

Notebook No. 202 - Leverett

COUNTY

Alcona: 3

Allegan: 2

Alpena: 3

Cheboygan: 3

Chippewa: 4, 5-18, 31-45, 54-56

Chippewa Co. & Mackinac Co. - Pickford vicinity water wells and
glacial geology: 18-31

Jackson: 2

Kalamazoo: 1

Luce: 5

Mackinac: 4, 17

Fresque Isle: 3

St. Clair: 3

OTHER STATES

Indiana: 1

Ontario: 45-54(?), 55

Donated by _____

I N D E X T O
L E V E R E T T ' S N O T E B O O K
N O . 2 0 2

- June 24, 1905. Waterworks data, Kalamazoo and Jackson.
- July 19, 1905. Railroad well at Wayland, Michigan.
- Aug. 7, 1905. Leave Detroit by boat on trip to Sault Ste. Marie.
- Aug. 8, 1905. Alabaster to Mackinac Island by boat.
- Aug. 9, 1905. Mackinac Island to Sault Ste. Marie.
- Aug. 10, 1905. Drove southeast from Sault Ste. Marie. Gives several well records and a group of flowing wells.
- Aug. 11, 1905. Drive Soo to Dafter and Pickford. Flowing wells near Dafter and from Pickford to Rudyard and Dryburg.
- Aug. 12, 1905. Plat of Pickford village with wells. Drive southwest and back; then east across moraine and back to Stirlingville and north past Barbeau and west to Meridian road.
- Aug. 13, 1905. Sunday. Drive southwest of Soo with Mr. Beadle.
- Aug. 14, 1905. On Sugar Island with J. Sebastian. Beaches, Moraines, etcetera.
- Aug. 15, 1905. On Sugar Island with J. Sebastian. Return to Sault Ste. Marie.
- Aug. 16, 1905. From Sault Ste. Marie, Ontario, north to Root River and west into Granite Hills and back. Summary as to beaches near Sault Ste. Marie.

Back end of notebook: Altitudes of Lake Survey Stations.

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June 24, 1905.

Took train on M.C. railroad Chicago to Kalamazoo, Michigan, at 8:45 a.m. Sand dunes at Michigan City, west of station, seem to be advancing on land and are covering houses south of the great lumber slide, among which are some good residences. Flowing wells at Kalamazoo waterworks, 80 to 120 feet; head 2 or 3 feet; cut off 8-12 feet below surface. Wells penetrate mainly sand and fine gravel. There is very little clay. Natural flow about 250,000 gallons a day for each well, 8 feet below surface, but several have diminished because of loss of water. The wells are in a bog 10 feet \pm below the level of the gravel plain near them. They are in south part of city about a mile from M.C. railroad depot. The principal supply is from an open well 31 feet deep, 22 feet in diameter. The flowing wells are distributed around another large well into which they flow. There are 13 wells, 6 inches in diameter, 80-130 feet deep. They are in water all the way down.

The distribution system, April 1, 1905, is $56\frac{1}{4}$ inches, as follows:

2-inch	200 feet
4 "	94,622 "
6 "	102,508 "
8 "	50,770 "
10 "	35,687 "
12 "	2,275 "
16 "	4,741 "
20 "	1,300 "
24 " suction pipe or system	<u>2,939 "</u>
Total -	297,042 + 528 = 56.25

Cost of plant to date: \$750,000

(See Water Supply Paper 31 for analysis made by R. C. Kedzie in 1895.)

2 Gaskell pumps used, with capacity of 3 million gallons each

Ordinary pressure: 45 pounds

Fin pressure: 80 to 90 pounds

Hydrants in 1905: 538 (In April, 1903, 443 hydrants)

Ten 8-inch; forty are 5-inch; forty 6-inch; remainder 4-inch.

Meters in 1905 over 2,000 -- see back end of Notebook No. 201 for other data.

Jackson waterworks, in south part of city. Municipal ownership.
Population 25,000. Using water? Majority. Source of water wells in
sandstone. Depth of 12 wells and diameter 200-300; 7 10-inch; 4 8-inch;
1 6-inch.

Kind of water bed: Sandstone
Quality of water: Analysis?
Head of water: 6 feet
Power used in pumping: Steam?
Type of pumps: 2 Holly, 4 million; 8 million.
Ordinary pressure: 60 pounds
Fin pressure: 80-100 pounds
Capacity of wells: 10,500,000
Capacity of pumps - gallons per day: one 4 million; one 8 million.
Average consumption: 2,000,000
Highest consumption: 4,500,000
Length of mains: 64 miles

2-28-05: Number of fire hydrants: 564 (4-inch largely used)
Number of other hydrants: -
Number of taps or of meters: 3,963
Cost of plant to date: \$500,000 or more
Income: \$35,000
Running expenses: \$12,000

July 19, 1905:

Railroad well at Wayland, Michigan. Reported by E. H. Barnes, resident
engineer of G.R. & I. railroad, Grand Rapids, Michigan. A 3-inch well
penetrated:

Sand:	25 feet
Clay:	120 "
Sand:	10 "
Sandstone:	<u>42 "</u>
Total -	197 feet

The pipe was driven to the rock to shut out other veins and a flow was
obtained from the rock but after flowing for some time, the pressure dimi-
nished until at date of writing, July 19, 1905, it is $2\frac{1}{2}$ feet below the
surface. The flow in surrounding wells has been diminished by this flow.
(Incorporated with Bowman's report.)

August 7, 1905.

I start for Sault Ste. Marie, taking boat from Detroit at 5:00 p.m. and reaching Algonac about dark. Observations on the sand and silt of the flats in delta at head of Lake St. Clair. Material is very fine sand built out in finger-like extensions. Refer to Lake Charts and to Leon M. Cole's discussion of St. Clair flats in geology of Michigan.

August 8, 1905.

On arising, I find boat opposite Alabaster and make first stop at Oscoda. The range of hills leading from the shore south of Thunder Bay southwest toward Lincoln with Harrisville in the foreground and the hills south of Harrisville at the edge would make a fine picture for illustrating this part of the shore. The cultivated tracts come out clearly among the parts covered with forest or with brush.

The next stop is at Alpena and I take temperature of the artesian well at the Fletcher Paper Company office which is in an old sandstone building. Temperature 53.5°F. Observation made at 10:45 a.m. when air temperature was 75°F. The well is reported to be 970 feet, but water may come from less depth. (See Annual Report of State Geologist for 1901 for records and Water Supply Paper 31 for analysis). The islands along border of Alpena and Presque Isle County are all low and probably do not rise to Lake Algonquin level. High shore appears a few miles east of Cheboygan on border of Hammond's Bay, some east of Ocqueoc River. It is 100 feet more or less above the lake level. I stop for the night at Mackinac Island, which was reached at 7:30 p.m.

August 9, 1905.

Mackinac Island. Aneroid 29.395 at level of Lake Michigan at 8:00 a.m.; 29.210 at back side of grounds at Fort Mackinac = 730 feet \pm ; 29.195-29.200 on a small rubble beach just back of fence to the north = 740 feet \pm ; 29.175 on lowest strong Algonquin beach, 760 feet; 29.145 = 790 feet on highest Algonquin beach. Taylor makes it 805 feet by hand level. Aneroid 29.100, or 830-835 feet at top of limestone on the Fort Holmes hill, south side; 29.070 at flag staff east of tower in Fort Holmes = 890 feet; 29.060 on top of embankment at Fort = 898 feet. The drift is a reddish till that has about the color of the red lake clay in northern part of Southern Peninsula but seems to be stony throughout. East of flag staff, aneroid 29.085-090 at top of limestone; 29.200 on lowest large Algonquin; 29.225 at beach just north of Fort Mackinac grounds = 740 feet \pm ; 29.400 at lake level at 9:00 a.m.

I take passage on "The Chippewa" from Mackinac Island to Sault Ste. Marie. The vessel is some distance offshore until it turns into the St. Mary's River. There are few exposures to be seen from the boat anywhere. Lime Island has limestone up to considerable height, perhaps to the top of the prominent part. (For altitude, see Lake Survey Chart of St. Mary's River). Drummond Island is all wooded at west end so I got no view of ledges. It is a prominent island and the mainland near Detour rises somewhat rapidly inland. This is cultivated.

The dredges along part of channel west of Sugar Island bring up a red clay and the low islands along the channel seem to have red clay under 3 to 5 feet of sand. I reach Sault Ste. Marie at 3:00 p.m. Mr. Beadle, a real estate man, tells me of prominent land along south side of Whitefish Bay west of Iroquois, which has hardwood timber and is rolling. It runs west to Strong's Siding with a sandy plain on its south border and there turns

northwest and runs into Luce County in the bend of the Tahquamenon River at upper falls. This seems likely to be a moraine. Dr. Lane notes a probable moraine a short distance inland, east of Munuscong that looks to be a probable continuation. The drainage is southward from this rolling belt to Lake Huron and Lake Michigan except the Tahquamenon River, and that has its upper course controlled by it.

August 10, 1905.

Sault Ste. Marie, Michigan. Aneroid 29,500 at Park Hotel at 7:45 a.m. = 605 feet \pm . I drive east along street car line to Country Club and then drive southward along west side of river. There is a cobbly ridge crossing the country club grounds and running southeast to the Hay Lake channel. The Potsdam sandstone is a conspicuous part of the cobble and was probably brought from the St. Mary's falls. This cobbly ridge appears on the island next to the Country Club grounds and this probably causes the "Sugar Island Rapids". I get across on skiff and find the cobble running across another little island and continuing across north part of a larger island in a southeast course. In places it is only 5-6 feet above water level.

The following data are on wells in eastern Chippewa County. Mr. B. Gilroy, in central part of Section 22, has made 3 wells. The one at house on west side of road is 60 feet. It penetrated 10-12 feet of sand; 45-50 feet of red clay; then gravel and sand to bottom. Head, 18 feet. One on east side of road is 77 feet and similar except that clay extends to 70 feet. The level is same as at the other or not much different. The head here rises 10 feet but does not stand quite that high. Altitude of well, 615-620 feet \pm A.T. A third, near No. 2, is similar in depth. This is on George Preston's farm, being at residence. No. 2 is at an outbuilding on Mr. Gilroy's land. A well at Sam Preston's, in south part of Section 22,

is about 70 feet. It is in clay from near top to the water-bearing gravel and sand at bottom. Telephone poles from here south have clay around them. It is free from pebbles. I cross ravine 20 feet deep south of these wells 1/4 mile that shows the clay nicely.

