 11 and 12, aneroid 29.480. There is very little rise east of it and the soil is heavier than to the west though not a clay soil. For 1/2 mile the aneroid reads about 29.480. A descent is then begun through a boulder-strewn tract with numerous large granite boulders to the district with red clay. Aneroid 29.500, 775 feet A.T., at west edge of the clay as exposed in ditches at 4:55 p.m. This is in Section 12, probably near the center. There is spruce, cedar and birch on this clay land but scarcely any maple or other hardwood. Aneroid 29.550 at a swampy sag near town line = 730 feet \pm ; 29.550 at a small creek near line of Sections 7 and 8 at 5:10 p.m. = 730 feet \pm .

Aneroid 29.540 at the Hunter flowing well in west part Section 9 at 5:22 p.m. Altitude, 740 feet \pm . A flow was struck on south side of road 60 rods east of here near center Section 9 at only 7 feet that would run out of a pipe 3 feet above the surface. There is a bluff on south side of this well close by. About 1/4 mile farther east on south side of road in another valley is the strong spring noted September 5.

Sand sets in here about 60 rods from east line of Section 9 where the road begins to ascend the hill to the schoolhouse. The clay, therefore, runs fully 3 miles on this road and it swings around on south side the schoolhouse hill and runs east to Twin Lake and thence north past the Peterson well.

I reach the schoolhouse corner at 5:35 p.m. Mr. Tower joins me here. He took a road east from North Manistique Lake in Section 17, T.45N., R.11W. to the Isaac Pentland well in Section 21. Aneroid 29.415 at schoolhouse at 5:50 p.m. = 850 feet \pm ; 29.550 at creek south of Dollarville near town line = 725 feet at 5:55 p.m.; same at Dollarville at 6:10 p.m.

Mr. Tower made following notes on the trip from Section 17, T.45N., R.11W., east to Mr. Van Dusen's in Section 20, T.45N., R.10W. Mostly clay in Section 17 (south half); sandy soil in places; hardwood timber. At line Sections 16 and 17 at 80 rods from south end, clay at surface and flat; occasional boulders. 2:50 p.m. at cross roads in Section 16, about south quarter post: Land to south is lower for 1/2 mile but rises farther south into a hardwood tract. Low land has spruce, cedar, etc. Hardwood from the cross roads northward to McMillan. East from this intersection of roads more sandy than west.

In Sections 15 and 22 land is more rolling with gradual eastward rise; small boulders and cobblestones numerous. At 3:25 p.m., probably in Sections 14 and 23, road becomes gravelly and there is a descent from it

southward. A road comes in from south near this gravelly land that was passed at 3:30 p.m. On the road south is a ravine 20 feet deep with gravelly banks; no water in it. At 3:35 p.m. crossed gravelly ridge 20 yards across and 8 feet high; seems to run north-south. Some limestone pebbles in it. At 3:40-3:45 p.m. in a swamp that extends north toward Section 11 where there is a lake.

At 3:50 p.m. sand ridge across road, probably in Sections 13 and 24, west part. 300 yards east numerous boulders. Ground from here east past the town line is rolling and bouldery with gravelly ridges and sandy sags.

At 4:05 p.m., at a farmhouse near town line. Well is 84 feet, nearly all through gravel. Water does not rise much in it. Has no decided mineral taste. (Well is south of road.)

4:20 p.m. About $3/4$ mile east of last well is another 53 feet deep through coarse sand. Made 12 years ago. This is near corner Sections 17, 18, 19 and 20. Very bouldery near these wells on both farms.

At 4:35 p.m. made drop of about 40 feet to a stream running north. Rise is less on east side.

At 4:40 p.m., at schoolhouse in northeast corner Section 20, by Van Dusen's.

We are joined at Newberry this evening by Professor Chas. A. Davis who is examining swamps in the Upper Peninsula of Michigan.

September 10, 1905, 2:30 p.m.

Aneroid 29.390 at Newberry = 765 feet A.T.; 29.445 at Tahquamenon River = 712 feet at 2:50 p.m.; 29.370 at swamp south part Sections 1 and 2 = 775 feet; 29.350 at schoolhouse in northeast part Section 2 = 800 feet \pm A.T. Potsdam sandstone blocks occur in the drift along the town line west from this schoolhouse.

Aneroid 29.340 a mile west in a swampy tract = 805-810 feet; 29.315 = 825-830 feet at base of ridge near middle of line Sections 3 and 34; 29.270 on top = 850 feet A.T. This height is maintained for only 1/2 mile south and there is a descent immediately to the north

Aneroid 29.260 = 860 feet at east border of small lake in Section 33; 29.250 on south border = 880 feet \pm . The lake is in a basin about 40 feet deep. There is another shallower basin south of road without water in it. Aneroid 29.290 at lake = 830 feet \pm ; 29.245 on south rim at highest point. The rim on north side is 20-25 feet.

Aneroid 29.230 at highest point on line Sections 4 and 33. This country is strongly morainic with numerous basins and rolling borders with boulders. Aneroid 29.210 on high point on line Sections 5 and 32; 29.205 on next point west; 29.200 on point 1/4 mile from west end of line Sections 5 and 32 = 875 feet A.T.; 29.225 = 850 feet \pm at corner Sections 5, 6, 31 and 32.

There is high land in Sections 5 and 6 and north half of Sections 7 and 8. There is hardwood west past the town corners and nearly all hardwood for 4 miles farther. The pine plains there set in. There is some pine in Section 25, T.47N., R.11W., but hardwood north and south of it.

There are suggestions of a shore line 80 rods east of line of Sections 31 and 32, the plain being developed at 875 feet \pm in front (west) of knolls that received the wave action. This apparent plain has sags below its level. The altitude of 875 feet \pm continues north about a mile.

There is a small lake in northwest part Section 29. The uplands are 850-865 feet here. Boulders are not so numerous as on the town line south of here. The drift is quite sandy. The highest points on line of Sections 19 and 20 seem to be 880 to 890 feet A.T., aneroid 29.185-29.190. A descent sets in about 80 rods from north end of line of Sections 19 and 20. Aneroid

29.250 = 840 feet at corner Sections 17, 18, 19 and 20; 29.275 at a marsh and small lake in southwest part Section 17 = 820 feet. There are sandy ridges on west side, 25 feet higher, or about 845 feet A.T.

Aneroid 29.210 at high point near middle of line of Sections 17 and 18 = 880 feet \pm ; 29.250 at bog 1/4 mile farther north; 29.250 at Halfway House in northwest part Section 17 at 5:35 p.m. = 845 feet \pm A.T.; 29.275 at lake east of Halfway House = 820 feet, John McLeod, proprietor.

The well here is 27 feet and has 10-12 feet of water. It was through quicksand all the way. There are patches of clay of red color on the hills here and for about a mile south, but farther south the drift is sandy.

September 11, 1905, 5:10 a.m.

Aneroid 29.160 at Halfway House in northwest part Section 17, T.47N., R.10W., = 845 feet. I go west-southwest $1\frac{1}{2}$ miles to the pine plains and find a level tract standing about 10 feet higher than at the Halfway House or 885 feet A.T. barometric. Aneroid 29.110 on the plain. There are only small pebbles in the sand here whereas on the hardwood tracts I just passed through boulders and cobblestones are frequent at the surface. The highest points crossed in the hardwood are no higher than this plain. There are numerous sags in the hardwood 10-15 feet deep, but this plain has no such sags where it fits against the hardwood belt. It seems to be an outwash apron. The hardwood is nearly plane for 1/2 mile. The pine plain runs from here west to Island Lake and covers Section 8 northwest of the lake, so I am told by Dan McLeod. It is in a recess in the moraine as indicated on the map, there being an extension of the moraine southward on the west side of it from Section 13, T.47N., R.12W., to Section 12, T.46N., R.12W. This spur running south is said to be only 2 miles wide and has

plains west of it in the southwest part of T.47N., R.12W., and in T.47N., R.13W.

Aneroid 29.160 at Halfway House at 7:00 a.m. at level of well = 845 feet; 29.165 at 8:00 a.m. = 845 feet \pm ; 29.150 40 rods north = 860 feet. There is a descent of 40 feet in the next 1/4 mile, aneroid 29.190 = 820 feet. Aneroid 29.180 on plain north of this sag.

Aneroid 29.200 at outlet of a lake on line of Sections 7 and 8; 29.210 at top of a lake bluff = 810 feet; 29.225 at base = 800 feet \pm ; this is at north edge of hardwood near the township line. There is a very bouldery strip for 40 rods south of this bluff. The bluff has cobble and boulders in a sandy matrix. The swamp north has spruce and tamarac for a short distance. Aneroid 29.230 at an old camp in north part of Section 6 = 790-800 feet.

The road turns east on a sand ridge in Section 31, aneroid 29.210 = 810 feet on crest. From this I can see the trend of the north edge of the hardwood for 3 miles nearly directly west, as shown on map. East of this road in Section 6 it swings around rapidly to the south and covers but a little of Sections 5 and 8.

Aneroid 29.240 in swamp north of sand ridge = 760 feet, in Sections 31 and 32, T.48N., R.10W., at 9:00 a.m. There is a gradual northward descent, if the aneroid is correct. Aneroid 29.250 near corner Sections 29, 30, 31 and 32. There is some hardwood and stony land in Sections 29 and 30-- birch, maple, hemlock, etc. This is no higher than the swamp south of it. Soil is sandy. This is only 1/4 mile wide on this road but it is wider east of Dawson Creek.

Aneroid 29.260, 770 feet \pm , at Dawson Creek at 9:45 a.m., near north line Sections 29 and 30; 29.285, 750 feet, at second crossing of creek in Section 20 about midway of west side at 10:00 a.m.; 29.290 at edge of hardwood burnings. It is burnt off about 1/2 mile south of the green hardwood

in Sections 7 and 8. It is gently undulating and has sandy soil.

Aneroid 29.335 at Dawson Creek, north part Section 8, T.48N., R.10W. at 11:00 a.m. = 720 feet \pm A.T. There are few, if any, boulders here. The green hardwood is not elevated land but seems to be just about on a level with the plains to the south. After crossing Dawson Creek, we enter bouldery drift and our driver says the green hardwood in Sections 6 and 31 along the stage road has bouldery drift.

As we go northeast into Section 5 we rise into a higher tract, aneroid 29.250, where the road to mouth of Two Heart River branches off. Aneroid 29.250 at Kneisley farm, about 1/2 mile northeast of Dawson Creek. This continues for 1/2 mile or more east. We then pass over sharp sandy ridges in Section 4 and west half of Section 3. The east half is morainic and so is Section 2 and north part Section 11, with numerous boulders.

Aneroid 29.200 at Mr. Hans McGarvey's in NW $\frac{1}{4}$ Section 11, at 12:10 noon = 800 feet \pm (corrected--Dan's makes it 830 feet A.T.). The well here is only 5 feet deep.

On the sandy ridges west of here in Sections 3 and 4 the principal forest tree is hemlock, but on the moraine there is hardwood, maple, birch, beach, and an occasional hemlock stub. I think the sand ridges are due to wind action. The highest ones are 40 feet. There are no pebbles on them. The swamps bordering them are about 760 feet A.T., aneroid 29.260. These sand ridges connect the two morainic tracts but can scarcely be considered morainic. Mr. McGarvey thinks the highest land in this vicinity is on the borders of a lake that lies in Sections 1 and 2, T.48N., R.10W., that is the head of the East Fork of Two Hearted River.

Aneroid 29.180 at Mr. McGarvey's at 1:00 p.m.; 29.170 at Captain Jenks, west side Section 2 = 735 feet; 29.150 on high sandy ridge near quarter post on line Sections 2 and 3 = 805 feet; 29.140 on high sand ridge

north of Stuart Lake in Section 35 = 810 feet \pm . There is hardwood on south side of this lake and on east from there across the East Branch, but north of the lake are plains extending to Lake Superior and this ridge is the highest land north of the lake and as high as anything in view south of the lake.

Aneroid 29.130 at Stuart Lake at 2:00 p.m. = 770 feet; 29.130 on ridge north of lake on highest points = 815 feet \pm . There is a little white pine on the ridge.

From east end of lake we strike east and cross a hardwood belt in Section 1 and perhaps on south edge of Section 36. There is a beach along the north edge of the hardwood. Aneroid 29.200 at base of bluff. The bluff is 25 feet \pm high. There is a sandy ridge north of this at same level, 20-30 rods or more from base of cut bluff. Aneroid 29.240 at another ridge (29.230 on crest) where we come out to a wagon road heading north between Sections 31 and 36 = 715 feet. This ridge is near the section corners. It is on the pine, but the higher one is on the hardwood only 30-40 rods southwest from here. Its border bears slightly east of south.

Aneroid 29.270 at Comstock Camp on range line T.49N., Ranges 9 and 10 West in Section 30 = 690 feet. A well here is 33 feet. Temperature, $46\frac{1}{2}$ degrees, by Davis' thermometer. Aneroid 29.240 = 715 feet at top of a bluff a mile north of camp; 29.270 at base. This is in the pine. There is a little hardwood 1/2 mile south, mainly east of road, and hemlock and hardwood most of the way to here.

We cross an alder swamp near corners Sections 18, 19, 13 and 24 north of which are pine plains with undulating surface with oscillations of 15-20 feet. Aneroid 29.280-29.300 = 660-680 feet. There are cobblestones in the sags and these were on the hemlock tract south of the alder swamp. There is a mixture of white, Norway and jack pine.

Aneroid 29.530 on low plain bordering east branch of Two Hearted River = 632 feet, Section 7; 29.345 at stream at 5:50 p.m. = 620 feet; 29.280 at forks east of river where a road leads off to Mr. Goff's = 680 feet. There are occasional large boulders on this tract and pebbles are numerous in the sand. Since the Norway and white pine have been cut the jack pine has started up. Aneroid 29.270 at next forks = 683 feet--a mile farther, on a ridge. This road goes north; the other, east. Aneroid 29.255 on plain a mile farther north at 6:45 p.m. = 700 feet \pm ; 29.250 at a ridge = 706 feet; 29.285 at base of bluff at 7:10 p.m. = 675 feet; 29.310 on bluff of Two Hearted River near mouth at 7:55 p.m. = 655 feet.

Aneroid 29.365 at Lake Superior at 8:00 p.m. = 602 feet A.T. There is a bar only 8-10 feet above lake on which the Life Saving Station No. 11 stands. The river runs on the back side of the bar. There are dunes west of here 60-90 feet high between the river and the lake. East from the mouth of the Two Hearted River the shore rises about 40 feet and, in a few places, it is higher--where there are dunes.

September 12, 1905, 6:00 a.m.

Aneroid 29.500 = 602 feet at Lake Superior shore at Life Saving Station 11; 29.405 = 690 feet on dune 1/4 mile west of station. From this dune the hardwood belt along east border of Luce County is in plain view for fully 6 miles south from the shore. It seems to be on a prominent ridge that is reported to be bouldery and uneven surfaced and, in all probability, a moraine. To the south and west nothing but pine plains are in view.

Aneroid 29.540 at Lake Superior at 8:00 a.m. We follow the beach west. The dunes are 50-60 feet, as a rule, and parts of the shore not ridged about 30-40 feet above lake level. Aneroid 29.550 at lake level 2 miles west of station at 8:30 a.m. The beach has pine for 5 miles west, or to a little

beyond where the shore changes from a southwest to a west trend. Here, birch, maple, hemlock, etc., are mixed with the pine. The shore is lower than to the east, being scarcely 10 feet above lake level. Aneroid 29.590 at lake level at 10:00 a.m. There proves to be only a few acres of this land with mixed timber. The pines hold most of the shore. White pine is scarce, most of it being Norway and jack pine. No change in aneroid from 10:00 to 10:30 a.m.

About $\frac{3}{4}$ of the pebbles on the shore are granites and gneisses and the remainder largely fine-grained, dark-colored rock. There is an occasional red quartz porphyry and other porphyritic rock. Red sandstone is not rare and there is an occasional white sandstone. Probably the waves would beat the sandstones to powder in a short time and this may account for their scarcity. The sand on the beach is charged with iron, in places very heavily. It is mainly black and yet is hematite. Where blackest, it constitutes so large a per cent of the sand that it is very heavy, apparently $1\frac{1}{2}$ -2 times as heavy as quartz sand.

Aneroid 29.605 at lake level at 11:00 a.m. There is scarcely a boulder on the beach in the 12 miles from Station 11 to Deer Park. I noticed no quartzite rocks, unless some of the red sandstones are quartzite.

Aneroid 29.640 at Deer Park at lake level at noon. The lake is cutting back to the Nipissing bluff for 2 miles east of Deer Park. The bluffs are 40 to 60 feet high and full of cobblestones up to about 50 feet above lake level. The ridges of sand above that level have no pebbles. There is higher land in view $1\frac{1}{2}$ -2 miles south and this may be the limits of Lake Nipissing. The cobbly material is a natural deposit for the Nipissing lake bed. Probably the cobblestones strewn along the shore east from here have been worked eastward from this outcrop unless, perchance,

the cobble is present there near lake level. I saw none of it on the banks of Two Hearted River, however, and none has shown on the low bluffs near Station No. 11. The shore currents are eastward here so any stones near Deer Park are liable to be carried toward Station 11.

Professor Davis went back on a ridge 1/2 mile east of Deer Park and found the altitude. The Muskallonge Lake lies southwest of Deer Park and is 28 or 29 feet higher than the present level of Lake Superior by hand level, or about 630 feet A.T. The gravel ridge between is 640 feet A.T.

About 3 miles from Deer Park is a small hardwood belt setting in at the stage road and running east a mile to the edge of Birch Lake. There is some burnt hardwood farther east. There is a belt of hardwood between Muskallonge Lake and Lake Superior. It runs east about 1/2 mile beyond the Muskallonge Lake. It has maple and hemlock, beach, birch--but largely hemlock timber. There is a rise of about 40 feet, I am told by D. H. Pratt of the Life Saving Station, at the north edge of the hardwood belt. This higher level is held south to Two Hearted River. The hardwood belt south of Two Hearted River is not much higher than the pine tract north.

Aneroid 29.645 at Lake Superior at 1:50 p.m.; 29.600 on the 640-foot ridge south of lake. We follow the shore west and soon come to a stream at base of the cut bluff. There is a terrace at 620-625 feet. Is this the Algoma hills beach? It is only occasionally preserved. There is a narrow strip of sand 20-30 feet high between the Sucker River and shore of lake for 3 miles or more above mouth of river that was formed by the eastward transportation of material along the shore, the prevailing winds being from the northwest.

Aneroid 29.700 at lake level at 4:00 p.m. at Ferry's Landing. We stop here for the night. There are no pebbles thus far on the bluff of the lake above the storm beach 6-8 feet above lake level. They are imbedded in sand

at storm beach level but the shore has, in places, nearly clear pebbles. It is probable that the sand blows back between storms and covers up the pebbles. The tract east of the Sucker River near Deer Park, that stands 40-60 feet above lake level, has well-rounded pebbles from top to bottom, apparently as well-rounded as the pebbles of the modern beach. The entire absence of boulders on this higher tract, as well as along the modern beach, seems very surprising. It is hardly probable that the boulders have all been battered into cobblestones here but more likely that they were not present in the vicinity of the shore to be left on the shore material. The large numbers in the straits such as the vicinity of Sault Ste. Marie are probably due to the nearness of the bouldery Canadian shore and the greater amount of ice that forms in straits than on the edge of the main lake. As a result, winter ice is a much more efficient transporting agent in the Straits than on the borders of the main lake. The source of the pebbles seen today is partly from the direction of copper-bearing rocks either from the north or from the Keweenaw Peninsula. The amygdaloid rocks with green pits and bands are quite common. The red sand associated with the black iron sand is thought by Davis to be garnetiferous.

September 13, 1905, 5:15 a.m.

Aneroid 29.860 at Lake Superior level by Perry's Landing, 12 miles east of Grand Marais. From the dunes just south of here we get a view of a strip of hemlock timber south of Sucker River with some hardwood with it. The country is low and dunes numerous from the lake shore south to Sucker River. The altitude south of the river is higher and, we are told, there is a double bluff there, the south one being higher than the one next to the river. The south one, it is said, runs to Grand Marais, while the north one comes to the lake shore 2 miles east of Grand Marais and forms

the point on the east side of the bay.

Aneroid 29.905 at Lake Superior at 6:30 a.m. We go west along a foot path past McLeod's warehouse $3/4$ mile west of Perry's Landing and take wagon road west. It crosses over a high sand ridge about a mile farther west and follows a low tract with lagoons. Aneroid 29.930 at one of the lagoons at 7:40 a.m. North of the lagoon is a gravelly tract 6-8 feet higher and north of this the high sand ridge 30 feet or more above the lagoon. This gravelly strip may be the work of the modern lake for it can scarcely be more than 10 feet above lake level. I go north to the lake from the lagoon. Aneroid 29.950 at lake level at 8:00 a.m. I return in 6 minutes to the lagoon and find the aneroid reads 29.950 on it also, so it is practically at lake level and the gravel bordering it no higher than a storm beach. There seems to have been a tract a mile or more wide built here by the modern shore or the strip between the shore and Sucker River yet the lake is now, on the whole, encroaching on this part of its shore, cutting very rapidly on the points that stand out and making but little addition to the shore in the recesses seldom 40 rods wide. Is this excessive cutting a change from what occurred while the lake was filling this part of its shore? If so, does the northward differential uplift come in as a cause? It would seem necessary if it does to suppose that it is now a more rapid uplift than when building of the shore was going on rapidly. It is a fact that the lake does its main cutting when at a high stage, such as now prevails, for it reaches parts of the shore that are not in reach at ordinary stages. I am not certain but it rolls up material from the lower to the higher level and builds considerably at a high level.

About a mile southwest we cross sand ridges reaching 660 feet A.T. A swamp south reads as low as Lake Superior but the aneroid may have had weather change. This tract south has a hemlock forest with a few yellow

and white birch and maples (hard, mountain, etc.). Aneroid 29.950 at this forest. This extends to the Sucker River 1/2 mile \pm . South of the river is higher land with white pine, hemlock, and some birch. It is in plain view from the top of the high sand ridges and seems to be higher than they are, or above 660 feet A.T.

We go along the north side of the chain of marshes in Section 5, T.49N., R.12W. They have willows and grass and sedge (mainly sedge *Carex riparia*). Aneroid 29.950 on the marsh; 29.900 at bridge on west-flowing Sucker River at 10:40 a.m. We go west a mile along the ditch and find course was changed by simply cutting a low sand ridge 10 feet \pm high. On returning to the bridge at 10:45 a.m., aneroid has changed to 29.880.

The current is rapid so the river here which is 8 feet below bridge must have considerable fall to the lake in the 4 or 5 miles. There is a bluff here 70 feet high (aneroid 29.810 at top) timbered with beach, maple and birch with a little hemlock. It is stony at top and there is a flat tract back of it. This is evidently the Mississippian bluff but the base is probably nearly as low if not quite as the Algoma Hills beach. I doubt if the base is above 640 feet A.T.

At 11:30 a.m. a breeze from the lake sets in. Up to this time the wind has been in the south since daybreak. As I go west I seem to descend quite rapidly. Aneroid 29.895 about a mile away from the bluff, or 625 feet \pm . The bluff runs southwest a mile or so and there turns west while the road runs west parallel and but a little south of the west-flowing Sucker River. About a mile farther I come to a swamp. Aneroid 29.910 on the swamp at 11:45 a.m. = 610 feet \pm . The bluff is about 15 feet high and is gravelly sand. The pebbles are all well-rounded like shore pebbles and range in size from about 6 inches in diameter downwards. I come to Sucker River a short distance west and this swamp is on Grand Narais Creek. The

Sucker bluff is 17 feet by hand level above the stream and is pebbly clear to top. There is no flood plain here where the road comes to the stream. The space between bluffs is not more than 78 feet. Aneroid 29.900 on the bluff = 625 feet \pm . I go northeast $3/4$ mile up the Sucker to the dam. The banks there are only 6-7 feet above the stream so there is at least 10 feet fall just below and in the dam.

I return to the mouth of Grand Narais Creek and take road toward Grand Narais on south side Sucker River that runs southwest. Aneroid 29.900 at intersection with a well-travelled road coming in from the east. The road I am on here turns from southwest to west course. Aneroid 29.920 at small creek $1/4$ mile west of road intersection at 1:00 p.m. This is within 5 feet of lake level for the Grand Narais Bay comes nearly up to here. The Nipissing bluff is only $1/4$ mile.

Aneroid 29.890 at Grand Narais; 29.925 at lake level at 2:15 p.m. The railroad track is 22' 8" above lake level, aneroid 29.900. Aneroid 29.875 = 640-645 feet at base of bluff; 29.830 = 670-675 feet at top of bluff. This is at the level of a cut bluff a few rods back and is the Nipissing. The bluff below the Nipissing is sandy with but few stones. The bluff back of it is full of cobblestones up to 10 or 12 inches. Aneroid 29.780 = 725 feet at top of bluff back of the Nipissing beach; 29.765 = 740 feet on a bar in front of the next bluff south; 29.750 = 750 feet at the base of the next lake cliff. The slope of this bank is bouldery. Aneroid 29.730 = 770 feet at a notch in the bluff, apparently an old shore line. The top of the bluff at a cemetery is 785 feet A.T.--aneroid 29.720. The surface is nearly plane up here and is bouldery material both at surface and below. The ridge $1/2$ mile west is 10 feet higher or about 795 feet.