I turn east at the first road through north part of Section 27 and find a stiff clay until I enter Section 26. Here, a thin coating of sand occurs for a short distance on back side of a bouldery beach. This beach runs along the 620-foot contour in the Lake Chart (Chart 2, St. Mary's River). It is very bouldery and the boulders are in sand. This ridge crosses the north-south road in Section 26 in a southeast course but seems to turn south through southeast part of the section into east part of Section 35. The Nipissing appears in Section 26 just west of the north-south road in south part of the section and is very bouldery. Aneroid 29.465 at Nipissing beach at base of a clay knoll in northwest part of Section 35, T.47N., R.1E., at 10:00 a.m. Knoll only covers 2 or 3 acres. Aneroid 29.430 on top of knoll. A ridge in SE $\frac{1}{4}$ SW $\frac{1}{4}$ Section 26, T.47N., R.1E., 60 rods long, has Nipissing along its base, 25 feet below top. The beach is very bouldery but the clay knoll is free from stones. It seems to be a lake clay. The boulders are 2-4 feet or more in diameter and largely granite. A few Potsdam sandstones occur. The Nipissing beach runs from this ridge in Section 26 southwest past a church to the knoll in Section 35. There is a southward continuation for 1/2 mile from this knoll past a dwelling. I go west to edge of Nipissing bluff and follow it southward through Sections 3, 10 and 16, T.46N., R.1E., to a road running east on line of Sections 16 and 21, 15 and 22. It is very thickly strewn with boulders rafted in by winter ice.

Aneroid 29.515 at place where I stop for dinner with David Grier = 610

feet ±. David F. Grier, on ground about 605-610 feet A.T., has well 70 feet deep entirely through red clay to gravel at bottom. Water rose almost to surface when made but now is down about 25 feet. It stayed near surface about a year. J. W. Hurds bored on ground only about 5-10 feet above the river in south part of Section 13 to a depth of 100 feet, and only gets surface water, no gravel being struck. Wells near quarter post of Sections 11 and 14 are only 25-30 feet deep. They go through clay to gravel and sand. They are on ground only about 10 feet above Sailor's Creek. From Sections 24 and 13 south, wells are generally about 70 feet deep and water rises nearly to surface.

There are no surface boulders along west border of Hay Lake north of Charlotte River until the borders of Lake Nipissing are approached. The boulders set in at about 620 feet in a weak beach, but are more abundant on the main beach, about 640 feet. The south edges of Sections 23 and 24 are sandy and the sand extends from there southwest to Charlotte River.

John Bayliss, in northwest part Section 25, has well 80 feet. It passed through sand $9\frac{1}{2}$ feet, and was in clay to gravel at bottom. Altitude 600 feet ±. Jacob Wright, in $NE\frac{1}{4}$ Section 26, has well 78 feet. It has sand 7 feet, and then red clay to 75 feet, or to gravel. Water stands 4 feet below surface. Huckleberry marsh, east of Charlotte River, in south part Sections 25 and 26 and in Sections 35 and 36 with sandy soil. Aneroid 29.510 on plain at Charlotte River, near corner Sections 35 and 36, T.46N., and Sections 1 and 27, T.45N., R.1E., about 600 feet. There are low ridges thickly set with boulders both south and west of this corner. The residents tell me this is the southeast end of the bouldery strip that runs down the southwest bank of the river. The altitude of top of ridges is about 615-620 feet. I drive west on the town line, rising gradually through

a clay plain. Aneroid 29.490 at McCarron post office, southeast corner Section 34, T.46N., R.1E., = 630 feet \pm . The Nipissing bluff extends a little into the west edge of Section 35 near middle of west line. It runs south through the east part of Section 3, T.45N., R.1E., and into the east part of Section 11, being in plain view from McCarron post office. Aneroid 29.470 on Nipissing beach 1/3 mile west of McCarron post office = 640 feet \pm ; 29.450 on summit of clay ridge, 3/4 mile west of McCarron.

Aneroid 29.465 at flowing wells noted below. Mr. Henry Farney, in southeast of Section 33, has a well 29 feet through clay to gravel. Other wells in this vicinity are 10 to 30 feet deep. Same Boyle has a flowing well 37 feet deep in southwest corner Section 34, made four years ago. Altitude 650 feet \pm . Temperature 44.9°F. David McCarron has a flow in northeast part Section 4, T.45N., R.1E., about 30 feet, made in 1903. Temperature 45°F. Sulphurous. Nat Holton has one about 3 miles southeast in Section 14, T.45N., R.1E. It is 2 miles south and 1/2 mile east of the old McCarron post office and store. It is on the flat east of the Nipissing beach. (I was told later this is merely a spring.)

I drive west along town line to a series of very strong, bouldery beaches. Aneroid 29.400, 700 feet, on highest, just south of corner of Sections 32 and 33, T.46N., and Sections 4 and 5, T.45N., R.1E. There is a network here in the west part of Section 4 and east part of Section 5, southeast part of Section 32 and southwest of Section 33, that looks like a moraine in places. The boulders are in a sandy matrix. It may, however, be only a great spit with the complexities natural to such a feature. It is above the beach I have called Nipissing, being fully 700 feet A.T. on the highest points. The northeast border of the boulders is at a level 30 feet lower, on the town line, and there may be 30 feet of sandy material here on the highest points. Observations made at 3:15 p.m. Aneroid 29.400 on

on plain north of beach (640 feet by Lake Survey Chart). There is a low beach along the 620-foot contour that runs through the southeast part of the city. It is very well defined from a large school building east-southeast to a small creek in east part of Section 8, T.47N., R.1E. There is sand from this beach north, capping the clay, but to the south, there is very little. In places, there is peaty muck. Aneroid 29.480 on the 620-foot beach at 5:40 p.m.

August 11, 1905. 7:45 a.m.

Aneroid 29.550 at south side of water power canal in Sault Ste. Marie on Mackinac Road = 620 feet; 29.530 at Nipissing beach = 650 feet \pm . Large boulders are scattered along it. Aneroid 29.480, 700 feet, on brow of bluff by cemetery; 29.460 = 720 feet where Mackinac Road turns southwest in north part Section 18, T.47N., R.1E. This is a flat tract with lake clay and I see no boulders on it.

John Holton, in northwest part Section 24, T.47N., R.1W., has well 60 feet deep that has 11 feet of water. It was through red lake clay to the quicksand at bottom. Aneroid 29.470 at well = 710 feet \pm . Other wells near here are of similar depth. On the McEvoy place, 6 miles south of Holton's (a man named Arnet lives on place) is a flowing well made 25 years or more, 45 feet in depth on east side of road in north part Section 14. It is a crock well.

I turn west to "Larke Hill" and come to a strong, sandy beach about 1/3 mile west of Mackinac Road, trending north-northwest - south-southeast. Aneroid 29.430 at beach. It is below the 740-foot contour but must be close to it. It is cemented in places. Aneroid 29.350 = 800 feet at highest point on Larke Hill by old lake survey station at 8:45 a.m. This

highest point = 700-715 feet; 29.425, 1/4 mile north at north edge of the beaches where the clay plain sets in = 680 feet \pm . I am told this stony, sandy strip runs west along the town line nearly to the township corners, or to a creek at middle of north line, Section 6. The greater part of Sections 32 and 31 is a heavy clay soil.

I go north and come to a bouldery strip in east part of Section 29, T.46N., R.1E. There is a little sand with it. Aneroid 29.430 at the boulders = 675 feet. This is possibly an offshore bar of the lake that formed the beaches 1 mile south. I come to the Nipissing bouldery strip on the south border of Charlotte River valley near middle of line of Sections 20 and 21. Aneroid 29.465 at boulder strip = 640-645 feet. There is a bank 10-15 feet high back of this to the south that rises very gradually. Aneroid 29.490 at Charlotte River = 620-625 feet. The stream flows in a narrow trench 20-25 feet deep in a broad valley about 1/2 mile wide that comes in from the northwest. Rosedale is in this valley.

Aneroid 29.465 at Rosedale = 640 feet \pm ; 29.420 at cross roads one mile north, corner Sections 8, 9, 16 and 17 on the general level of a very smooth clay plain. No till or boulders on it so far as I can see. The red, laminated clay is at the surface with scarcely a skim coating of sand. Aneroid 29.410 at corner of Sections 4, 5, 8 and 9 on the clay plain at 4:20 p.m. = 690 feet. Wells on this plain are 30 to 60 feet or more to a good supply of water. The altitude is about 690 feet. I took temperature of Nelson Lash's well, 35 feet deep, in southwest part of Section 33, T.47N., R.1E. It is 45° by pumping. The water level is 30 feet or more below the surface. Depth 35 feet \pm . Aneroid 29.400, 695 feet \pm A.T. on brow of bluff above Nipissing beach, south of Sault Ste. Marie; 29.440, 650 feet \pm at level of beach in southwest part Section 17; 29.450

ridge has a nucleus of sand with a capping of cobble and boulders several feet thick. It is a lake beach or bar. Basins were shut in by the double phase of crest. Aneroid 29,385 = 770 feet on plain west of this beach at 9:00 a.m. where road crosses it. The boulders are largely granite, but Potsdam sandstone cobble and slabs are common.

Aneroid 29,395 at top of clay $1/4$ mile west of ridge on wagon road. There are scattered boulders on the sandy strip between here and the beach. William Hardy's well here, at edge of the sand, is 45 feet and has only 3 or 4 barrels of water in it at a time. No rise of water. Aneroid 29,390 at Hardy's. It was through red clay to a seep at bottom. Along the base of Larke Hill are springs on the east side and as far east as the lower beach or sandy ridge where aneroid read 29,430 (740 feet \pm). I return across Larke Hill. Aneroid 29,370 at crest in road. The east slope is terraced at about 25 feet below the highest point, or 775 feet A.T. and at the base at about 755 feet. Aneroid 29,420, 740 feet \pm , at ridge $1/4$ mile east of Larke Hill where it read 29,430 on way out about $3/4$ hour ago. Time now 9:15 a.m. Aneroid 29,435 on clay east of this sandy beach, probably 720 feet.