We turn south on line sections 11 and 12 for $1/2$ mile across a plain to base of a hill, making no rise on this plain. I go east 40 rods up the

slope. Aneroid 29,670 = 830 feet at top. There is cemented sand like ledges of rock on this hill.

We go west to Sable river bluff, aneroid 29,740 = 765 feet \pm . Aneroid 29,765 = 740 feet at river by the east edge of the dunes; 29,750 = 750 feet at Grand Sable Lake. This lake has a bottom that dips at the slope taken by dune sand about 30 degrees below the horizontal. Some of the sand has iron in it here on the back side of the dunes. The dunes attain a maximum altitude of 975 to 1,000 feet A.T. I go to one that is 930 feet about $3/4$ mile southwest from north end of this lake. The highest are $1/2$ - $3/4$ mile farther southwest. Point Sable is also nearly 1,000 feet, for it shows above ridges to the west of same height as the one I am on. There is a knob of hardwood 3 - 4 miles west of the point I am on which is higher and may reach 1,000 feet A.T. About 2 miles east-southeast is land of about the same altitude as my viewpoint--930 feet \pm .

There is a range of high hardwood timber $3\frac{1}{2}$ miles \pm south of here or about 1 - $1\frac{1}{2}$ miles south of south end of the lake that reach nearly 1,000 feet A.T. and this range runs west-southwest to the Lake Superior shore.

After an interval of about an hour I come back to Grand Sable Lake, aneroid 29,740 = 750 feet A.T. (a very slight barometric change). It seems probable that the high range south of this lake has the rock of the pictured rocks as its nucleus.

I return to line of sections 11 and 12. Aneroid 29,670 = 800 feet A.T. at a sandy ridge just south and east a few rods of the road intersection. This may be a beach. I continue east over the hill with sandstone in it, noted on way out. Aneroid 29,630 at top = 830 feet \pm ; 29,615 = 845 feet at a terrace $1/3$ mile farther east. There is a rise of 15 feet or more within a short distance south of the road and there appears to be a gradual rise from there but it is in forest from 40 rods south. The drift here is a

reddish sandy loam, and small boulders are quite common.

I turn south on the range line. Aneroid 29.630 at foot of first bank about 30 rods south of crossroad, 825-830 feet. The bank is gravelly here. Aneroid 29.615 at foot of another bank 40-50 rods farther south = 840 feet. In this the material is not so well assorted. Aneroid 29.600 at top; 29.590 at base of next bank 80 rods farther south, 865 feet, just north of a road that is being cut out to the west; 29.580 at top of bank. This is a gravel and cobble bank. Nearly 1/2 mile south is another bank, aneroid 29.565 at base = 890 feet. The terrace north of it is strewn with small boulders and cobble. Aneroid 29.550 at top of bank, 900 feet. This has a flat 20-30 rods wide back of it to south. Aneroid 29.540 at a notch in bluff south of this = 910 feet; 29.520 = 530 feet on undulating upland south of here that does not seem to be wave washed. The altitude is 925-935 feet here.

The high knob I saw from the dunes is less than a mile east of here and perhaps 75 feet higher. This undulating land is strewn with large boulders and has boulders imbedded in its sandy material. The end of range line road is 1/2 mile farther south and just east of here are two sharp knolls on which aneroid reads 29.475-29.480, or about 950-960 feet A.T. They are a sandy gravel with granite and greenstone boulders and some sandstone blocks imbedded and strewn on surface. There are cuts where road is graded 5-6 feet deep. About 1/2 mile east I come to the end of the cut out road and just south of here is a knoll that reaches 960 feet \pm or more. I only go to its east end. It runs back into the forest. These knolls are sharp and probably kames.

I return to range line road and read beach levels on way back to Grand Harais. Aneroid 29.535 at highest wave cutting, or Beach No. 1 = 890-895 feet; 29.555 at Beach No. 2 = 870 feet; 29.575-29.580 at base of beach just

north of a road cut out west on line of Sections 13 and 24, Beach No. 3 = 855 feet; 29.600 at beach No. 4 = 830-835 feet; 29.610-29.615 at base of beach 20 rods south of quarter post of Sections 7 and 12, Beach No. 5 = 820 feet.

Thus far there has been hardwood, but cedar swamp occurs near Beach No. 5 with some hardwood. Aneroid 29.650 at Beach No. 6, about 60 rods north of quarter post = 785-790 feet. Nearly all cedar swamp from this to the next or Beach No. 7, 100 rods farther north or near corner of Sections 1 and 6, 12 and 7. Above this beach is a narrow strip of hardwood, very stony, that seems like a weak moraine. It stands 5-10 feet above the swamp south of it and has a wavy surface.

I go east 1/4 mile. Aneroid 29.650 at range line = 785-790 feet; 29.675 at place where road turns north. This marks change from a steep to a more gradual slope that is probably Beach No. 7 = 765 feet \pm . Aneroid 29.710 at base of bluff 40 rods north = 735 feet; 29.760 at beach No. 8 on the Nipissing beach. Levels next day make beach 670 feet. There is a descent of 10-15 feet in 20 rods to base of next bluff. Aneroid 29.815 at base of bluff = 640 feet \pm ; 29.835 at level of railroad by Grand Central Station = 625 feet.

Davis found pebbles in the dunes west of the middle part of the lake up to an altitude of 890 feet or the level of the highest beach. There are cobblestones 6 inches \pm in diameter and many smaller pebbles. The sand is blown off in many places down to this pebbly horizon. The dunes near where he saw these pebbles were 950 feet, and he estimated the highest ones to be 1,000 feet A.T. The pebbly tracts cover hundreds of acres in this western part of the high dunes. The dune building may have begun at time the highest beach was forming. The lake is in a recess which was never filled by gravel. There seems to have been a prominent point on Lake Algonquin

west of the Grand Sable Lake.

There has been a deep boring made at Grand Marais (write to Wm. Leighton of Grand Marais, Michigan for data. He is now out of town). It was a test boring by the city made to get water. It was not successful so water is pumped from Lake Superior and a municipal plant put in about 1898. The pipe takes in water from west part of town. There is not a sewer system except one short pipe from a saloon to the lake. There is a general use of the village supply. Two wells in east part of town are 6 feet and 10 feet and both enter rock. They are on lower ground than the main part of town, probably 615 feet. Sandstone outcrops in the Nipissing bluff south of these wells.

September 14, 1905.

Grand Marais, Michigan. The Nipissing beach is 635 feet by hand level. The Fort Brady is 670 feet. Aneroid 29.845 at railroad track in Grand Marais = 625 feet at 6:50 a.m.

We take road east along railroad. Aneroid 29.810 at junction with Deer Park road 3 miles east of Grand Marais. The aneroid is working toward storm, for this is 625 feet A.T. We rise to 700 feet at top of bluff about 1/2 mile east. Aneroid 29.700. Davis makes this 730 feet. It is probably not far from 715 feet. Aneroid 29.690 at foot of next bluff = 725 feet; Davis has 740 feet. Aneroid 29.650 = 750-760 feet at top of bluff; 29.645 = 760-765 feet at base of next bluff = Beach No. 8; 29.610 at a low sandy ridge = 785 feet by Leverett and 810 by Davis.

From here to Sucker River there is no ascent. About 1/2 mile east of river is a pine strip. Aneroid 29.570 at river = 735 feet. Davis reads the same. Aneroid 29.620 at top = 780 feet; 29.600 = 800 feet on general level of pine plains east of Sucker River. The plains have "blow outs" and low

dunes. There are several square miles of the plains mainly on east side of stream.

Our course this morning was across Sections 15 and 14 to the bend of Sucker River near line Sections 14 and 23. From this river we run south-southeast along east side of river. The plains reach east nearly to county line in Sections 13 and 24. Aneroid 29.600 = 800 feet by Leverett, 810 by Davis, at a small creek in southeast part of T.49N., R.13W. The bluff is 25 feet high west of creek.

We enter hardwood at McLeod's camp in Section 6, T.48N., R.12W. Aneroid 29.560 = 830 feet \pm at camp at 9:15 a.m. Davis makes altitude 850 feet. Aneroid 29.500 on high sand ridges about 60 rods southeast of camp = 890 feet \pm ; 29.575 at creek 40 yards farther; 29.470 on summit a short distance beyond where road turns southeast in southwest part Section 7 = 910 by Leverett's and 935 by Davis' aneroid. This is morainic with angular stones and occasional large boulders. The knolls reach 30-40 feet higher within 40-60 rods south or to 950 feet \pm . Within 1/2 mile farther, or in Section 18, we come to points 975 to 1,000 feet. Aneroid 29.350 on one high point just west of road. The road leads eastward in Sections 20 and 21. The lowest points are 930-950 feet and the highest about 1,000 feet.

We pass just north of a lake probably on line Sections 28 and 29 near north end. The altitude of upland here is 1,000 by Leverett's and 1,020 feet by Davis' barometer. About 1/2 mile east the altitude is still 990-1,000 feet. Aneroid 29.460 = 910 feet by Leverett's and 960 by Davis' aneroid at a lake near line of Sections 26 and 27. The bordering morainic tracts are 40-60 feet higher. There is an old camp on north side of the lake.

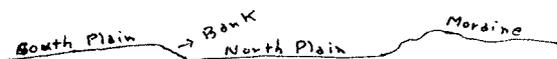
The drift all through this moraine is sandy and boulders are not numerous. We see one at intervals of about 1/4 mile. They occur generally

on slopes, as exposed by the road. There are no road gradings to show whether they are also imbedded in the drift. There are a few sandstone blocks, probably Potsdam.

Aneroid 29.360 on upland 1/4 mile east. There are several acres at this high altitude. It is quite common to find flat tops on high points. We continue through high hardwood with undulating surface to Section 8, T.47N., R.11W., at the border of the pine plains.

Aneroid 29.430 at camp by Island Lake in northeast corner Section 17 at noon = 950 by Leverett's and 1,000 feet by Davis' aneroid. Probably both are too high--875 feet corrected. (Island lake probably not over 875 feet. The aneroid readings are far from correct in altitudes.) Aneroid 29.400 at Island Lake at 12:45 p.m., where it read 29.430 at noon = 875 feet \pm . The lake is only 6-8 feet below the gravel plain.

We are in the edge of hardwood at southeast end of Island Lake and a lake southeast of it, but farther south the road runs through pine plains that had heavy pine. Wild cherry has started on parts of the plain and gives it the name "Plum Orchard". The plain is flat for about 3 miles from Island Lake. The road then rises 20 feet \pm to a higher plain dipping southward. It seems probable that the ice stood just north of this south plain



for a time and then shrank back to the north side of the north plain. The whole plain is in a recess in the moraine as shown by the county map. We enter rolling ground in Section 26 and hardwood before we strike Section 31. The soil is richer in Section 31 with more loam and more numerous boulders than in Section 26. Water stands in the depressions in the roads as if they were underlaid by clay. There were no such puddles in the hardwood northwest of Island Lake. The well at wood camps in Section 1, T.46N., R.11W., is said to be 60 feet deep and has a temperature of 45 degrees F. by Davis' thermometer. The aneroid indicates a descent of 140 feet from these wood

camps to the Tahquamenon River, of which 110 feet is made in getting down from the moraine to the swamp $3\frac{1}{2}$ miles northwest from Newberry. The moraine is, therefore, not far from 850 feet A.T. at the wood camps.

September 15, 1905, 8:05 a.m.

Aneroid 29.190 at Newberry = 765 feet. I take train to Soo Junction. Aneroid 29.205 at range line; 29.250 at Sage switch. No ridges thus far to exceed 6-8 feet in height and these are few and sandy. About a mile south from Little Sage Creek, which is $1\frac{1}{2}$ miles west of Sage Station, there is hardwood timber not more than a mile south, but from Sage it is flat and open marsh much of the way for 5 miles. There is a good view that far and the hardwood is in view beyond there.

Aneroid 29.260 = 720 feet at Soo Junction at 8:25 a.m. = 720 feet. The high hardwood is about 7 miles north-northeast of here and very prominent. There is hardwood $1\frac{1}{2}$ -2 miles south on west side of railroad. Red clay underlies the swamp at Soo Junction.

I take train to Hendrie and am in midst of swamp with no outlook far enough back from track until I pass Mile Post 40 at cabins by Bradkins and here there is a little red clay swell. Little can be seen but swamp till I pass Hendrie Station. Aneroid 29.250 = 738 feet at Hendrie, 9:00 a.m.; 29.230 at Mile Post 35 at 9:40 a.m. Although there is a rise of 19 feet from Mile Post 36 to 35 by railroad survey, it seems a dead level and is a swamp with standing water over much of it. Part of it is open marsh. The peat is a foot or so in depth. Below it is sand. I am told the hardwood each side the railroad lies northeast and northwest of Hendrie, there being none due east or west for a long distance back from the railroad.

Sand ridges set in about $1/4$ mile north of Mile Post 34 that rise 20 feet above the swamp to the north. The edge of the swamp is about 785 feet.

The sand ridges near the Mile Post are 810 feet, the Mile Post being 805 feet. There is hemlock, spruce and cedar on the ridges and the sags between them. The plain between ridges is about 805 feet near Fiborn Junction where a spur leads southwest to a quarry in Section 16. (Fiborn is contraction of Fitch-Osborn.) The ridges are 10 feet higher. I notice an occasional boulder on the flat tracts between ridges near the Junction.

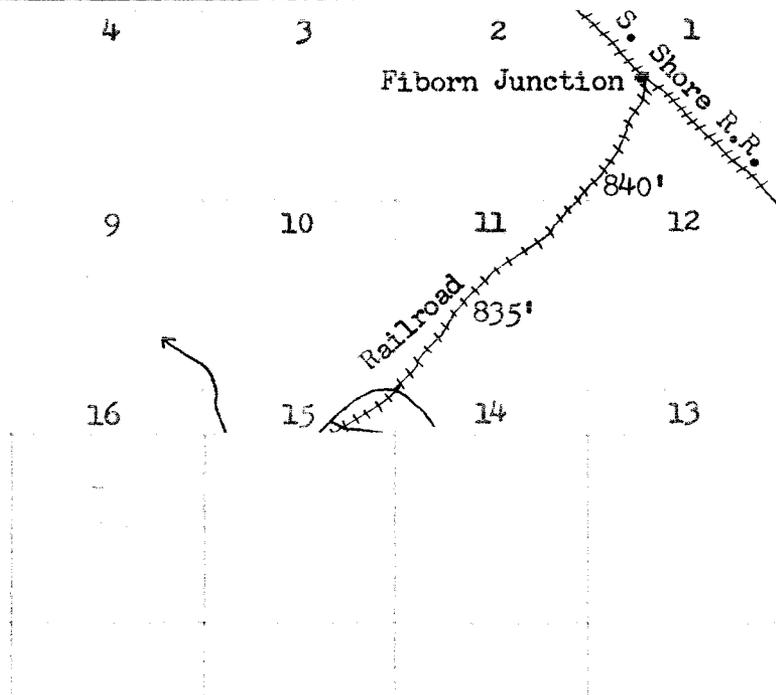
Aneroid 29.175 at Fiborn Junction at 10:20 a.m. = 821 feet A.T. I take road southwest to the quarry, rising to 840 feet within 1/2 mile of the Junction and holding this level to 1st Mile Post. It is nearly plane here with sandy material in soil and subsoil. The timber is mainly hemlock and birch. Aneroid 29.155 at 1st Mile Post at 10:45 a.m. = 840 feet. The ridges and sags differ only 10-15 feet in level for the next mile. Aneroid 29.160 at Mile Post 2 at 11:05 a.m. = 835 feet.

I cross two small streams near together midway between Mile Posts 2 and 3 and a third just west of Mile Post 3. Aneroid 29.170 at streams east of Mile Post; 29.180 at stream west. This is larger than the others. Aneroid 29.170 at Mile Post 3 at 11:30 a.m.; 29.160 at limestone outcrop 1/4 mile southwest of 3rd Mile Post. There are faint striae bearing S40°E. This exposure is in a ditch south side of track.

Aneroid 29.150 at the quarry in Section 16 at 11:45 a.m. There is rock here within 2 feet of surface but in places nearby there is 10-20 feet or more of sand on the rock. A few boulders and a few limestone blocks are imbedded in the sand. There are scarcely any pebbles in it. The quarry is near center of SE $\frac{1}{4}$ Section 16. There are caves in this vicinity into which streams discharge and pass underground. A cave just west of the camp had ice that was taken out in cakes until July 13 and the ice did not entirely disappear until about July 20. The cave was used as a refrigerator for meats, butter, etc. This cave is west of the camp about 20 rods.

The large cave at the quarry is 10-15 rods east. The channels from the two join a short distance northeast. The caves are all about 30 feet deep at the lowest sink holes. It is said that one can go a long distance underground in the stream channels. A map at the quarry office shows the courses of underground drainage for about 1/4 mile north of the caves. The eastern line is about 1,000 feet east of the stone crusher and there are numerous shallow sink holes south and east of a large one 30 feet deep, so one can easily trace the course from where the water first sinks to where it is 30 feet below the surface. The one between the camp and the crusher that is now being quarried receives the creek direct from the surface. The one west of the camp receives it through a line leading underground past shallow sink holes. Output of this quarry, 400-500 tons a day.

SKETCH OF CAVES AT FIBORN QUARRY IN SE 1/4 SECTION 16



Aneroid 29.160 at Fiborn (Fitch-Osborn) quarry at 1:15 p.m. I go back on the stone train. Aneroid 29.180 at creek near Mile Post 3; 29.160 at Mile Post 2; 29.150 on highest part of road 1/2-1 mile from Fiborn Junction; 29.150 at Fiborn Junction = 821 feet A.T. at 1:40 p.m. The sand ridge just

south of this has cut 15 feet so reaches 840 feet A.T. Aneroid 29.110 at Mile Post 32 in Section 7 in a pine forest--mostly Norway, = 842 feet. Land seems flat and is largely covered with water near Mile Post 31. Altitude 847 feet. There is tamarac for a short distance but jack pine sets in before reaching Mile Post 30 which is 860 feet. The surface is flat here but 1/2 mile farther sandy ridges set in 10-15 feet high. These were timbered with pine. There are small marshy tracts among the ridges. They reach a height of 30 feet or more high 1/2-3/4 mile northwest of Trout Lake. Aneroid 29.120 at Trout Lake = 837 feet. The high sand ridge rises southeast past Trout Lake.

On Soo Line track, about 2 miles west of Trout Lake, a bouldery strip of hardwood is crossed, aneroid 29.100. Farther west the cuts are bouldery and many have stone. These extend 4-5 miles west of Trout Lake. The railroad there enters swamp and is in it nearly to Lewis. There are sharp ridges both east and west of Lewis for 1/2 mile \pm and a hardwood belt. The hardwood runs just north of Rex and seems quite undulating like a moraine.

Aneroid 29.090 at Rex = 874 feet. There is a hardwood strip west of Rex also and I see sharp knolls southwest of Rex 1/2 mile. There is limestone in cuts west of Rex a mile or so. This has hardwood timber and is the summit on the railroad--887 feet.

At Garnet are rock ledges and large loose masses of rock (limestone) and this continues toward Gilchrist a mile or more. Hardwood timber and a slightly uneven surface--probably due to inequalities of rock surface. Aneroid 29.180 at Gilchrist at 4:40 p.m. = 780 feet. I stop off here.

There is a well 1180 feet deep at Gilchrist. Head, -70 feet. Rock is struck at 70 feet. Drift mainly sand.

There is a rapid descent from Gilchrist southwest to the plains which set in 3 miles west of this station. Sandy ridges east of Gilchrist 10-15

feet high with alder swamps among them. The ridges had pine.

I cross Black River just west of Mile Post 433 and limestone appears on the east bluff in loose masses. This stream is 769 feet. Aneroid 29.170 in cut 10 feet deep in a sand ridge $1/4$ mile east from where road turns from northeast to east course. This may be a shore line yet it is not gravelly. It runs north-south. There is much swampy land west but not east of it. No limestone seen between the stream at Mile Post 433 and this ridge. Mile Post 434 is $1/2$ mile east of sand ridge and seems to have same altitude-- 29.170 = 805 feet.

About midway between Mile Posts 434 and 435 limestone boulders and blocks become numerous and the altitude is high, aneroid 29.150 = 820 feet \pm . The crest is a ridge west of Garnet Station. The ledges set in about $1/4$ mile west of Mile Post 435 and continue east past Garnett.

Aneroid 29.140 = 840 feet at Garnett Station at 6:00 p.m. I am told the limestone only runs a mile south of the track in this belt west of Garnett. Farther south is a sandy district sloping toward Lake Michigan. The rock runs northwest from Garnett several miles to a quarry in the northwest corner of this township--T.44N., R.8W. Rock outcrops on the high land but there are swampy places where it may lie at considerable depth.

I catch a freight train at Garnet and ride back to Lewis after dark, so can take no additional notes to those made on the trip from Trout Lake to Gilchrist this afternoon. Aneroid 29.110 at Rex at 6:30 p.m. = 874 feet.

Aneroid 29.110 at Lewis at 6:45 p.m. = 864 feet. I am told by the postmaster, Mr. Caffey, that there is a boulder train running northwest-southeast across the railroad midway between Rex and Garnet and passes $1/2$ mile southwest of Strubles Lake (a lake a mile south of Lewis). There are knolls along this line and they continue about $1\frac{1}{2}$ miles beyond this lake. The swamps east

of Lewis drain both north and south. Struble Lake drains southeast. There are places on west edge of the swamp near Lewis where the railroad sounded 40 feet deep. It is a muck and quicksand or slush. The drainage from this is northward. There was 10 feet of muck with timber. This muck is peaty. The Brevoort River drains the swamp southeast from the railroad a little farther east. There is a sink hole just east of Garnet Station. The sharp knolls southeast of Lewis are sand but those southwest are bouldery and gravelly but not waterworn gravel.

Wells at Lewis (Caffey Post Office) are about 16 feet deep through sand and do not reach rock.

There is limestone at surface along the town line south and southeast from here in south half Section 34 and in Sections 3 and 4 which stands up in ledges several feet above general level. The sand ridges southeast of Lewis are along the border between the swamp and this limestone. South of these ridges drainage is southward to Lake Michigan, while north of them it is northward to Lake Superior. The swamp in the divide is east of the ridges in Sections 35 and 36, T.44N., R.7W.

September 16, 1905, 5:00 a.m.

Aneroid 29.220 at Lewis = 864 feet; 29.200, 882 feet, on gravelly knolls southwest 1/4 mile. These have limestone blocks and granite boulders and small angular stones in a loamy sand. They are evidently not waterworn as they should be if this were a beach.

Aneroid 29.220 at Lewis at 6:00 a.m. = 864 feet; 29.225 at swamp 1/4 mile east = 858 feet. Mile Post 442 is in this swamp. The swamp extends 1/4 mile west and 7/8 mile east. There is then a low sandy island, 6 feet \pm above the swamp on which Mile Post 443 stands, altitude 861 feet A.T. The island is fully 1/4 mile across east-west and has hardwood timber--birch,

maple, etc. It seems to be not more than 1/4 mile north-south. There are pebbles in the sand 2 inches or less in diameter.

At Mile Post 444 the railroad cuts the south end of another smooth sandy island. The Mile Post is 2-3 feet above marsh. There is hardwood on this also, as on the other. The swamps are largely spruce. About midway between Mile Posts 444 and 445 the railroad cuts through 2 very stony ridges 20 feet \pm high, trending northwest-southeast. The stones are largely limestone but there are also a good number of granite boulders. The limestone masses are, in some cases, several feet in diameter. The matrix is a gravelly sand. The shape is a little like a drumlin, the ends of the ridges being pointed. Another ridge lies south of the track just east of Mile Post 445 with similar height and trend.

The striae at Fiborn bear in about the same direction as these ridges and suggest that the ridges are on the line of ice movement, rather than at a right angle with it. This seems to be a similar chain to the one noted above that runs southeast from west of Rex past Struble Lake. The striae at Ozark, however, bear westward and suggest that those ridges may be morainic tracts formed by ice coming from St. Marys River this way.

I pass another knoll lying south of the railroad just west of where road turns eastward about 1/3 mile east of Mile Post 445. The flat land among the knolls is nearly all dry land. There is a small amount of spruce swamp. These ridges are timbered largely with maple.

About 60-80 rods west of Mile Post 446 the railroad cuts the southeast end of another ridge 20 feet high and 60-80 rods long, as sharp as an esker. It is full of limestone blocks in a matrix of sandy gravel. The ridges to the west from here are not so sharp as this one. A low ridge full of limestone blocks is cut near northwest end about midway between Mile Posts 446

and 447. It is only 6-8 feet high near the track but may be higher at the southeast end. The land each side is swampy--cedar and spruce. There are sandy spots a foot or so above the swamp that have pine and hemlock.