I take Mackinac Road southward and in $1/4$ mile rise to a clay ridge; Aneroid 29,415 = 730 feet, that has some large boulders on it but no sand. This connects westward with Larke Hill. It is 20 feet \pm above the main clay plain east of it and has an irregular surface, and irregular east border. The rise is quite abrupt in places. It suggests glacial, rather than lake work. A little farther south there is a sag between the clay tract and the gravelly Larke Hill. The hill sets in a short distance west of the Mackinac Road, $1/4$ mile or less, nearly to the next road leading west. The gravel there ends but an undulating clay tract, strewn with

boulders, continues in a course west of south along west side of the Mackinac Road. I rise west on this road to the crest about 1/4 mile west of the Mackinac Road. Aneroid 29.415. This has undulations of 5-10 feet and looks like a weak moraine, but there are no boulders except on the surface, the clay being a laminated, pebbleless material like that to the east. There is a narrow ridge simulating a beach but having clay at top that runs along the east side of this undulating strip at a slightly lower level. It is 5-10 rods wide and 5-10 feet high, thickly strewn with boulders. The sharpest parts seem to have cobble beds to some depth. There is a sag on its west side, but it shades off into the lake plain on the east. Aneroid 29.435 on this beach-like ridge. Aneroid 29.440 ± at intersection of road with Mackinac Road, a few rods east of this ridge. I continue south and find this becoming a strong cobble ridge within 1/2 mile. It rises, in places, 20-25 feet above this plain, but very little above the plain to the west, the conditions being similar to conditions each side of Larke Hill.

Several wells in Sections 35 and 36 are 90 to 100 feet to water, in sand under clay. Mr. Hoornstra, in Section 34, T.47N., R.1W., has 3 wells that strike water at 29-30 feet, but he bored 40 feet; 12-inch wells. Head at first, 10 feet, but not so high now. Mrs. Knox, west of U. P. Church, in Section 35, has bored about 100 feet. Aneroid 29.440. Andrew Burtram, in Section 36, has a well east of the church that is 90 feet deep and lots of water. There was gold found in a duck's crop. This led to digging a large shaft 80 feet and boring still farther to test for gold. Quicksand in the lower part of the shaft stopped operations.

I go west about 1/2 mile along town line to a church where road runs north. This is at the west edge of the undulating land. Aneroid 29.460

on the plain just west of the church = 660 feet. The highest points are 15-20 feet above this plain. The road cuts into a ridge east of this church 1/4 mile and exposes a bed of boulders and cobble in a gravelly matrix under 3 to 4 feet of pebbleless, red clay. There are surface boulders scattered over the swells and ridges in this vicinity. It looks as if there might be an old beach here, covered with still water deposit, and the boulders may have been rafted in in floating winter ice. The explanation is not clear as yet. Aneroid 29.445 at buried cobble bed = 675-680 feet. A few rods northeast, in the field, is a gravel pit, 15 feet deep, with no clay at highest part, but the gravel dips under clay in the southeast slope or lakeward side. There are numerous large stones, mostly Potsdam sandstone, but granite boulders are not rare. Another pit, a few rods east, in the field, has 8 feet \pm of red clay above the gravel. A branch of Charlotte River runs along the east side of these pits.

I continue south on Mackinac Road across Charlotte River and a series of sloughs and low ridges trending west-northwest - east-southeast. The aneroid reads 29.460 in the sloughs, 660 feet, and 29.445-29.450 on the ridges, 675 feet. The first ridge south of Charlotte River contains gravel and has a small pit in it. A few boulders occur in the sloughs on surface. A stone school house in north part of Section 23 is in one of the sloughs. I drive west about a mile to a ridge along which there are boulders. Aneroid 29.415 on ridge = 700-705 feet; 29.420 on railroad, a few rods west, one mile north of Dafter = 698 feet. The ridge is not opened for gravel and seems to have a pebbleless clay under the surface boulders. This is a mile north of Dafter Station. The ridge runs south 80 rods and then southeast across the Mackinac Road. Aneroid 29.430 at Dafter at 11:40 a.m. = 692 feet. A well here, at Mr. Hillier's, is 84 feet deep and the

temperature is 44.8°F. by pumping. Water stands 42 feet from top. It was dug 3½ feet square for 44 feet and then bored 3-inch to bottom. No sand was struck. The water is from a seep in the clay. There are several knolls southwest, south, and southeast of Dafter, rising 10-25 feet above the station, which contain some gravel. There is some clay covering the gravel as in the ridge near the town line of T.46N. and T.47N.

The well on the McEvoy place is in north part Section 14 and has been flowing fully 25 years. The depth is about 45 feet. It is in one of the sloughs south of Charlotte River noted above. Charlotte River crosses the Mackinac Road 1¼ miles south of the town line, instead of ¾ mile, as shown on map. I am told that bouldery strips occur from Dafter west wherever there are low ridges and knolls. Aneroid 29.420 at Dafter at 1:00 p.m. = 692 feet; 29.395, 715 feet, on knoll 1/3 mile west-southwest of Dafter Station. This is very thickly strewn with boulders and is gravelly. West of it is a lower plain than the one Dafter stands on. Aneroid 29.470 about a mile west of Dafter, 660 feet. There is a sandy strip along the east side of this plain where the aneroid reads 29.425, or 690 feet A.T. There is a knoll 15-20 feet high near west end of line Sections 20 and 29, and one 60-65 feet high in southwest part Section 29 and northwest of Section 32, chiefly in 32.

I go south between Sections 28 and 29. Aneroid 29.470 at corner Sections 28, 29, 32 and 33 = 660 feet ±. A ridge crosses section line 1/4 mile west that is 20 feet ± above this plain. The plain has a red clay soil. I go west along line Sections 29 and 32 to the high knoll. Aneroid 29.440 where boulders set in on its east face. The slope below is a stiff red clay. Boulders are granite with occasional large slabs of Potsdam sandstone and a few other rocks, chiefly Archean crystallines. I find one conglomerate with granite pebbles included in a greenish, fine-grained

rock (see specimens). Aneroid 29.395 on highest point on hill, or the same as on the one near Dafter = 715 feet. It runs north-northwest to south-southeast for nearly 1/2 mile. There is a very smooth plain west of it on which the aneroid reads 29.440, 675 feet, on line of Sections 30 and 31. I can see a long distance west and south across a very smooth plain said to have a clay soil.

I return east and repeat the readings. Aneroid 29.390 on crest of knoll = 715 feet; 29.430 at lower limit of boulders = 675 feet; 29.460 at corner Sections 28, 29, 32 and 33; 29.436 at railroad track, 1 mile south of Dafter at 2:15 p.m. = 695 feet by railroad profile. A bouldery knoll northwest of here is 10-12 feet higher and one 120 rods east-southeast is 15 feet \pm . This crosses the Mackinac Road. I turn south on Mackinac Road and have low swells in view to the east, 10 feet \pm high with boulders scattered over them. They are largely clay at surface. I cross a sharp gravel ridge with cobble and boulders coating it, in north-west part of Section 3, T.45N., R.1W. Aneroid 29.400 on crest = 725 feet; 29.430 on plain south of ridge = 700 feet, where a road leads west. I can see a knoll 20 feet \pm high, crossing the road about 3/4 mile west of here, near the railroad.

I enter a tamarac swamp about a mile south of the town line. About 2-2 $\frac{1}{2}$ miles south of the town line this road is on a rise of ground with hardwood timber. It is very bouldery with numerous limestone slabs, the first I have noted among the bouldery tracts south of the Sault. It is 15-20 feet above the marsh and covers 40 acres or more. Aneroid 29.400, 725 feet \pm on this hardwood tract. South from here is swampy land for a mile or so with low sandy ridges 3-6 feet high from which material is drawn to grade the road. The aneroid indicates a slight change to lower

barometer as I continue south across this sandy tract, being 29.410 about center of township; 29.385 at base of sand ridges, $1\frac{1}{2}$ miles farther south; 29.370 on top of sandy ridges near an old saw mill. Within $1/2$ mile south, I rise to a higher tract with hardwood timber on top and pine on the north slope. Aneroid 29.310 on top = 800 feet \pm . The soil is sandy and blown into low dunes 5-10 feet high. Boulders are quite numerous in the sags and on the slope north of this tableland. It seems to be productive land except where drifted into dunes. There is a farm here on the north slope, of the tableland, with good crops, but a farm north of it on the slope has been abandoned. I take road east. Aneroid 29.355 at foot of slope = 760 feet \pm . This is apparently an old shore line but the tableland does not seem to be. I go south to a schoolhouse that is likely to be in the northwest corner Section 34, T.45N., R.1W. There is an observation tower $1/2$ mile west on this high plain. Aneroid 29.310 at schoolhouse at 4:00 p.m. = 800 feet \pm . About a mile east, I leave the tableland and enter a swamp. Aneroid 29.410 in swamp at 4:20 p.m. Boulders are scattered over it.

Daniel Cameron, $1/2$ mile west of Meridian, in north part of Section 36, has a well 20 feet deep with water having a temperature 44.5 degrees. It passed through sand 2 feet and clay 8 feet, then entered quicksand. Aneroid 29.430 at well = 675 feet \pm . Boulders are numerous in Sections 25, 26, 35 and 36 and the soil a sandy loam with ground water table near surface and crops are very thrifty -- a good farming district. On some farms, springs occur, so no wells are bored. Aneroid 29.430 at Meridian Road, corner Sections 25 and 26, R.1W., and Sections 30 and 31, R.1E., of T.45N., = 675 feet \pm .

I take road south at 4:45 p.m. It crosses numerous ravines, 20 feet

or more deep, that drain east from the high tableland that I left 2 miles west of here. The cuts along the road show a fine loam of red color instead of the stiff red clay. There are some sandy spots, but generally, this loam comes to the surface or within a foot or two. I leave the bouldery tract near the township corners, or rather they are scarce farther south. Aneroid 29,440 on general level of plain along line of Sections 1 and 6. It apparently slopes eastward. The forest is so dense to the west that I can only get views to the edge of the clearings, $\frac{1}{4}$ - $\frac{1}{2}$ mile. It is a flatter surface between ravines than in southeast part of T.46N., R.1W.

About $4\frac{1}{2}$ miles north of Pickford, or near middle of line of Sections 12 and 7, the surface becomes gently undulating again and boulders numerous. Aneroid 29,430 at corner Sections 12 and 13, R.1W., and Sections 7 and 18, R.1E. I can see west here more than a mile over a gently undulating bouldery tract like that in southeast part of T.46N., R.1W. It rises perceptibly westward. I cannot see the border of the high tableland on this line. At a church (Bethel M.E.) and cemetery about 3 miles north of Pickford, I come to a sandy ridge along the top of the bluff back of a lower plain. Aneroid 29,430 on the road at this beach. The sand is drifted to a height of 5 to 15 feet above this level, or to 665-675 feet A.T. It is clear sand with no pebbles, so possibly it merely marks wind action from the shore of a lake in the plain to the south. From here, I look across a lower plain to high tracts near the county line, five or six miles south of Pickford. Aneroid 29,450 at foot of slope $1/4$ mile south of the sand ridge = 645 feet \pm . This slope is clayey and has no beach at its base. I am now inclined to think this beach is above the Nipissing and corresponds to the Fort Brady, for there has been some differential uplift to the north, possibly 40 feet, from here to Sault Ste. Marie.

Aneroid 29.450 at cross roads $1/4$ mile north of red frame schoolhouse = 645 feet \pm , probably corner Sections 13 and 24, 18 and 19. This plain runs east and west as far as I can see (a mile or more). The sandy ridge on its north border runs east at least a mile before bearing northeast. The plain has a stiff, red clay soil like that on the tableland back of Nipissing beach south of Sault Ste. Marie. Aneroid 29.470 at small creek, 2 miles north of Pickford = 625 feet. It has a small trench, 12-15 feet deep. Aneroid 29.455 at cross roads south of creek a few rods = 640 feet \pm . From here, I catch glimpses of high tableland in the central part of T.44N., R.1W., rising above the timber on the low plain this side. Aneroid 29.455 at cross roads 1 mile north of Pickford = 640 feet \pm . The country is cleared in the southeast part of T.44N., R.1W., and I can see a plain for 3-4 miles or more. The high range of country south of this plain is visible for several miles both east and west from the Meridian Road. It is probably the Niagara Escarpment. Aneroid 29.465 at Pickford at level of stores and post office = 630 feet. I am told there is a sandy ridge $1\frac{1}{4}$ miles west of Pickford on the town line that may be correlated with the one $3\frac{1}{2}$ miles north. There is a clay plain from Pickford west to Rudyard Station with the exception of this, and perhaps other, small sandy ridges.

Mr. A. Roe has a flowing well 128 feet deep, made in June, 1905. It struck gravel at 114 feet and went into it 14 feet. There was 80 feet or more of red clay. Below this was a brown slush with water in it that would rise about to surface but as it fills up pipes, the casing is driving through it to the gravel. It is a sandy gravel. It has a head $3\frac{1}{2}$ feet above surface. It flows 4 quarts a minute. Temperature 46.2° . It is said to have been 10 quarts at first.

A well at the back side of the Grand Central Hotel is 128 feet, made about 10 years ago -- 4-inch pipe. This is the pioneer well. It did not flow until 2 months after it was made when, after a pump was attached, it increased until it would flow. It is piped $3\frac{1}{2}$ feet below surface to supply a gasoline engine at grist mill on lower ground to act as a cooler. It may be thrown to top of a store by hydraulic ram to serve as fire protection.

John Crawford has a flow 22 feet west of the hotel well, of same depth. It was similar to the Roe well, except there is only 8 feet of gravel. This is 2-inch and was made in spring of 1904 and flows a weak stream because it is drained by the hotel well. When this was made, it was pumped vigorously and muddied the water in the hotel well and lowered the head till it stopped flowing. The temperature, when pumped vigorously, is 43.5°F . Air temperature 75 degrees at 7:15 p.m.

Dr. John Cameron has a flow 30 feet west of the Crawford, 128 feet deep that is 8 feet into gravel. It was cored 6 inches through a crust at bottom. It flows only a quart a minute. Temperature 46° degrees. Made in autumn 1902. It is a 2-inch well.

Thomas Robinson has one 150 feet west of Dr. Cameron's, 129 feet, made in August 1905, 2-inch well. It rises about 2 feet above surface and flows only a quart in 3 minutes. It cannot be pumped down but 8 feet below surface after 2 hours vigorous pumping. Temperature 45° . It is 129 feet and has 20 feet of sandy gravel. It was red clay nearly to the gravel at 109 feet. It was driven 100 feet in $1/2$ day. Mr. Daly charges 25 cents a foot for work in the clay and 50 cents in the gravel, not including pipe.

George Wilson has a well 175 feet \pm , south-southeast of the Robinson

well, just 131 feet deep. It is on same level and has head 3 feet above surface. It was made in summer of 1903. There was 107 feet of red clay. It went about 24 feet into gravel. Temperature in well, 50°F.

Mr. Henry Miller's, across back street southwest of Wilson's 200 feet \pm , is 127 feet deep that terminated in sand, and sand comes up in pump. Temperature 44.8° by pumping. It was made in 1901 in summer. The head is 2 feet below surface, being on higher ground than the flowing wells. It was red clay nearly to bottom. Gravel 3 feet at bottom.

Isaac Watson, on west side of the Meridian and in northeast corner Section 1, on slope of a ravine, has a well 88 feet deep. It was in sand in the lower 40 feet or so. Gravel at bottom. It flows a small stream, 3 or 4 feet above surface -- 2 quarts a minute. Temperature 46°F. Made in 1901; 2-inch well.

At Fred Green's, in north part of town, is a well that flows in cellar. Made several years ago.

At the creamery in Pickford in north part of town is 67-foot well and just struck gravel. It is 3-inch and discharges 12 feet below surface into a dug well and is strong. It has been fixed and new pipes driven 3 times; the last about 1900.

David Bacon has well north of Mr. Miller's 127- $\frac{2}{3}$ feet deep, 119- $\frac{1}{3}$ feet of red clay; 8 feet of gravel. Made in 1903.

Mrs. Dawson has a well at Ruyard Station, 278 feet, that penetrated red clay 204 feet. Black mucky clay 20 feet, quicksand -- gray color, to gravel at 277 feet, or 53 feet. The head is 22 feet above surface. It was made in June 1903. This is the deepest Mr. Daly ever made.

The deepest near Pickford is 1- $\frac{3}{4}$ miles south on east side of Meridian, probably in southwest part Section 7, at William P. McDonald's.

Depth, 151 feet. It was red clay 100 feet \pm and then black, sandy slush 49 feet, and gravel 2 feet. It was made in 1903. It just rises level with surface. Drained perhaps by Taylor well mentioned below.

William Best, 1/2 mile east of Pickford, on north side of road, has a well 91 feet deep with 18 feet of gravel and sand at bottom. Head, 11 feet. Made in 1904; 2-inch well.

William Bacon, a little farther east, on south side, has a well 86 feet that penetrated clay 74 feet and gravel 12 feet. Head, 2 feet above surface -- a weak flow. Made in 1903.

On east side of Section 6, T.43N., R.1E., James Clegg has a flow just level with ground. It runs out 3 feet below surface into tank. Made in 1904. Depth, 120 feet. Red clay with some slush, 118 feet; blue gravel, 2 feet. Driven 2-inch.

Isaac McDonald's on back street west of Meridian, near a planing mill, is 130 feet. It has solid red clay 115 feet, gravel 15 feet. Head, 4 feet. It supplies an engine. Made in 1901.

A well at James O'Neil's, at a store in Pickford, has a flow in basement of store. Made in 1901. Depth, 98 feet. It was into gravel a little.

John Taylor, 2 miles south and about 1/2 mile west of Pickford, in Section 13, T.43N., R.1W., has well 114 $\frac{1}{2}$ feet. Made in June 1905. It was in clay with some slush in lower part to gravel at bottom. It flows a very good stream, about 6 gallons a minute from a 2-inch pipe with 3/4-inch escape.

J. McDonald, near river bank, in northeast part of Pickford, east of river, has a well 87 feet deep that just reached gravel. It flows a good stream above surface, but is run into cellar.

Across street, east from this, is Fred Taylor's well -- 89 feet, that

just reaches gravel. It flows into cellar and runs out with cellar drain.

About 200 feet north of the McDonald well is Joseph Barton's well, 119 feet, made in 1902. It has head 1 foot. It entered gravel some distance. It flows into a hole 3 feet deep.

About 200 feet east of Barton's on general level of plain, 5 feet above Barton's level, is a well 127 $\frac{1}{2}$ feet on Dudley Aldridge's land that has head 3 feet below surface, discharging into tank. It was made in 1905.

Thomas Morrison, in northeast corner Section 12, T.43N., R.1W., has well 98 feet deep that has considerable sand, 35 feet \pm . It flows with head of 4 feet or more. Made in fall of 1902.

Mr. Kirkbride, 1/2 mile north of Pickford, has well 105 $\frac{1}{2}$ feet that is flowing 8 feet below surface into a dug well. Ground is probably 10 feet above Pickford. Made in April 1903. It penetrated clay 95 feet and gravel 10 $\frac{1}{2}$ feet.

E. Cottle, 4 $\frac{1}{2}$ miles west, on south side of road, has well 105 feet, 3-inch pipe, with head 23 feet. It is fully 18 feet into gravel and was largely sand. Altitude is higher than at Pickford.

On same side of road, in northwest part of Section 5, T.43N., R.1W., is a well on Mr. Bronson's land, 120 feet, that was all sand. Mr. Bronson dug 27 feet and well caved in and killed him. This was made in June 1905. It struck gravel at bottom. Water is 27 feet from top. There is a patch of sand here with clay each side.

Fred Johnson, west of Meridian, about 200 feet south of Isaac Watson's well, in Section 1, T.43N., R.1W., has well 140 feet deep. Made in 1901, with head 16 inches below surface but so strong that it could not be lowered by pumping. It penetrated red clay with a little slush at

bottom for 133 feet, then gravel 7 feet. It is probably a little higher than the flowing wells in Pickford.

A well at Hugh Blair's, in northeast corner Section 1, opposite a church, is on a slope a little lower than Johnson's. It is 122 feet, and has head nearly at surface. Would probably flow if carried into gravel. Made in 1901. It stopped near top of gravel.