Aneroid 29.200 on a low, broad ridge midway between Mile Posts 447 and 448 at 8:00 a.m. This is 10 feet higher 20-30 rods north of track. It is full of limestone blocks. The railroad ditches are 5-6 feet and in one place expose rock in situ. The blocks are in a sandy gravel. The exposure is on north side of track and 8 feet lower. Aneroid 29.220 at top of rock ledge.

There is a ridge 10-12 feet high just west of Mile Post 448 that is full of limestone blocks. It runs nearly north-south and is mainly north of track. The broad, low ridge west of here has no definite crest so I cannot make out its trend. It seems to rise northward from track. Aneroid 29.220 at Mile Post 448 at 8:15 a.m; 29.255 at Trout Lake = 837 feet at 8:45 a.m. For a mile west of Trout Lake Station along north side of the lake is a sand ridge 40 feet or more higher than track, or fully 50 feet above the lake.

The water tank is supplied by water from the lake. It is not so hard as to scale badly. It is not cleaned oftener than once in three months.

Mr. Tower obtained following notes on wells at Newberry:

The furnace well is 80 feet and was drilled in 1902. At chemical works 100 yards north are 10 wells 92-108 feet. Last well made in April, 1905 is only 80 feet. All the wells flowed and will still flow if pumping is discontinued for a few hours. Wells are all 6-inch. At surface is a shallow depth of sand; then 16-18 feet of clay; then fine sand--almost a quicksand --40 feet. The sand here becomes coarser. Water is first struck below the clay and increases in amount with the depth. Wells drilled by James Kinney Jr. of Belleaire, Ohio. The first well was put down 128 feet but sand came

in and prevented its use. Rock (?) was struck at 126 feet, or what seemed to be rock. The water is hard with lime, as shown by coating on stills. State Geologist (?) may have samples taken at intervals of 20-30 feet. Amount used not known. Temperature not determinable because piped.

Ben Alson, 300 yards west of depot at Newberry, has a well only 30 feet that used to flow before chemical works wells were drilled and will flow now when they are not pumping at chemical works. Distance from chemical works, 500 yards \pm . The flow was 3 gallons a minute. The well penetrated sand, 3 feet; clay, 6 feet; sand to bottom.

I take train at Trout Lake at 9:30 a.m. for St. Ignace. Aneroid 29.250 = 830, 837, 842 feet; 29.235 at Ozark = 848 feet \pm ; 29.300, 786 feet at Kenneth or Palms at 9:47 a.m. This is at south end of a steep grade to Carp River. There is limestone for 1/4 mile down the slope. Aneroid 29.385 at swamp about a mile from Kenneth = 720 feet \pm ; 29.400 at a sand ridge 1/4 mile north of Carp River in cut 10 feet \pm = 690-717 feet; 29.405 at river bridge, 6-8 feet above water, making water level 695 feet \pm . Swampy to the south for nearly a mile to a sand ridge. Aneroid 29.400 in cut 10 feet, 717 feet; 29.405 at a switch by an old camp at Mile Post 14 = 684 feet.

From here there is a rapid descent to 29.440 at about Mile Post 13 = 670 feet, followed by a rise to 29.400 at Mile Post 12 = 695 feet. Aneroid 29.400 at north edge of a clearing by Moran Station = 717 profile. Moran is at Mile Post 11.1 and 713 feet. There are numerous boulders here on a plain. They are in piles in the fields and stone fences.

Limestone sets in just north of Allenville Station and the surface here is uneven. The station is at Mile Post 10.1 = 694 feet. Aneroid 29.405 at Allenville or Mile Post 10.1 = 706 profile, 694 Gan. There are little hummocks of an acre or less, 8-15 feet high. Have they a limestone nucleus? There is a rapid descent setting in just south of Allenville. The drop

seems to be to 671 feet at Mile Post 9 and 75 feet a little farther south. This probably brings to Nipissing. Aneroid 29.480 at Mile Post 8 = 632 feet and Mile Post 7 = 632 feet \pm ; 29.490 at edge of Grass Lake between Mile Posts 7 and 6 = 627 feet. The lake is only a few feet lower--6 feet \pm --or 621 feet. Pine sets in south of this lake.

Aneroid 29.490 at Mile Post 5 = 630 feet. There is a higher tract in view to the south from here, a limestone ridge on border of Lake Michigan or Straits of Mackinac. The aneroid soon drops to 29.510 = 610 feet, but changes to 29.495 at base of a limestone ridge between Mile Posts 3 and 2 (613 feet at Mile Post 3 and 610 feet at Mile Post 2) that lies north of the railroad track. This ridge extends southeast to north edge of St. Ignace. The Nipissing beach runs southward across from this limestone cliff to one south of the railroad cuts it 15 feet deep at aneroid 29.495-29.480. Reading on it would be 29.480 \pm or 630 feet A.T.

Aneroid 29.535 at lake level, 580 feet, at 10:35 a.m. St. Ignace Station is 590 feet. We go up to the court house and find it on a stony beach that is about 650 feet A.T. It runs from a cliff 20 rods south of the court house in a northward course for 60 rods to a low limestone cliff 20 feet higher than beach that runs west from here some distance but soon drops off to the east. This ridge is south of the railroad. The public schoolhouse stands on a Nipissing bar running from this ridge southeast to a limestone bluff and is 625 feet \pm .

The aneroid is changing since noon, the reading at lake level being 29.460 at lake level at 2:00 p.m. Aneroid 29.410 = 625 feet at foot of Nipissing bluff in north part of St. Ignace where the bluff faces east. The bluff is limestone and rises abruptly 30 feet \pm . Below this is a succession of gravelly ridges at intervals of 5-10 feet extending down to the modern beach. The bluff becomes higher north and rises about 100 feet above the

Nipissing and bears off to the west-northwest away from present shore which trends northwest. About 4 miles out I come to the base of a steep cliff standing out with bare walls on west side of the turnpike. Aneroid 29.400 at its base = Nipissing; 29.290 at top = 740 feet A.T. There are only a few square rods at this height but it runs back at an altitude of 700-710 feet for several rods. There is then a rise to fully 740 feet, aneroid 29.285.

Aneroid 29.425 at lake level, 580 feet A.T. at 3:30 p.m. near the sharp hill known as Rabbits Back peak in central part Section 30, T.41N., R.3W. There is a reddish shale on the flat south of the peak. Aneroid 29.385 at Nipissing beach at base of peak; 29.250 = 745 feet at top of peak. There is a geodetic station here. Aneroid 29.365 at Nipissing beach in return at 3:45 p.m.; 29.415 at lake level at 3:50 p.m. The ridge is so narrow that there is barely room for a footpath on its crest. It is about 50 rods long west-northwest - east-southeast and scarcely half as wide at base.

The nearest hill above Nipissing beach is nearly $1/3$ mile west-northwest in the northwest part of Section 30. Aneroid 29.300 = 690 feet on its highest point. It is wedge-shaped with a sharp point to the southeast. It runs northwest about $1/3$ mile. There is a cultivated field on it at a level 670 feet \pm A.T., aneroid 29.315. There is a shallow depression 8-10 feet in this field that may be a sink hole. The rim has only a small amount of waterworn material. It is 3 or 4 rods wide and 15 rods \pm long. On the west slope a few feet lower (aneroid 29.325, 660 feet A.T.) is a good beach, probably the equivalent of the Fort Brady beach. Aneroid 29.365 at the Nipissing. The higher or Fort Brady beach has been cut away on the east side by the encroachment of Lake Nipissing. This ridge is in the NW $\frac{1}{4}$ Section 30, T.41N., R.3W. It is also cut away from west side of southeast end of ridge. Aneroid 29.300 on highest point on this ridge on return to southeast end at 4:15 p.m.

A Nipissing bar 5-10 feet below level of beach connects this ridge with the Rabbits Back peak and lower ridges are shingled onto each side of the bar both north and south.

I go north 1/2 mile \pm from the Indian schoolhouse on west edge Section 30, T.41N., R.3W., to the highest ridge of the Nipissing, aneroid 29.355. It seems to run out a little west of this old Mackinac road, for there is lower ground west and north as well as south. I turn around in southeast part of Section 24, T.41N., R.4W.

On my return I find the red shale with some blue shale exposed south of the very sharp peak below the level of the Nipissing at 610-615 feet. This is probably in Section 36, T.41N., R.4W. In the northeast part of St. Ignace near a schoolhouse near line Sections 6 and 7, T.40N., R.3W., I ascend the bluff back of Nipissing beach and find it a gravel bar. Aneroid 29.320 at top = 660-665 feet. The plain back of it is 10-15 feet lower. Aneroid 29.365 at Nipissing beach at base of bluff cut on east side of this bar; 29.405 at lake level = 580 feet A.T. There is a limestone ridge with which this bar connects toward the northwest and this limestone also runs along south side of Fort Brady bar to edge of East Moran Bay.

September 17, 1905, 8:45 a.m.

Aneroid 29.300 at lake level = 580 feet A.T.; 29.225 at court house at 9:00 a.m. = 650 feet \pm . About 50 rods west of court house I come to a gravel beach on south side of road at 10 feet higher level (660 feet). The pebbles are well-rounded beach material. About 100 rods west of court house I reach a tableland, 675 feet A.T.--aneroid 29.200.

Aneroid 29.185 where road trends to the southwest about 1/2 mile west of court house = 685 feet A.T. I turn southwest and rise to a strong beach on crest of a limestone ridge, aneroid 29.160 = 710 feet. It runs southward

(bearing is S30°E) from this road. It runs north about to the east-west road and there curves around to the east and dies out on the bluff. It was apparently formed by waves rolling in from the southwest. There is a rapid descent of 50 feet in that direction on this road. I there rise gradually to a flat tract standing about 670 feet A.T., aneroid 29.200. This is thickly strewn with boulders and has a reddish clay or till under it. There are numerous limestone blocks as well as granite boulders and other erratics. This is 1/2 mile ± wide. The road then descends to a gravel beach at top of a bank. Aneroid 29.235 at beach = 645 feet A.T.--probably Fort Brady beach. There is a bluff of rotten limestone below it. Aneroid 29.260 at base of cliff--Nipissing beach. Aneroid 29.285 at another gravelly beach on the plain between this cliff and the lake. The Nipissing beach just noted here runs northwest-southeast.

Aneroid 29.310 at lake level at 9:45 a.m.; 29.210 on a cliff lying back 40 to 50 rods from the lake. It has angular blocks at top and a few boulders. There is a tableland back of it. Aneroid 29.265 at base of cliff = Nipissing beach = 625 feet ±. This is by a schoolhouse by Pointe La Barbe. There is an isolated pillar of rock about 1/4 mile northwest of the schoolhouse standing as high as the cliff north of it and distant 150 feet ±.

Aneroid 29.210 on cliff 1/2 mile farther west; Near its west end in Section 15, T.40N., R.4W. A cliff fully as high sets in west of a creek where road turns west in southeast part of Section 9 on north side of West Moran Bay. Its greatest distance from the shore is about 120 rods, 1/4-1/2 mile east of Gros Cap Post Office. About 1/4 mile north of Gros Cap schoolhouse is a very bold limestone cliff rising to about 710 feet. Aneroid 29.160 on highest point = 720-725 feet. This is a narrow ridge a few yards back from the brow. It has coarse angular blocks on it but the form is that of a beach.

Aneroid 29.275 on Nipissing beach; 29.320 at lake level at 11:00 a.m. I go north a mile and take road east. The Nipissing beach swings around the base of this hill a short distance and then runs across to another hill 60 rods north. Aneroid 29.265 on beach = 630 feet \pm ; 29.220 = 670 feet on Fort Brady beach on southwest face of limestone hill. This is strong. There is a weak ridge 10-15 feet lower only a few yards from it. Aneroid 29.170 = 715 feet on a strong beach at top of steep part of hill (Battlefield beach). This circles around to the north forming a rim on brow of bluff like a coral reef but composed of beach material well-rounded.

The road turns east and rises to the lowest Algonquin beach, aneroid 29.135 = 750 feet. It runs east on line 80 rods south of town line. A few rods east are ridges 5-10 feet higher on what seems to be the highest point on the ridge = 760 feet \pm . The road soon descends to the beach at 715 feet, aneroid 29.170, which runs around this limestone island but is weaker on the east side than on the west.

I come to the 670-foot beach at the east base of the cliff. There is a cliff 25-30 feet high back of it. Limestone at top and red shale below, near base. From the beach at base of cliff is a rapid slope down to the Nipissing beach which here borders a swamp that opens out to the west to the lake on the north side of this limestone hill. Aneroid 29.285 in the swamp. The beach is 10-15 feet higher, or 630 feet \pm .

From the hill I just crossed there is a view to a range of small hills farther north than the one noted yesterday on the north side of a lake and which runs into the north part of St. Ignace. They are apparently little islands rising above the Nipissing and possibly above the Fort Brady beach.

Aneroid 29.290 at railroad crossing in the swamp. The road comes out to the extreme northwest end of the ridge that runs north of the lake. Aneroid 29.270 at foot of hill at Nipissing beach; 29.230 in a recess in

the cliff which is filled in by the 670-foot beach; 29.195 = 700 feet on the crest of the ridge. This does not have a beach here but is covered with angular material. There are also numerous granite rocks.

The Nipissing barrier beach built at southeast end of the little lake is about an eighth mile wide and 60-80 rods long and 20 feet high. The beach is very strong on north side of the little lake, having, in places, a relief of 15 feet above a sag between it and the limestone bluff north of it. Aneroid 29.270 on Nipissing beach or bar at 12:40 p.m. = 625 feet \pm ; 29.320 at lake level at 12:45 p.m. = 580 feet.

Mr. Chas. M. Whiteside, County Surveyor, locates the castle rock I saw yesterday in northeast part Section 36, T.41N., R.4W. It runs about 1/2 mile southwest from there as a narrow ridge and passes just east and south of center of Section 36.

The northwest end of the ridge north of the little lake in Sections 11 and 12, T.40N., R.4W., is in SE $\frac{1}{4}$ SE $\frac{1}{4}$ Section 35 and passes near quarter post east side of Section 2. It is scarcely 1/4 mile in average width. Its north edge passes the range line near corner of Sections 1 and 12, 6 and 7, T.40N., Ranges 4 and 3 West.

Aneroid 29.270 at courthouse, 650 feet \pm , at 5:00 p.m. The highest points on the ridge south of the courthouse are only 715 feet A.T. The gravel beach that is so well defined 1/2-3/4 mile west of courthouse and carries waterworn material is not composed of waterworn material south of the courthouse but instead there is a rubble of angular rocks. There is a succession of narrow sharp parallel ridges 8-10 feet high and only 2-3 rods wide.

There is a very gradual slope down to the shore of Lake Michigan from the west limits of St. Ignace westward nearly to the road on which I

crossed this morning on way to Pointe La Barbe. A sharp point 100 feet above the lake comes nearly out to the present shore just within the west limits of the city and the limestone cliff extends out to within 1/2 mile of the extreme end of Point St. Ignace.

Mr. Whiteside says the small lake north of St. Ignace in Sections 11 and 12, known locally as "Whore House Lake" is not more than 20 feet deep and much of it only 6 or 7 feet. It stands about 15 feet above Lake Michigan. The bottom is nearly as low as the lake.

The islands of limestone in vicinity of St. Ignace were outlined from maps at the courthouse. One prepared for John McLeod shows the hills while the old land survey charts show the dry land (which is mostly limestone) and swamp which is low land between limestone ridges.

Mr. Whiteside has run levels to Brevoort Lake and found it about 40 feet above Lake Michigan, or 620 feet A.T.

There is a limestone ridge south of Round Lake on line between Ranges 4 and 5 West, T.41N., in Sections 18 and 13 trending north-south. Another in south part Section 17 and north half Section 20, T.41N., R.4W., trends east-west. These are the only conspicuous ones north of the one I crossed east of Gros Cap west of the one the railway crosses near Allenville. I get the outlines of all the ridges in T.41N., R.4W. The one in northeast part of township in Sections 1, 2, 11 and 12 has a red clay surface and it is thought there is no limestone on it.

There is also a ridge of red clay in Sections 20, 29, 30, 31 and 32, T.42N., R.3W., on which the Mackinac wagon road runs. This road is in sand from Carp River northeast to within a mile of Pine River--ridges of sand with swampy tracts between them. After passing a little creek in Section 3 clay and boulders appear.

The Nipissing beach probably runs along the east base of the two clay

ridges just noted. Possibly they are islands in Lake Nipissing. The high land around Allenville runs south to center of Section 9 and east to east edge of Section 4 and north over most of Section 33 and the S $\frac{1}{2}$ of Section 32 of T.42N., R.4W.

Mr. J. A. Mamieson made a well north of Moran in east part Section 19 that was in clay for 50 feet and much of the country around there is clayey.

There is said to be considerable clay shale around Allenville, though the rock comes to surface in spots. The clay is said to be of blue color and stony (Whiteside).

There is limestone at northeast edge of St. Martins Bay in Sections 1, 11 and 12, T.42N., R.3W., and bordering parts of T.42N., R.2W., from which Professor Russell is said to have taken specimens for study.

The limestone in T.43N., R.3W., seems, by the plats, to run east across Sections 20 and 21 and north part Sections 29 and 28. There is also a hardwood tract probably limestone, in Sections 10, 11, 14 and 15 with flat land around it. Most of the township is flat, red clay land.

There is high land north of Brevoort Lake but I cannot ascertain whether it is underlaid at slight depth by limestone. There is limestone along the line on west in Sections 6, 7 and 18, as indicated on map and it extends slightly into Sections 1 and 12 of T.42N., R.6W. The falls on Carp River at middle of south line Section 30 of T.43N., R.5W., are 6 feet high by the plats.

The water supply for St. Ignace is pumped from Straits, pipe being laid on bed of lake. It is pumped to a standpipe about 100 feet high. Village owns plant. It has been in operation for several years.

September 18, 1905, 9:30 a.m.

Aneroid 29.460 at lake level, St. Ignace. I take train north to Allenville. Aneroid 29.410 = 625-630 feet at Nipissing bar; 29.430 on railroad track where it crosses bar = 605 feet. The lake is probably 10 feet lower or 595 feet A.T. Aneroid 29.420 on pine plains south of Grass Lake = 625 feet; 29.415 at Mile Post 6 by southeast end of Grass Lake = 627 feet. Red clay soil northwest of Grass Lake in cedar swamp. Aneroid 29.400 = 650 feet \pm at north edge of swamp at center Section 9; 29.350 at Allenville = 706 feet profile, 694 feet Gannett.

Mr. Erskine made a well at Allenville about 150 feet; rock all the way. Chas. Sobalesky has one 125 feet and no water.

Rock is near surface here--a soft shaly material, blue color at depth of 3 feet but reddened at surface. Boulders are very numerous, both granite and greenstone and occasional large limestone blocks, apparently Niagaran.

At a north-south road $1\frac{1}{2}$ miles west of Allenville is a gravel beach running along the northeast edge of a swamp. Aneroid 29.360 = 675 feet at beach. It runs out to the range line $1/4$ mile north of the town corners and there dies out. There is a rapid slope from it down to the Nipissing shore which passes very near the town corners. Aneroid 29.400 at beach.

Aneroid 29.410 = 620 feet at Brevoort Lake at 11:10 a.m. There is a shaly tract with hardwood timber at the summer resort hotel in Section 2, T.41N., R.5W.. It rises 15 feet \pm above the lake and is strewn with boulders. A well at the hotel only 7 feet above lake level is 38 feet deep and gets scarcely any water. It is only 10 rods from bank of lake. It is the shale that causes this northward projection of the shore. Aneroid 29.390 on highest part; 29.400 on swamp $3/4$ mile south of hotel in south part of Section 2. This was probably covered by Lake Nipissing but the hardwood rocky belt was, I suppose, an island. Lake Brevoort lies within the limits of Lake Nipissing.

There is higher land in nearly all the SW $\frac{1}{4}$ Section 2 and in NW $\frac{1}{4}$ Section 11. Aneroid 29.390 at schoolhouse at center of SW $\frac{1}{4}$ Section 2. Near south line Section 2 is a bar of the Fort Brady beach (aneroid 29.370) running from the road east 30 rods \pm .

There is another gravel ridge in the central part of NW $\frac{1}{4}$ Section 11 on which Mr. Rapin's house stands. Aneroid 29.360 on it at noon. This is nearly 1/4 mile long and trends west-northwest - east-southeast. Mr. Rapin tried to get a well here and penetrated gravelly material 22 feet and struck hard rock at 28 feet.

The Nipissing bluff is at the point where the road turns southeast about 80 rods west of center Section 11 and runs toward the center and westward to Brevoort River. Aneroid 29.395 on the highest Nipissing sand ridge at base of bluff; 29.400 at swamp with red clay soil. There is a series of ridges and swales from here through to the Lake Michigan shore. The ridges are 5 to 15 feet above the swales. They are of clear sand with no pebbles.

Aneroid 29.385 at stage road at middle of line Sections 22 and 23 at 12:50 p.m. and at 1:30 p.m. I was told by Mr. Rapin that a well at the extreme east end of Lake Brevoort, 2 $\frac{1}{2}$ miles west of Allenville, was sunk 60 feet to water yet it is only 5 feet above Lake Brevoort and not 20 rods distant. It has a strong supply of good water that rises nearly to the surface. The shaly formation in this region from Brevoort Lake to Allenville and eastward from there seems to be a very poor water bearer.

Aneroid 29.400 at Brevoort River at 2:00 p.m. = 600 feet \pm in Section 9. It is about a mile from the shore of Lake Michigan. The valley is only 6-8 feet deep here below sags. The sand ridges are 8-10 feet above sags.

There is a belt of pine along the shore of Lake Michigan extending a little north of the stage road. Along the shore of Brevoort Lake is a strip of hemlock timber with scattered pine and birch. It is about 1/2 mile wide.

There seems to be no marked difference in the soil in hemlock from that in pine belts. Both have sand ridges and swales. There is a little oak along the lake shore about 3 miles southeast of Brevoort. It is south of the marsh that lies west of Lake Brevoort. Sand ridges here are 20-25 feet high.

Aneroid 29.390 at Lake Michigan $2\frac{1}{2}$ miles east of Brevoort. There is gravel 25 feet above lake level and sandy to top of bluff 40-45 feet. This is at Charles Carlson's place. At Brevoort a high tract comes out to the lake from the east. Aneroid 29.260 at level of plain = 690-700 feet. It is a gravelly sand on slopes and top. The top is flat for more than $1/2$ mile north. Aneroid 29.300 at foot of steep part of slope just north of post office = 660 feet; 29.330 at brow of lake cliff; 29.385 at water's edge at 4:05 p.m. There is hardwood timber all through this region for 3 miles east of Brevoort. Aneroid 29.250 at beach side of cemetery in west part of Brevoort at top of tableland = 700 feet. Mr. John McLeod of Pte. Epoufette says limestone is found in this bay at about 14 feet. The bluff is a fine sand. Springs are numerous along its base.

From Brevoort to Pte. Epoufette there is high land close to the shore 120 to 160 feet above Lake Michigan. It is all sandy but there is a hardwood belt a mile or more in average width fronting on Lake Michigan. The trees are generally small, seldom reaching 1 foot in diameter. North of these are pine plains extending to the north edge of T.42N., R.6W. Boulders and limestone blocks occur in the hardwood belt from about Section 17 northwest beyond a small creek at the range line. There is a slight outcrop of limestone at side of the road just west of this creek at a height of 125 feet above the lake and it outcrops, I was told by County Surveyor Whiteside, along west side of this creek for a mile or more north of the stage road. There are also outcrops of limestone eastward from the corner of Townships 42 and 43 North, Ranges 7 and 6 West on north border of the sandy pine plain.

I stop with John McLeod, the County Register of Deeds at Pte. Epoufette and he outlines the course of the south border of the high land that I entered at Brevoort. It passes eastward from Brevoort along or very near the center east-west line through T.42N., R.5W., keeping about $1\frac{1}{2}$ miles north of Brevoort Lake and probably swings around the east end of the lake to the cultivated land near Moran.

From Pte. Epoufette it runs westward, lying back scarcely a mile from shore for several miles to vicinity of Black River and then runs up the east side that stream, passing across the Sault Line Railroad 2 miles northeast of Gilchrist. The steep bluff runs about 2 miles beyond Pte. Epoufette. A lower bluff keeps parallel with shore to the bay east of Naubinway where it is only a mile north. Thence it runs to Millecoquin Lake.

September 19, 1905, 6:00 a.m.

Aneroid 29.060 on bluff in Section 4, T.42N., R.7W., near center of section. There is a sandy ridge here 10 feet \pm above ground north of it at about 700 feet A.T. Pebbles occur at the brow of bluff where aneroid reads 29.080 but there are scarcely any in the face of the bluff below. Aneroid 29.190 at level of Lake Michigan; 29.165 at Mr. McLeod's house at base of bluff at 6:30 a.m.

Mr. McLeod says there is ridged bouldery land in Sections 9 and 16, T.43N., R.7W., like that south of Lewis but east of it to the swamp in Sections 12 and 13 is a level tract with beach and maple. Aneroid 29.150 at John McLeod's at 7:15 a.m.; 29.050 at top of bluff = 700 feet \pm .