A well on east bluff of river in east part of Pickford at S. Crawford's, is 87 feet -- clay 74 feet, gravel 13 feet. This flows 3 feet above surface. Made in 1902. Driven 2-inch.

Pickford schoolhouse, east of Meridian, in south part of village, is 122 feet. Red clay 102 feet, gravel 20 feet. Head, 4 feet. It flows into a walled well 8 feet deep. Made in 1902.

A well in the ravine in north part of village flows. It is about 87 feet deep. It is west of street running north from Grand Central Hotel. F. H. Taylor.

A well on east side of Meridian, on low ground, north of ravine, will flow 5 feet or more above surface. O. S. Roe, owner. Depth, 68 feet. Has screen in bottom and gets water in sand under clay. Made in 1899.

A well near creamery, in north part of town, owned by George and Andrew Taylor, is 78 feet -- clay 68 feet, gravel 10 feet. Head is at surface so it will run out.

Mr. Everett's well, about 4 miles west-southwest of Rudyard, flows. Depth, 104 feet. Small flow. Clay 102 feet, gravel 2 feet. Made in 1901; 2-inch well.

Across railroad, on bank of Bear Creek, 25 feet or more above creek, on Herman Fuerstnau's farm, is one with depth 116 feet. Head 3 feet or more. Flows a gallon a minute. Made in 1901.

The above two wells are probably in Section 16, T.44N., R.3W.

Two miles south of there, on land of Mr. Derscher, is a flow 114 feet. Head, 2 feet or more. Made in 1901.

A flowing well, 2 miles east of Rudyard, on Andrew Haballa's land, is 108-1/3 feet; into gravel 8 feet. Flowed a barrel a minute from a 3-inch pipe, so was driven down and now flows only a quart a minute. Flow shut off by driving down pipe with a sledge.

Another flow, 1/2 mile farther east, on Reverend Smith's place, near river. Depth, 171 feet. Into gravel, 2 feet. It was largely soft slush. It was driven 115 feet in about 1 1/2 hours.

Wells around Pickford are low in flow twice a year -- in August, and in February and March. Cause not clear. The rate is less but whether loss of head is not noticed. Some are clogged by sand thrown in top of pipe. Mr. Daly does not put in screens because they get clogged in 3-4 years. These flows near Pickford all have a little iron and some a little sulphur. Dr. Cameron's shows sulphur to the taste.

Dr. David Webster, on north side of street in Pickford, has 3-inch well 128 feet that is in a muddy gravel at bottom and doesn't quite flow. The water ran out at top for a little while when first made in 1899.

Near the Robinson's flowing well, 25 feet west, on south side of street, at Chippewa House, (John Stanley, proprietor) is a 4-inch well that is 126 feet \pm and it first flowed just at surface, but is now not flowing because pump is attached, but has not lost head.

The cost of 2-inch pipe is only 17 cents a foot. Mr. Daly uses a horsepower drilling machine. He drives the pipe down to the water and then clears out the hole. There is about 25 feet to clear out near bottom, for the upper part gets picked and enlarged, by the drill rods. Driving through clay and slush is 25 cents a foot and through the gravel, 50 cents. The slush has water and wells could be made in it if screens were used that

would be as strong as those in the gravel. The gravel of which Mr. Daly has samples is fine and of various kinds of rocks of all colors. He seldom brings up anything more than 1/4-inch, but says the pebbles reach 2 inches or more.

WELL RECORDS FROM MR. JUDSON DALY, WELL DRILLER, PICKFORD, MICHIGAN

Charles Harrison well: Located 5 miles west of Pickford on south side of road from Meridian in Section 4, T.43N., R.1W., on level 16 feet above Pickford Post Office. Made in September, 1905. 2-inch driven pipe. Well depth, 92 feet. Depth to principal water bed, 14 feet -- in clay and gravel. Water 14 feet below surface -- pumped. Cost of well, \$23.00. Water is used for drinking, washing, cooking, stock, boilers.

Richard Smith well: Located 6 miles west of Pickford on south side of road from Meridian in Section 6, T.43N., R.1W., on bank of river, 20 feet above river. Made in August, 1905. 2-inch driven pipe. Well depth, 160 feet. Water-bearing material -- clay and gravel. Water is 30 feet below surface -- pumped. Used for drinking, washing, cooking, stock, boilers.

Fred Rye well: Located $1\frac{1}{2}$ miles west of Pickford on south side of road from Meridian in Section 2, T.43N., R.1W., on hill 12 feet above Pickford post office. Made in September 1905. 2-inch driven pipe. Well depth, 88 feet. Water-bearing material -- clay and gravel. Water comes within 10 feet of surface -- pumped. Used for drinking, washing, cooking, stock, boilers.

William Wise well: Located 4 miles (1 mile south, 3 miles west) from Pickford on south side of road from Meridian in Section 10, T.43N., R.1W., on bank of Pickford River, 20 feet above Pickford, or 650 feet. Made in October 1905. 2-inch driven pipe. Depth, 112 feet. Water-bearing material -- clay and gravel. Water flows over surface without pumping, 1/5 gallon per minute. Used for drinking, washing, cooking, stock, boilers.

Robert McKee well: Located 1 mile north of Donaldson on east side of road from Meridian, in Section 31, T.46N., R.1E., on bank of creek, 15 feet above creek. Made in August, 1905. 2-inch driven pipe. Depth, 78 feet. Water-bearing material -- clay and gravel. Water flows over surface without pumping, 1/3 gallon per minute. Used for drinking, washing, cooking, stock, boilers -- also public supply for the town of Donaldson.

John Henderson well: Located 3/4 mile east of Pickford on south side of road from Meridian in Section 6, T.43N., R.1E., on east Munuscong River 25 feet above river. Made in August 1905. 2-inch driven pipe. Depth, 92 feet, 2 inches. Water-bearing material -- clay and gravel. Water comes within 3 feet of surface -- pumped. Used for drinking, washing, cooking, stock, boilers. This well is located about 15 rods from William Beacon's, about 8 feet above same.

John Dunbar well: Located 1/4 mile north of Mackville on east side of road from Meridian to west-northwest in Section 30, T.44N., R.1W., on west side of ravine level with Mackville post office. Made in October 1905. 2-inch driven pipe. Depth, 82 feet. Water-bearing material -- clay and gravel. Water is within 7 feet of surface -- pumped. Used for drinking, washing, cooking, stock, boilers.

August 12, 1905. 5:15 a.m.

Aneroid 29.460 at Pickford at hotel; 29.470 at 6:30 a.m. = 630 feet. I level up from river up to the hotel well and find it 24 feet above the stream, making stream about 606 feet, and the head is 27 feet.

The well in the ravine north of the hotel is 16 feet lower and flows a very weak stream, so that the temperature is 54° because of a narrowing

of pipe near top. It flows only about a pint a minute 2 feet above surface.

David Stevens has a flow east of river in Pickford on north side of town line between S. Crawford's and James McDonald's wells. It is 95 feet deep and just flows above surface a mere drip.

(see next page for plat copied from Notebook)

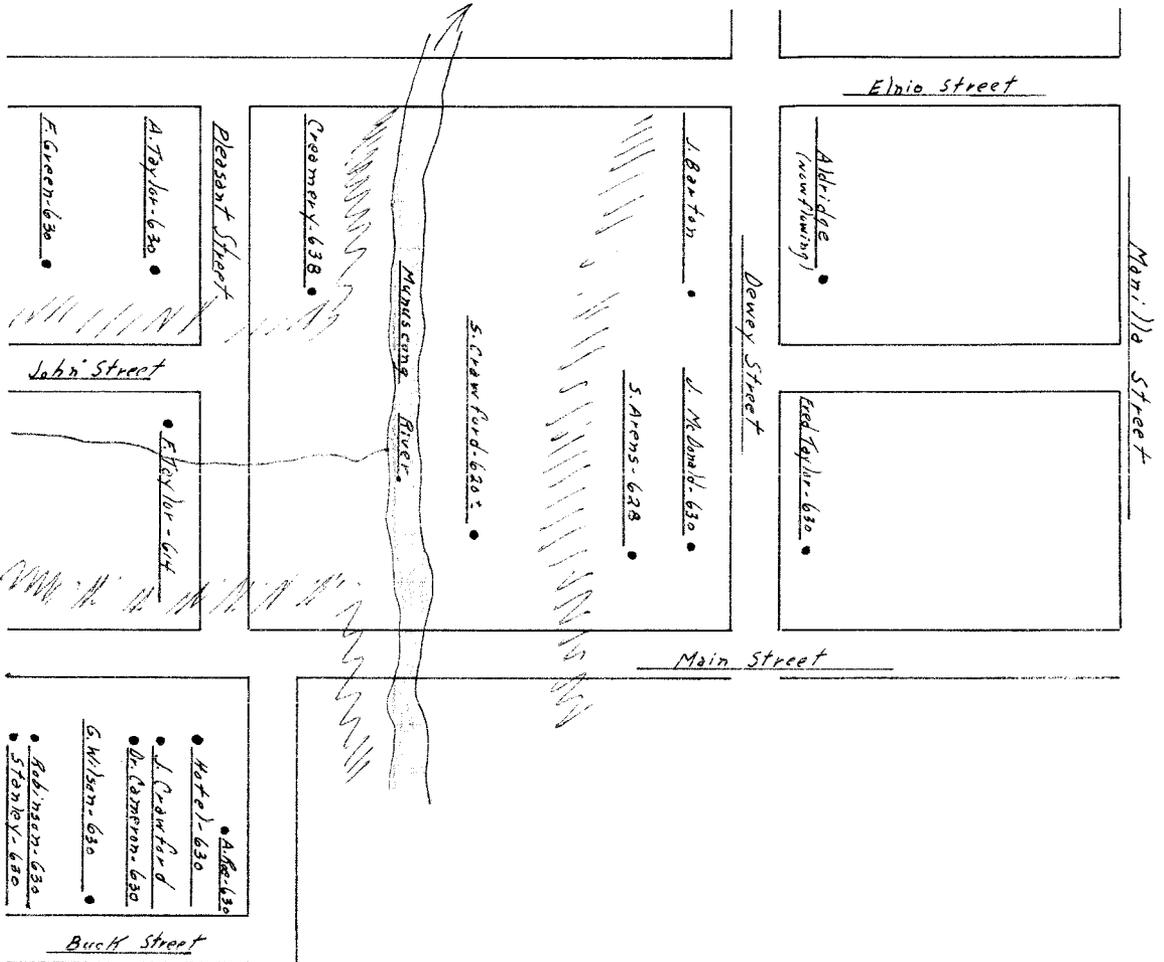
Isaac Watson's well is in northeast corner of Section 1. O. S. Roe's well is 650 feet west of Pleasant Street on north side of a ravine, about 16 feet above river level, or 622 feet A.T. Hotel is 24 feet above river. Frank Taylor's well in ravine, 8 feet; S. Crawford's, about 12-14 feet above river. All the others are about 24 feet, except O. S. Roe's, which is perhaps 16 feet.