Aneroid 29.000 at place where road turns north in northeast part Section 4 = 735 feet at 7:30 a.m. There is a series of low ridges of sandy gravel here, trending west-northwest - east-southeast or parallel with the

high bluff. I reach a tableland of sandy gravel in south part Sections 33 and 34, aneroid 28.980 or 755 feet \pm A.T. at 7:40 a.m. Aneroid 28.970 at south bluff of stream near quarter post between Sections 33 and 34 = 760 feet \pm at north edge of pine plains. There is a hardwood belt north of this stream from here east. There are small boulders eight inches \pm in diameter on south bluff--granite, greenstone, etc.

Aneroid 29.040 on bridge 30 feet above stream at 8:00 a.m. There is a plain for about a mile north from this stream or to north part Section 28 on which aneroid reads 28.960. This is the reading at an abandoned schoolhouse that seems to be near middle of line Sections 28 and 29. North from the schoolhouse $1/4$ mile I cross a beach on which boulders and limestone blocks are strewn. Aneroid 28.950, 775 feet, at beach. This runs east-west.

About 60 rods north I come to base of a cut bank, aneroid 28.930 = 795 feet; 28.910 at top = 810 feet. I can see the continuation of this higher tract to the eastward a mile or more. Its south border trends about 10 degrees north of east. This cut bank here is 40 rods south of corners Sections 20, 21, 28 and 29. Aneroid 28.930 at lake 60 rods north of section corners. This higher land is on the west as well as south sides of the lake. It is ridged by wave action, the little ridges having a trend west-northwest - east-southeast. This may prove to be the highest shore of Lake Algonquin.

I go west on line Sections 20 and 29 and drop down to plain south of this high beach about 80 rods from west end where road turns north, aneroid 28.930. The beach runs into the NE $\frac{1}{4}$ Section 19 to a valley that crosses the NW $\frac{1}{4}$. I go west through center of Section 19, descending to the creek at the range line. Aneroid 28.910 on beach in east part of Section 19 at 9:20 a.m. It is very gravelly here where it curves around to a northward course.

Aneroid 28.960 at east bluff of creek in west part Section 19. There are a few large boulders here. I saw none farther east on this $1/4$ line.

Aneroid 29.040 = 700 feet at creek on line Sections 19 and 24 at 9:45 a.m. There are no rock outcrops here nor were there any on the creek I crossed in Sections 33 and 34.

I go north on range line road to Rex. Aneroid 28.950 at northwest bluff of creek north part Sections 19 and 24. Limestone blocks occur here. Aneroid 28.930, 790-800 feet, on plain at middle of line Sections 13 and 18 where a road runs east. Scattered limestone blocks here. Soil a light sand, yet farms are being made here. The farms south of the lake in Sections 20, 21, 28 and 29 have been mostly abandoned.

Aneroid 28.920 on swampy, gravelly land at corner Sections 12, 13, 7 and 18 = 800-810 feet. At an old camp about $1\frac{1}{2}$ miles south of Rex I seem to have reached the level of a beach of Lake Algonquin crossed in Sections 19 and 20, 810 feet \pm , aneroid 28.910, and there is a low gravelly ridge here 2-3 feet above bordering swamp. There are sandy ridges 3-5 feet high south of it in Sections 7 and 12. Aneroid 28.900 at north edge of cedar swamp about a mile south of Rex = 815 feet. The swamp has waterworn gravel on its northern edge. Aneroid 28.885 on first ridge in hardwood north of swamp = 830 feet. There are cobblestones 6-8 inches in diameter here. This is only 40 rods wide and has a marsh and tamarac swamp back of it. Aneroid 28.885 in marsh = 830 feet \pm . Is it a glacial ridge? or a lake feature? probably lake. There are very sharp knolls north of this stream with limestone blocks. Aneroid 28.785 on one east of road $1/2$ mile south of Rex = 920 feet \pm , time 11:00 a.m. This is 100 rods south and 20 east of corner of townships in $SW\frac{1}{4}$ $NW\frac{1}{4}$ Section 6. The knoll is a very sandy gravel. It has a notch on the west at about 885 feet that may be a lake product. Aneroid 28.860 at pond about $1/8$ mile north of the knoll = 850 feet \pm ; 28.835 at Rex Station at Mile Post 439 = 874 feet at 11:30 a.m.

I am told that a well made by Mr. Hubbell, $1/4$ mile west of Rex Station,

is into rock at slight depth. One 1/2 mile north, on the railroad line to the quarry is in rock at 10 feet and rock seems to be generally present to the northwest.

The old Algonquin shore seems to be at the ridge on edge of hardwood in south part Sections 1 and 6 and it runs from there toward Strubles Lake. Probably the ridges noted in Sections 19, 20, 28 and 29 are bars on a shoal. The rocky land reported to occur in Sections 9 and 16 would seem to place the lake border west of those sections, so it may run southward from Strubles Lake along the west side of these knolls. The altitude at Trout Lake, 837 feet, is about same as the beach south of Rex, so it is probable the Algonquin shore runs from Sections 20 and 21 toward Trout Lake, perhaps running past the south and east sides of the swampy tract at the head of the south branch of Carp River where Mr. McLeod reported dry ground. This would be in Sections 18, 17 and east parts of Sections 8 and 5, T.43N., R.6W. From Trout Lake it probably soon doubles around to the south toward Ozark and then runs east through the limestone country northeast of Palms.

Aneroid 29.810 at Rex at 12:45 p.m. = 874 feet A.T. I go north on the railroad track and for 1/2-3/4 mile am on high rolling land with boulders and a sandy gravel in the knolls. I then enter a cedar swamp that runs north fully 2 miles to a high sand ridge 25-30 feet above the swamp. It trends from north of west to south of east and is about 20 rods wide at base where cut by the railroad, apparently in northeast part Section 24. Aneroid 28.800 at top = 880-885 feet at 1:25 p.m.; 28.825 = 860 feet at level of swamp. The railroad swings westward 40 rods north of this cut in the sand ridge. There are sandy ridges northwest from here 5-15 feet high, free from pebbles. A gradual descent. About a mile northwest I come to where grassy tracts alternate with low sandy ridges having hemlock on them. Aneroid 29.850 = 835 feet at 1:40 p.m. These may be Algonquin shore lines.

I soon enter a cedar swamp and run west on it to an old camp that

stands on a low sand ridge. Aneroid 28.860 at camp = 825 feet \pm . About 7 miles from Rex the road makes a northward turn and descends to a lower tract. Aneroid 28.865 at top of bank = 820-825 feet; 28.885 at foot = 800-810 feet.

There is a creek valley here $1/4$ mile wide and stream runs westward. North of here in north part of Sections 3 and 4, T.44N., R.8W., is a morainic belt which the creek cuts through along the line of this railroad track. The gap is only 50-60 rods wide. Aneroid 28.860 at crest of moraine = 830 feet \pm at 2:10 p.m. There is a red clay in bottom of railroad cut and above this a sandy material with small boulders. The clay is crumpled and folded as if the ice had shoved against the ridge from the north.

About $1/2$ mile northwest the railroad descends to where aneroid reads 28.910, or 790 feet, in a swamp. There is a sand ridge north of the swamp timbered with hemlock. The swamp has spruce. There are a few boulders on it. The railroad soon crosses this sand ridge and then passes to west side of a north-flowing stream. Aneroid 28.920 at bridge 8-10 feet above water at 2:30 p.m.; 28.960 = 760 feet at forks of railroad $1/2$ mile beyond creek bridge. I take the western spur toward the quarry and make an ascent of fully 50 feet in about a mile. Aneroid 28.890 at a cut 10 feet deep in a sand ridge = 840 feet \pm at top of ridge at 2:50 p.m. The rapid ascent continues $1/2$ mile farther to a switch, aneroid 28.830 = 860 feet A.T. at 3:00 p.m.; 28.780 at a high till ridge full of limestone blocks just south of the quarry = 900 feet A.T.

There are striae here at west end of quarry bearing 5 degrees east of south. There are low places on the top of quarry 4-5 feet below general level that are striated and the faces of the cliffs bordering them also about S18-20 $^{\circ}$ E, but the striae on higher layers are about S5E Magn.

Aneroid 28.770 at top of ledge $1/2$ mile north of this quarry = 910 feet A.T. This has an escarpment 60 feet high facing north. Beach at base

of ledges, 850 feet \pm . This runs west a mile and then the highest part of cliff jogs south 40-50 rods while the lower part--about 875 feet A.T.-- keeps on west. The rock in the high part has no drift covering but the soil a foot or less in depth, yet there is a good hardwood forest on it. I return to the quarry and stop at the camp overnight.

There is 3-6 feet of reddish stony till on parts of the quarry that are lowest and above this 3-4 feet of sand but in the highest part there is only a soil less than 1 foot in depth. Sand extends south over the north part of the till cut made by the railroad south of the quarry 40-80 rods. The till has angular and rounded limestone all mixed together. This quarry is in the NW $\frac{1}{4}$ of NW $\frac{1}{4}$ Section 6. The ledges are in Sections 31 and 36 in Luce County (T.45N., Ranges 8 and 9 West).

Mr. Hanson, the Superintendent of quarry, tells me that the swamp north of Rex runs nearly 2 miles west of this railroad and fully 2 miles east. The sand ridge on its north border does not run far east but by going about a mile northeast on ridges we can get dry footing through to the quarry in Section 16. There is a swamp setting in $1\frac{1}{2}$ miles south of the quarry and running west some distance. It runs eastward along south side of the ridge that had clay on it. That ridge is in north part Sections 3 and 4.

There are two wells at the camp about 100 feet deep and 80 feet to water. It was all limestone (see analysis, p. 84 of notebook). A test boring was carried to a depth of about 200 feet--entirely limestone.

The limestone is mainly in NW $\frac{1}{4}$ Section 6, but not farther south and east. It runs west 2 miles or more along the county line, keeping south of road that runs west in Sections 31, 36 and 35.

Analysis of scale from boiler at quarry in Section 6, T.44N., R.8W., made by Dearborn Drug and Chemical Works, C. M. Eddy, Secretary, Chicago:



Silica	3.20%
Oxides of iron and Aluminum	1.16%
Carbonate of lime	80.08%
Carbonate of magnesium	14.01%
Sulphate of lime	1.40%
Loss, etc.	.15%
Total:	100.00%

Mr. Hanson says the Sage River swamp has a red clay soil like that at Rudyard but the Hendrie Creek swamp is more sandy and mucky. There is a little oak timber on the Sage clay plain.

September 20, 1905, 6:30 a.m.

Aneroid 29.060 = 900 feet at quarry in Section 6, T.44N., R.7W; 29.035 on highest points 40-60 rods north of the camp = 925 feet; 29.050 at brow of ledges in Section 31 = 910 feet; 29.115 at base of ledges at wagon road = 850 feet.

There is a slope to north from here of 10-20 feet to the flat land. I follow the base of ledge west about $1\frac{1}{2}$ -2 miles, holding an altitude of 850 feet. The ledge then bears away to the south while the road continues westward to Sage Creek. Aneroid 29.185 at creek = 780 feet at 7:30 a.m. There are limestone blocks on the plain bordering this creek as well as along the base of the escarpment. Granite rocks also abound.

Aneroid 29.150 = 815 feet on a sandy ridge $1\frac{1}{2}$ mile west of creek. It runs north-south here but north of road it seems to swing westward and run parallel with it in a course north of west. The creek and plain bordering it show no clay thus far.

I soon pass a clearing where some pine has been taken out. The timber to the east of here is all hardwood--largely beach and maple. Aneroid 29.160 at clearing = 805 feet. There are sandy ridges 10 feet \pm higher here or 815 feet A.T. In the next mile west sand ridges are 10-25 feet high, or 810-825 feet A.T. and are numerous. The flats have occasional boulders.

The timber is largely hemlock.

Aneroid 29.170 at small creek running north, probably in Section 28, at 8:05 a.m. = 795 feet A.T. West of it road is on sand ridge 10-15 feet high and only a few rods wide. The road soon turns northwest, crosses some corduroy and another sand ridge, and then rises to a bouldery ridge with hardwood timber, aneroid 29.150 = 815 feet \pm . The sand ridges have scarcely any pebbles unless at the base. Aneroid 29.200 at a creek flowing northeast, probably in east part Section 29, at 8:20 a.m. = 790 feet A.T. \pm . At 8:30 a.m. I come into a pine chopping at a smaller creek flowing east. Aneroid 29.190 = 800 feet at creek; 29.170 = 820 feet on north bluff.

West from here the aneroid is 815-825 feet on upland plain. I soon come out of timber to a cleared tract from which I look northwest to the asylum 3 miles or more away. Aneroid 29.150 on the railroad grade on southeast edge of this clearing = 840 feet. I leave the wagon road and follow this grade west-northwest through a plain that lies south of the moraine on which the asylum stands. It was timbered largely with beach and maple but there was some hemlock and perhaps pine.

East from here near the streams there certainly was pine with the hemlock. Some cherry and poplar are starting on this plain. Aneroid 29.130 at north edge of plain about a mile southeast of asylum = 850 feet \pm at 9:50 a.m.; 29.110 at east end of railroad track east of pumping station = 885 feet \pm at 10:15 a.m.; 29.125 at foot of bank at east side of building at upper beach = 875 feet; 29.105 at brow of bluff 80 rods north of township line on road south from Newberry = 898 feet; 29.125 at foot of bank cut by lake = 874 feet. The bouldery material in the bluff above this is likely to be glacial. Aneroid 29.180 at foot of bluff on beach 40 rods north = 850 feet \pm ; 29.180 at foot of steep slope near quarter post on line Sections 35 and 36 = 815 feet; 29.205 at foot of bank 30 rods south of section corners

= 795 feet \pm . Aneroid 29.235 at depot in Newberry = 765 feet at 10:50 a.m.

I am told by Chas. Carlson that the Homer well in Section 9, T.45N., R.10W., is 103 feet. It is mainly red clay but there was a little blue slush and water at 45 feet and it stops in the blue slush at bottom. The pipe dropped 4 feet in this slush to a coarse gravel at bottom. The casing sets on the gravel. Flow was enough to fill 2 pipes 3/4-inch. Aneroid 29.255 at Newberry at noon.

Mrs. John Carlson in east part Section 10 has well 102 feet, dug and curbed. Water comes up to surface. It was made in 1889 and has not lost head. It was all through red clay. Water comes from the blue slush. Diameter, 3 feet at bottom and 5 feet at top.

Aneroid 29.250 at Newberry at 12:15 p.m. = 765 feet. The highest shore south of Newberry bears slightly north of west for fully 1/2 mile and possibly a mile to the end of the high point southeast of Dollarville. Aneroid 29.300 at Dollarville = 725 feet at 12:20 p.m. This is 5 feet above water above dam.

The railroad is in a tamarac swamp with considerable open marsh from Dollarville nearly to McMillan. Toward McMillan a few spruce and cedar set in. Aneroid 29.285 at McMillan at foot of morainic tract (see p. 1 of notebook), altitude 734 feet. Spruce and cedar, as well as tamarac west from McMillan to Lakewood. This is at foot of moraine, aneroid 29.280. There is reddish clay on the moraine capping a gravel deposit. This is the only point west of McMillan where the moraine comes to the railroad. The divide between Lake Superior and Lake Michigan on the great swamp is a short distance west of Lakewood.

Aneroid 29.290 at east branch Manistique River; 29.270 at north side a group of hills 50 feet \pm high about 1 1/2 miles east of Seney. There are others south of track just east of Seney--sand hills. Aneroid 29.270 at Seney at 12:50 p.m. = 739 feet. There is some jack pine in view to the

north and a little Norway with it. The river at Seney is only 6 feet lower than track.

West from Seney sand ridges are generally low--10 feet or less, and there is a large amount of open marsh, part of which has been mowed. The aneroid reads 29.245 at Mile Post 84 on level of marsh = 754 feet; 29.235 at Driggs Station, Mile Post 88, on sandy ridges perhaps 6 feet above marsh = 767 feet. The stream just west of station is 8-10 feet below station. There is a sand ridge 20 feet high west of the river--the first prominent one seen this side of Seney. The strongest ridges seem to be along stream. Aneroid 29.200 = 795 feet at Mile Post 93 on a wet tract. West of this 1/2 mile are sand ridges extending past Mile Post 94 = 800 feet.

Aneroid 29.195 at Creighton Station only 5-6 feet above a stream just east of station = 800 feet. There is some cobble on the bank of stream and there is an undulating surface to the northwest that was timbered with pine and within a mile up the river green hemlock forest is standing. This proves, however, to be simply a belt along the stream. At Mile Post 97, altitude 803 feet, and west from there is marsh and tamarack with a little poplar. Hemlock forest between Mile Posts 99 and 100 for 1/4 mile, but cedar swamp at Mile Post 100 and for 1/2 mile west. A hardwood forest is entered 1/4 mile east of Star.

Aneroid 29.190 at Star at Mile Post 101 = 801 feet; 29.195 at stream 1/4 mile west. There is a cedar swamp west from here to Mile Post 102 where an open marsh sets in. The hardwood belt at Star is, therefore, only a narrow belt along east side of stream. Hemlock forest sets in at Mile Post 103, 817 feet, and west about to Mile Post 104, 817 feet. There is a narrow cedar swamp along the stream east of Shingleton but at Shingleton is hardwood with some hemlock and large pine stumps. Aneroid 29.170 at Shingleton = 827 feet. West from Shingleton there is a clearing for 1/2 mile north of track

and 1/4 mile south. There is, to the north, a rolling country heavily timbered setting in 1-1½ miles north of track. This is probably the moraine that runs westward on north side of Tahquamenon marsh. Aneroid 29.100 at a railroad crossing near Mile Post 108 = 879 feet. The moraine is entered just west of here in a cut 15 feet deep of sandy gravel. There are only shallow cuts west from here past Mile Post 111. Aneroid 29.090-29.110 on the moraine to Mile Post 111 = 885 feet. West from here it becomes higher, rising to 900 feet or more; 29.080 in cuts 10 feet deep 1/2 mile east from Wetmore (877 feet at Mile Post 112). There are boulders here and a little clay in cuts. The cuts, however, usually show a gravelly sand with cobble and small boulders.

Wetmore is on a prominent part of the moraine. Aneroid 29.110 at station = 859 feet. Parts of the village are 35-40 feet higher. There is a stream just west of the station with morainic topography on both sides. Aneroid 29.120 in cut 20 feet deep at Mile Post 114 = 846 feet; 29.150 at Mile Post 115 = 817 feet. Cuts 20 feet deep here and to the west with boulders. Material generally sandy.

Aneroid 29.170 at Munising Junction = 809 feet on a strong morainic belt at 2:15 p.m. I change cars and take train northeast to Munising which lies nearly north of Wetmore. Aneroid 29.220 at cut 15 feet deep in red clay. Above this the drift is sandy. The pebbles in this clay seem to be confined or limited to streaks, much of it being a laminated, pebbleless deposit. Aneroid 29.250 at Mile Post 4 in a ravine 20 feet deep at Hallstone (see notes September 24 and 29 as to red clay). There is a brickyard just north of this Mile Post with a pit in the red clay. Within a mile farther northeast at altitude of 750 feet ± sand and gravel sets in on the bluffs of this stream. Aneroid 29.350 where a swamp runs west back of a high hill

about a mile south of Munising. The hill is part of a range that runs north on the west side of the bay on which Munising stands. Aneroid 29.360 at Munising Station at 2:45 p.m. = 618 feet by hand level from Lake Superior; 29.380 at Lake Superior level = 602 feet A.T. There is a beach just south of depot 627-628 feet A.T. The sag back of it on which much of business part of town stands is 8-10 feet lower, or 618-620 feet A.T. The courthouse is 40 feet, by aneroid, above the lake and stands near foot of a high bluff. The base of the bluff is 650 feet A.T. The 628-foot beach is regarded, by F. B. Taylor, as Nipissing. W. C. Gordon, of Michigan Geological Survey, joined me at Munising.

September 21, 1905, 8:50 a.m.

Aneroid 29.110 = 602 feet at lake level. I level south from shore west of business part of town to top of beach (Nipissing?) and find it $26\frac{1}{3}$ on highest parts but general level is 25 feet above Lake Superior = $627\text{-}628\frac{1}{3}$ feet. Levelled down to sidewalk on north side near street = $625\frac{1}{2}$ feet for a start up hill. There is a slope rising gradually to foot of steep bluff back of a tar paper house 14.5 sights = 80 feet + 625 feet = $705\frac{1}{2}$ feet; 305 + 625 = 930 at top of bluff. (This, by Ormsbee's levels, is 966.5 feet. See notebook 206, p. 48.) Aneroid read 950 feet at 9:30 a.m. where it should be 966.5 feet. There is a gradual rise back from here to about 980 feet A.T. The depression back of it is about 930 feet. A hill south of it is 980 feet and the next one south still higher, aneroid 28.700 = 990 feet \pm . Reddish sandstone pebbles, some of them well-rounded but deeply etched and rotten, lie on the surface. Granite and gneiss are also abundant. The boulders are nearly all angular. These are of various sizes. The majority of the small stones are well-rounded like beach pebbles. Aneroid 28.730 at brow of bluff

north of here at 10:20 a.m.; 28.755 at a terrace a little farther west; 28.790 at next plain where a terrace occurs. Possibly these are land slips. Aneroid 28.810 at the mouth of a ravine that opens out at this level at face of bluff = 870 feet by Leverett; 885 feet by Gordon's barometer = 875 feet clocked; 28.745 = 945 feet by Gordon and 930 feet by Leverett = 930 on a sharp ridge west of Munising with a deep ravine back of; 28.770 on a beach at north end of point that may perhaps mark remnant of a lake level = 905 feet (very doubtful); 28.800 = 880 feet \pm at the next stop; 28.825 = 860 feet \pm at next stop; 28.850 west of this ridge in a broad flat, opening out northward to the lake = 840 feet; 28.840 at a sandy ridge running south-southeast - north-northwest = 845 feet; 28.930 at a cut bluff at base = 780 feet \pm ; 28.950 at top of a gravel pit in northwest part of Munising = 760 feet; 29.085 at base of steep bluff in west part of Munising = 650 feet-- Fort Brady? beach; 29.130 = 602 feet at Lake Superior level; 29.150 = 602 feet at lake level at 1:10 p.m.

The Munising waterworks are supplied, in part, from springs in west part of city (75,000 gallons a day) but mainly from the lake. Usual consumption, 100,000 gallons a day. Water is pumped to a standpipe 296 feet above lake level and standpipe is 25 feet in diameter and 40 feet high. Works were established in 1897. Largest pipe, 10-inch.

Drive to Train Point and back in afternoon. We turn west $1/4$ mile above the waterworks and rise to a summit at road intersection, aneroid 28.980 = 765 feet. There is a beach at this level. I walk north up a gradual slope 45 feet higher (aneroid 28.830) to base of a steep hill = 810 feet. Aneroid 28.840 at top of hill = 875 feet. There is a beach (?) here along the crest, running nearly east to west. We soon descend westward to a beach at about 660 feet formed by waves from the west side of Powell's Point. West and north of this is a cedar swamp with spruce and tamarack

that sets in at 635 feet and soon descends to 620 feet. There is a tract of 2 or 3 square miles near the old iron furnace only 610-620 feet. We go along shore northwest from the furnace on a plain 8-10 feet above the lake. There is a bluff 20 feet \pm high setting in 1/2 mile west of furnace and running parallel with the shore--probably same as the beach considered Nipissing by Taylor. The road turns away from the shore and enters hardwood belt in Section 18, T.47N., R.19W. This is bouldery and so were the plains. The stones are mainly less than a foot in diameter.

We soon rise to a bluff, 635 feet A.T. at top. There is a gradual ascent to about 660 feet A.T. and then a plain running west across this projecting tract. We go south a mile to an abandoned camp and there find road at an end. It is in northeast part of Section 23. There is a low sandstone ledge along shore in north part of Train Point in Sections 12 and 11 and 15. It is only 15-20 feet as a rule, but it rises in places to 35 to 50 feet. Sandstone blocks abound in Sections 13 and 14, 23 and 24 and to the west.

We drive back on same road to Munising and map in the first well-defined beach above the present shore. It leaves the present shore in Section 13, T.47N., R.20W., and runs southeastward to a stream in Section 29, T.47N., R.19W. It swings eastward on south side of that stream and passes across Sections 32 and 33 and northwest part of Section 34. It then runs north nearly to the end of Powell's Point in Section 27. It then follows the west shore of Munising Bay to village.

The low tract between this beach and Lake Superior, where dry, is largely pine with some hemlock. The wet tracts are cedar, spruce, etc. The high range of hills runs westward from Munising through north part of T.46N., R.19W., touching only the south edge of T.47N., R.19W except at Powell's

Point where it runs north into Section 27. A point west of Munising, probably in Section 3, seems to reach nearly 1,000 feet. It rises far above tracts north, south and west of it and seems to be a little higher than the range that runs past the south edge of Munising. The ridge southwest of waterworks in Section 34 and north edge Section 3 is 840 feet \pm at the crest where road ascends from the gravel pit west of the waterworks.

The swamps I have marked on the map in eastern part of Alger County are taken from the plat book at courthouse and also the data on forest and soil.

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