Aneroid 29.485, 630 feet, at Pickford at 7:40 a.m.; 29.475 at level of plain in southwest part of Pickford on Meridian, 640 feet; 29.500 at Morrison well in northeast part Section 12, T.43N., R.1W., = 630 feet \pm . It flows a weak stream, about 1 quart a minute. No good temperature test. Head is about 4 feet above surface. Depth, 97 feet. There is 46 feet of sand in bottom. Aneroid 29.530, 620 feet, at Munuscong River, on Meridian.

John A. Taylor, in north part Section 13, has well with head fully 8 feet above surface. Aneroid 29.510 at well at 8:20 a.m. = 630 feet \pm . Rate of flow: 6 gallons a minute through 3/4-inch hole, 4 feet above ground, inside of pipe. Water is slightly chalybeate. Temperature 45.4°F. Air temperature 73°. The well is 8 feet above water level on a small tributary of Munuscong River just west of well. This is above a dam at sawmill in south part of Section 12 about 8-9 feet high.

Aneroid 29.500, 640 feet, at corner Sections 11, 12, 13 and 14, on a clay plain that extends about 2 miles farther west to base of a limestone ridge. This extends but 3/4 mile farther north but runs west several

MAP OF EAST PART OF PICHMOND
 (each square is 60 feet)



miles. It does not connect with the limestone ridge that lies south of here 3 miles, there being a gap 2 miles \pm wide southwest from here. I take road north across the west fork of Munuscong River. It is in a narrow trench 18-20 feet deep. Aneroid 29.500 at corner Sections 1, 2, 11 and 12 on clay plain, 640 feet \pm . There are occasional granite boulders near line of Sections 1 and 2. Aneroid 29.485 at corner Sections 1 and 2, T.43N., and Sections 35 and 36, T.44N., R.1W. A sand ridge a few rods north is 5-6 feet higher. Aneroid 29.490 = 645-650 feet. It runs north through west part of Section 36. It cuts across southeast part Section 35 and runs westward across north part of Section 2, crossing near middle of line of Sections 2 and 3 and then bearing west-northwest, crosses the town line $2\frac{1}{2}$ miles west of this corner, or on line of Sections 4 and 33. It is said to die out in Section 33. It is about 20 rods wide and 5-6 feet high. The land north of this ridge has more boulders than that south.

I go east into Pickford. Aneroid 29.525 at Grand Central Hotel at 9:10 a.m. = 630 feet; 29.510 on plain 1/4 mile east of river, 640 feet; 29.525 at Bacon's well, northeast part of Section 6 on west bluff of south fork of Munuscong River, = 630 feet at flowing well; 29.560 at river level = 600 feet \pm ; 29.520, 635 feet, on plain east of river. There are occasional large boulders on this plain. The soil is, in places, peaty and has willows but generally, clay is at surface. Aneroid 29.520 at schoolhouse, southeast corner Section 32, T.44N., R.1E., at 9:30 a.m. = 635 feet. I drive north to a knoll in west part of Section 33 that has a cut cleft in west side lined with boulders up to a height of 10 feet above the plain. Aneroid 29.510 at top of boulders = 645 feet. The boulders are largely limestone slabs, apparently Niagaran. Aneroid 29.495 at top of knoll, 660. It covers only 5 or 6 acres. Northeast of it 1/2-3/4 mile is a gently undulating tract not so high as this knoll.

Charles Remington has a well on ground 635 feet A.T., in west part of Section 33, 92 feet deep, that has head 10 feet, or at 625 feet A.T. It is 8 feet into gravel. It was made by Judson Daly about 1897. Aneroid 29.520 at well at 9:50 a.m. Mr. Remington says a well dug into the knoll northeast of his house noted above, struck a yellowish rotten rock at about 15 feet which had sparkling particles in it. From his description, I cannot determine whether it is a cemented sand or a limestone ledge. The top of the hill is a stiff, red clay.

Aneroid 29.515 at schoolhouse southeast corner Section 32 at 10:00 a.m., where it read 29.520 1/2 hour ago = 635 feet; 29.505 on sandy beach line at middle of line Section 33, T.44N., and Section 4, T.43N., R.1E., = 645 feet. This runs slightly east of south through Section 4. It is only a few rods wide and 6-8 feet above the plain west of it. It has scarcely any relief above a clay plain east of it. Aneroid 29.500 at corner Sections 3, 4, 33 and 34. There is a low, sandy ridge here and a sandy soil in Sections 3 and 34 which has strong beaches developed. Aneroid 29.485 on western one, west of middle of section line = 660 feet \pm ; 29.470 on high ridge about 60 rods from east end of section line, 675 feet. There are other ridges crossing line of Sections 2 and 35, near west end. They trend east of south. East of the high ridge along line of Sections 2 and 35 is a bouldery, sandy tract. It holds this level nearly to corner of Sections 1, 2, 35 and 36, then a descent to the east begins. Aneroid 29.485 at section corners. Mr. Joseph Kelly outlines the course of the border of the sandy tract and swamp from near corner of the Sections 1, 2, 35 and 36 to forks of the Gogomain and then it runs east on south side below the forks to the mouth of the stream. The drift at Mr. Kelly's is sandy down as deep as he has driven -- 35 feet. Aneroid 29.490 at Mr.

Kelly's on the beach above the swamp at corner Sections 1, 2, 35 and 36 at 10:45 a.m. I return west. Aneroid 29.470 on crest of sandy ridge near west end of line Sections 2 and 35 at 11:00 a.m. = 675 feet.

I go north through east part of Section 34 on the ridge. Aneroid 29.475 at line of Sections 27 and 34. The swamp is about $\frac{1}{4}$ - $\frac{1}{2}$ mile north of this line for $1\frac{1}{2}$ miles in Sections 26 and 27. There are clearings here in south part of the sections that extend nearly to it. I take road west, crossing the western large sand ridge near west end of line of Sections 27 and 34. Aneroid 29.480 on the ridge = 675 feet; 29.500 on the swamp west of it = 655 feet. A road on line of Sections 27 and 28 cuts this ridge near north end of Section line. Aneroid 29.510 at corner Sections 27, 28, 33 and 34 at 11:35 a.m.; 29.510 on brow of cut bluff = 660 feet; 29.525 at base of cut bluff = 645 feet, a little east of middle of line Sections 28 and 33. This runs north-northeast from the knoll in west part of Section 33, noted this morning, passing near the center of Section 28. It is a stiff, red clay with a little sandy capping in places. Clay is at the surface east of it for $1/4$ mile but the eastern parts of Sections 28 and 33 have sandy soil. Aneroid 29.535, 640 feet, at corner Sections 28, 29, 32 and 33.

Aneroid 29.540 at Stirlingville at 11:45 a.m. = 630-635 feet. A well at James Hill's store at Stirlingville was drilled (3-inch) to 125 feet. Head about 10 feet below surface, or 625 feet A.T. With a northeast wind, the water gets roilly. It was in a putty sand which was dug into 27 feet. It is bluish gray. The river falls about 15 feet from Stirlingville to the mouth. Aneroid 29.590 = 595-600 feet at river west of Stirlingville. The flat land runs east from Stirlingville without any rise except a little sandy strip $1\frac{1}{2}$ miles east that dies out just north of the section line. The land is sandy from this ridge east to the bay and all along the shore

of the bay to the mouth of the Gogomain River and not settled. Aneroid 29.545 at Stirlingville at 1:00 p.m. There is a narrow strip of sand along the southeast bluff of the Munuscong from Stirlingville northeastward scarcely 1/4 mile wide -- apparently a flood plain deposit when river was beginning its channel. There is heavy clay soil for $1\frac{1}{2}$ miles east of Stirlingville but it does not extend quite a mile north, the north parts of Sections 21 and 22 being sandy. The clay, however, is at slight depth and, in Sections 15 and 16, comes to the surface in places. Aneroid 29.595 at Munuscong River, 585 feet \pm , on line of Sections 15 and 16, or only 2 miles by direct line from its mouth; 29.570 on clay plain north of river on line Sections 10 and 15. The river is practically at lake level here, for when a strong east wind blows, it causes a rise of 1-2 feet as far up as this bridge. Wells in this vicinity are 15 to 30 feet. No deep borings have been made to test for flowing wells. Aneroid 29.595 at creek in north part Section 10 = 590 feet; 29.570 on plain at store south side Section 3, = 610 to 615 feet at 2:00 p.m.; 29.570 at northeast corner Section 3 = 610 or 615 feet.

I take county road north between Sections 34 and 35 and am on flat land for $2\frac{1}{2}$ miles. Aneroid 29.550 at north edge of flat land = 640 feet. There is a shore line here running west-east to the river channel $2\frac{1}{2}$ or 3 miles with rolling land north of it, standing 30-60 feet higher. Aneroid 29.510 at Barbeau post office at 3:00 p.m., 660 feet \pm . The postmaster says the south edge of rolling land 2 miles east is about at the corner of Sections 24 and 25, 19 and 30. East of this range line is flat land within 1/2 mile or, in places, 1/4 mile. It is rolling along line of Sections 13 and 18, but flat in much of Sections 12 and 7. Barbeau is 1 mile east of center of T.43N., R.1E. Lake Survey Station, just east, is 660 feet. The

land is stony for $1\frac{1}{2}$ miles north of here. It was stony for $1/2$ - $3/4$ mile east of this north-south line. The ridges are sandy that have boulders in them. The flats between ridges have few boulders. Wells in vicinity of Barbeau are shallow, seldom over 30 feet.

I go west and come to a stony ridge near center of township. Aneroid 29.475 = 690-700 feet. It has a steep west face that looks like a lake cliff. Aneroid 29.510 at west base = 660 feet \pm ; 29.550 at creek $1/2$ mile west = 630 feet. I come to a high boulder-strewn hill on line of Sections 20 and 21 where the aneroid reads 29.475, or 700 feet A.T. There is one about 10 feet lower on south side of $SE\frac{1}{4}$ Section 17. East of these hills is a plain where aneroid reads 29.510 at base of the bouldery parts = 660 feet. The land slopes down 20 feet or so below this level but has a smooth surface. The surface of the stony hills is irregular. They are sandy and gravelly but the plain has the pebbleless lake clay. This clay covers the southeast part of Section 18 and northeast of Section 19 with altitude about 660 to 670 feet A.T. In the west part of these sections is a rise to the high sandy plain that is boulder-strewn. Aneroid 29.480 on this plain at the meridian by a red frame church and a cemetery. The plain extends west into Sections 13 and 24, T.45N., R.1W., as far as I can get a view. This was a pinery and has grown up to brush. Boulders are very numerous. About $1/2$ mile north of this church I pass a large jasper conglomerate 5-6 feet in diameter, lying on east side of road. The red pebbles are in bands. The sandy plain seems to cover about all of Section 13, but the north part of Section 14 seems to be a hardwood forest. The southeast part of Section 12 is on this plain but the remainder is mainly lower and has hardwood in knolls, while the low tracts are marshy. Section 7, in R.1E., is largely pine stump land but has hardwood in the eastern part.

Aneroid 29.480 at corner Sections 12, 13, 7 and 18 = 680 feet; 29.495 on low tracts on line Sections 7 and 12 = 680 feet \pm ; 29.480 at corner Sections 6, 7, 1 and 12 = 690 feet; 29.495 on clay plain 1/4 mile north of corners Sections 6, 7, 1 and 12 = 690 feet; 29.500 = 680 feet at Lattram's store by township corners on a low clay knoll. West of here, in north part of Section 1 and central and south parts of Section 36, are ridges with numerous boulders. They rise 30 feet or more above this elevation and possibly 50 feet, or to 710 to 730 feet A.T. A high hardwood forest caps them and makes them look very prominent. This rolling strip seems to rise westward along north side of the town line to the Mackinac Road.

Aneroid 29.550 at creek on line of Sections 36 and 31 = 640 feet. (Flowing well obtained at level 15 feet above creek -- Daly's notes). The country west of this has a morainic topography, yet the lower knolls seem to be a red, pebbleless clay with scattered surface boulders, while the higher ones are gravelly and sandy with numerous boulders. Aneroid 29.510 on clay plain at corner of Sections 25 and 36, R.1W., and Sections 30 and 31, R.1E., T.46N., = 670 feet. In Section 31 are gentle swells, but Section 30 is plane and this plain covers much of the east half of Section 25. The southwest half of Section 25 is rolling, with swells 15-30 feet. Aneroid 29.515 = 675 feet at corner Sections 24 and 25, R.1W., and Sections 19 and 30, R.1E., T.46N., at 5:20 p.m.; 29.520 at middle of town line where road turns north into Section 18, T.46N., R.1E., at 5:35 p.m. There is a very stiff red clay here free from pebbles. Aneroid 29.515, 675 feet, at line of Sections 7 and 18 at 5:48 p.m. The Charlotte River border does not show the system of ridges and sloughs on this line that it does on the Mackinac Road.

In the north part of Section 7 there is a gradual rise, and a crest is

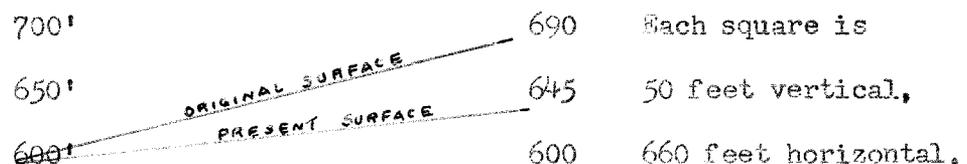
reached in south part of Section 6 where the aneroid reads 29.460 = 725 feet. This ridge is capped by boulders and has a few short gravelly ridges superposed. There are none on it in Section 7, but Section 6 has them scattered nearly all over it. There are also knolls with clayey matrix in which striated pebbles occur as well as boulders, giving it every appearance of till. I collect a sample from north part of Section 6. Aneroid 29.460 at north line of T.46N., on this high tract = 725 feet. There are swells in Section 31, T.47N., R.1E., west of this road, but the east part is flat surfaced. There is a knoll near the Meridian about 3/4 mile north of township corners. Aneroid 29.460 at line of sections 30 and 31 = 725 feet. The surface is plane from here west to the Mackinac Road and to the east also. This belt of bouldery drift seems to be connected with Larke Hill. That may be a spur between a lobe in Whitefish Bay and one in Hay Lake. The shallow depth to gravel and sand on this high tract was noted August 10, wells being often only 30 feet to good supplies of water. This suggests that the upper 30 feet is a deposit over glacial material (perhaps lake deposit) -- subsequent. The interpretation is not an easy one, in the general absence of till and pebbly material in the red clay.

The aneroid remains steady at 29.460 across Section 30, 725 feet, but changes to 29.465 in Section 19 and holds this reading to intersection with the Mackinac Road where the altitude, by Lake Survey Charts, is 720 feet A.T. I reach this point at 6:50 p.m. The aneroid seems to have been very steady all the afternoon, though there has been a great lowering of temperature. Aneroid 29.520 at south end of street car track at about the upper limit of Nipissing beach or of boulders strewn along the shore. Aneroid 29.550 at Livery south of there. Water power canal about 20 feet above water level, or 620 feet A.T.

I noticed limestone blocks near the red church on east side of meridian at west end of line of Sections 18 and 19, T.45N., R.1E. This is nearly east of their occurrence on the Mackinac Road in a knoll covered with hardwood (see yesterday's notes). The limestone is white and may be calciferous. Is the outcrop this far north, or has there been a northward drifting either in lake waters or by glacial action?

August 13, 1905. 2:45 p.m.

Sault Ste. Marie, at court house. Aneroid 29.715 at bench mark, 615 feet A.T.; 29.685 at Nipissing beach = 645 feet. A boulder of granite just east of the road south of end of car line on Ashman Street is 15 by 12 feet maximum dimensions and would average 9 by 12 by 7 feet if it extends underground. Aneroid 29.610 at the forks of road south of Sault Ste. Marie, where Mackinac Road turns southwest = 720 feet. The slope east of this high tract, if continued eastward, would strike the lower plain about $1\frac{1}{2}$ miles east of the Nipissing bluff. The bluff is about 40 feet.



Aneroid 29.620 at quarter post Sections 13 and 24, T.47N., R.1W.; 29.595 at the beach = 740 feet. This crosses the southwest corner Section 13, passing 400 feet north of corners and 500-600 feet east. Aneroid 29.535 at crest of Larke Hill on section line at 4:00 p.m. = 785-790 feet; 29.555 at west base = 770 feet \pm . The sandy matrix in the gravel pit in Larke Hill is not calcareous and I see no limestone pebbles. There is a clayey matrix in the cobbly material in lower part of the pit, 15-25 feet

from surface, so it seems like a very stony till. The upper part is water deposited except perhaps the boulders. Aneroid 29.595 at corner Sections 15, 14, 22 and 23. There is no beach here like that on the east side of Larke Hill but a flatter surface than farther up the slope toward the hill. There are sandy patches in this slope but the sand seems to be only 2-3 feet thick. The Nipissing beach or cut bluff passes across this line 1/3 mile west of section corners 14, 15, 22 and 23, T.41N., R.1W. The level at middle of line of Sections 15 and 22 is only 32 feet above the St. Mary's River. The bluff is about 50 feet high. There is a decided westward dip to the gravel in Larke Hill where road crosses and in the gravel pits on each side the ridge.

I take a wood road northwest from Larke Hill and find a terrace on the face of the bluff that seems to be about 650 feet A.T. Aneroid 29.650; 29.600 on bluff in Section 11 by the tannery; 29.650 at Nipissing beach. This bluff is bouldery on the slope clear to the top. There are pits east of the tannery in which till is exposed, and with it are pockets of gravel and sand. The stones are very scarce in the upper 10 feet and it is laminated there like the red lake clay but under this, it is not laminated and seems to be glacial. Aneroid 29.645 at South Street where road runs southeast around base of highest Nipissing cut by Mr. Chandler's residence. This seems to be about 655 feet A.T. Aneroid 29.685 at Court house level (619 feet) at 6:00 p.m.

There are boulders scattered over the surface on the slopes around Fort Brady up to 695 feet or more A.T. The north end of the ridge on which the Fort stands seems to have been worked upon by Lake Nipissing to 655 feet or more. Possibly the early stage of the lake was the one that formed cuts at 655 feet or more and the uplift caused a separation of the

beach into a series that extends down to 645 feet. I saw only laminated clay in a large gully southwest of Fort Brady on west slope of this ridge. There seems also to be only pebbleless laminated clay where the Mackinac Road leads up the hill.

August 14, 1905. 8:40 a.m.

I take skiff from Sault Ste. Marie to Sugar Island. Aneroid 29.645 at river level, 585 feet A.T. Temperature of water in north channel 63°F. at surface, at 9:10 a.m. Air temperature 70°F. at 9:15 a.m. Mr. J. Sebastian, who is my guide and is supervisor of Sugar Island, says the water in channel is high this year -- about 8 inches above ordinary stage. We reach shore at 9:45 a.m. Aneroid 29.645. Low terrace is 10-11 feet; steep slope up to 45 feet, or 630 feet A.T. Gradual slope to 88 feet, where a slight bank sets in at upper limit of boulders = 673 feet A.T. Aneroid 29.550 at upper limit of boulders. At 22 sights = $5\frac{2}{3} \times 22$ feet, or 124 feet above the water, is a sandy ridge. Aneroid 29.510 = 710 feet. The slope is loamy below this level but there is a stiff, red clay underneath.

I take road east on township line and reach the tableland just east of township corners. Aneroid 29.510; 29.485 at section corner by school house corner Sections 5, 6, 31 and 32, R.2E. We go south on the McMahon Road, rising gradually across a clay plain. Aneroid 29.460 at corner Sections 5, 6, 7 and 8. There is a bank 15-18 feet high about 40 rods south of the corners. Aneroid 29.440 on top of bank. The boulders set in here and stony material on top of clay. The roadside ditches seem to be in till of same color as the red clay -- in places, a sandy capping 1-2 feet thick. Boulders are very numerous, almost making a pavement.

Aneroid 29.435 at quarter post of Sections 7 and 8 = 780 feet by Lake Survey Chart. The surface is slightly ridged and rises rapidly westward to a gravelly ridge at 820 feet \pm . Aneroid 29.410 about 40 rods west of section line; 29.380 at top of steep ascent at center of Section 7 = 835 feet \pm A.T.; 29.370 at Lake Survey Station (Mission), 844 feet A.T. This is on a boulder-strewn flat tract. The soil here is gravelly, but there may be clay at slight depth. The boulders are numerous all over this tract above the 760-foot contour. I return east. Aneroid 29.375 at place where steep descent begins 40 rods \pm west of the section line; 29.415 at section line = 790 feet; 29.415 at gravel spit 70 rods \pm east of section line in Section 8. This dies out a short distance north of road but ties into the main high tract to the south or southwest. The contouring seems to be defective here in places.

Aneroid 29.410 at John Sebastian's residence at 12:15 noon = 780 to 790 feet. The west side of this island has no outcrops of rock but the east side has ledges about the line of T.46N., and T.47N., at Hill's Point and also near Payment and west about 2 miles from Payment. Aneroid 29.400 at 1:00 p.m. at John Sebastian's, 780-790 feet. A quartzite boulder in east part Section 9, on north side of road in field is about 14 x 14 feet and stands 4-5 feet above ground. Aneroid 29.370 at corner Sections 3, 4, 9 and 10 = 800 feet by Lake Survey contours; 29.345 at middle of line Sections 3 and 4 = about 825 feet where map indicates 840 feet. The land is gravelly and stony on this slope. About 20 rods east is a sharp ridge. Aneroid 29.315 = 850-855 feet. It trends north-northwest and runs to section line 40-50 rods north of quarter post. This has a narrow slough along its east side with no timber on it for 1/4 mile or more in length and 6 rods wide. East of this is a rise to ground about 870 feet A.T.

Aneroid 29.300 on crest 75 rods west of center Section 3 at 2:00 p.m.; 29.285-29.290 on a crest about 40 rods west of center of Section 3; 29.285 at center of Section 3 at 2:08 p.m. A steep descent begins immediately east of this corner. Aneroid 29.325 at a gravelly strip at edge of a gradual slope, it being steeper to the east. This runs west beyond the town line, crossing it 20 rods west. Aneroid 29.350 on a narrow gravel ridge about 20 rods west of line Sections 2 and 3; 29.360 at line Sections 2 and 3. We follow this southwest a short distance and then go up to higher ridge, aneroid 29.320, and follow it southwest. It runs west in south part of Section 3 and then north to where I struck it. It disregards the contour of the Lake Survey chart and proves them incorrect. There is a slough on north side of it at its extreme southern part in Section 3, like that noted east of the quarter post of Sections 3 and 4. Mr. Sebastian says this runs north from this quarter post nearly along the line of Sections 3 and 4 and continues north about 1/2 mile into T.43N., near line of Sections 33 and 34 to the lower country that faces the north channel of St. Mary's River.

We come to a faint beach in east part of SW $\frac{1}{4}$ Section 3, where aneroid reads 29.530 and a better defined one where it reads 29.350. We follow this south across the road just east of the quarter post of Sections 9 and 10. It is between the 800 and 820-foot contours here. I follow it around its curve in NW $\frac{1}{4}$ of SW $\frac{1}{4}$ Section 10. It extends 247 paces south of the quarter line and returns to it 280 paces east of where it runs across it near the quarter post. It is about 30 paces east of the quarter post. There is a slough on its north side at the southernmost part of the beach. The beach is about 10-12 rods wide and stands 3-5 feet above the land back of it. There is a rapid descent from it to the lakeward side. It is gravelly. The other beach, 30 feet higher, is also gravelly.

Aneroid 29.370 at John Sebastian's at 4:00 p.m. We go west to section line and then south. There are gravelly and stony ridges in SE $\frac{1}{4}$ Section 8, one reaching 760-foot contour and the others above 740 feet. Aneroid 29.400 on one nearest road; 29.435 at a spring by the roadside in a ravine just south of section corners. This is curbed and a fine drinking water. The plain in Sections 17 and 16 above the Nipissing beach has a red pebbleless clay at the surface but a ravine 20 feet deep has a lot of boulders in its bed. The glacial deposits seem, therefore, to have a few feet of lake deposits on them on the plain but not on the knolls. The lake deposits seem to be singularly scanty on slopes of knolls.

Aneroid 29.425 at corner Sections 16, 17, 20 and 21 at 4:40 p.m. We go west and find sharp stony ridges in south part of Section 17. Two near the quarter line are 20 feet \pm high. The land is rolling and stony west from here to a beach that seems to be at the crest. It is a fine gravel beach, running north-south near middle of line of Sections 18 and 19. Aneroid 29.340 on beach, 785 feet. It has a relief of 5-6 feet above land each side. Aneroid 29.415 at the uppermost beach of the Nipissing series = 690 feet. There is a cut bank here 10 feet \pm high. Aneroid 29.450, 660 feet, at main Nipissing beach with a bluff 25 feet high back of it. There are numerous boulders on the slope. Aneroid 29.535 at Hay Lake, 582 feet A.T., at 5:00 p.m.; 29.515 at Hay Lake at 5:30 p.m.; 29.395 at highest cut bank on the LeCoy Road nearly to the section corner, = 690 feet \pm , -- perhaps 10-15 rods west of it; 29.290 on gravel ridge on crest = 785 feet \pm .

The Lake Survey Chart does not space contours correctly on the slope where LeCoy Road descends to Hay Lake. There is said to be a southward continuation for 1/2 mile or more but to the north it is said to run out in 1/4 mile or less. The land is up to the 780-foot contour for over 2 miles, or past the Green Island Road. The gravel ridge is represented to

be disjointed. One ridge runs westward across the section line within 1/4 mile south of corner of Sections 19, 20, 29 and 30 and then runs south in east part of Section 30. There is another crossing the Green Island Road that does not tie into this. Aneroid 29.380 at 6:20 p.m. at corner Sections 16, 17, 20 and 21 on place where it read 29.425 at 4:40 p.m.; 29.420 at Nipissing beach in Section 21. This has a bouldery strip below it fully 1/8 mile wide. On the farm of Mr. McKenney, northeast part of Section 20, in a ravine 15-20 feet deep, is an immense quartzite boulder that is in several pieces. This has been under the red lake clay but the ravine cuts down to it. There are many other boulders here under the red clay as well as in Section 21 and Section 16. This lake clay probably was deposited by Lake Algonquin and its successors. It seems singular that the drift under the bouldery knolls is also a nearly pebbleless clay.

Aneroid 29.315 at John Sebastian's, 780 feet, at 7:00 p.m. Mr. Sebastian tells me that the low tract at west side of this island north of Wasig Bay is a succession of cobbly ridges and mucky sags. The ridges are only a rod or two wide. There is a very bouldery strip about 3/4 mile wide just west of the Nipissing beach, its west border running from Wasig Bay north-northwest to a beaver marsh and then northeast to the channel. There is also a cobbly ridge along edge of Hay Lake by Pleasant Park Island. The strip of boulders along the Nipissing shore east of the island ranges from 1/4 mile wide down to a narrow fringe, but generally, it does not reach to the shore of Lake George. A sandy, fertile tract borders the shore usually for nearly 1/4 mile back from the water's edge. Just west of Hay Point, however, stony land runs clear out to the water. The southern end of the island from about opposite the south end of Duck Lake northward to Latitude 46°, 25' is mainly tamarac and poplar brush with an altitude only 2-3 feet

above the water. There are extensive cranberry marshes in it. The high land in southern part is rather gravelly and timbered with maple. The soil is loamy rather than clayey where not gravelly. Much of Neebish Island also is hardwood timber and a gravelly or loamy soil.

The wells on the island are shallow, seldom reaching 20 feet. Water is obtained in sand at the bottom of the red clay on the clay plains. In the ridges, water is struck near the level of the base. The flat, clay land with poplar and white oak covers the west half of Section 9 and all of Section 4 except the east and west edges; all of Section 8 except the southwest part -- about 3 forties. Section 5 is all burnt land. The east half of Section 17 and all of 16 above the Nipissing bluff is in it. All of Section 20 except a little on northwest and southwest borders is on this land and it runs south into Sections 29 and 32 back of the Nipissing beach.

August 15, 1905. 7:00 a.m.

Aneroid 29.285 at line Sections 8 and 9 on the flats; 29.350 on gravelly ridges 1/4 mile east from west quarter post of Section 8 at 7:20 a.m. This runs about 1/2 mile slightly west of south but is not well defined. From corner of Sections 7, 8, 17 and 18, we strike west to a ridge standing 780 feet A.T., aneroid 29.350, and follow it westward past a camp and through a clearing with abandoned house and barn that is about 1/2 mile south-southwest of the tower. It is fine gravel ridge all the way, used by cattle for a trail. Aneroid 29.270 on it at north side of clearing at 8:50 a.m. We go northward along this beach to the east-west road in Section 12 and level east to the Lake Survey Station. We come to a beach 30 feet above this one about 80 rods west of the range line and

to one 47 feet above it right at the range line. The tower is 51 to 52 feet above the beach I started from, making the level of the beach 792 feet A.T. and the higher one 822 feet A.T. The 820-foot contour comes just west of it. There is a ridge in the cleared field by the tower at 844 to 845 feet. Aneroid 29.210 at the tower at 9:45 a.m.; 29.270 at the beach from which I started leveling = 790 feet \pm . I pace west from section line 400 paces to the gravel ridge. Mr. Sebastian made 440 of 3 feet each = 1,320 feet. Aneroid 29.235 at this beach = 820 feet \pm A.T.; 270 paces from this beach down to the 790-foot beach = 54 rods. Mr. Sebastian makes it 295 paces \times 3 = 885 feet. Aneroid 29.280 on this beach.

We go northward, zigzagging from one beach to the other about to corner of Sections 1 and 12, 6 and 7. We then follow the 820-foot beach around until it crosses the line of Sections 6 and 7 west of the middle, about as shown on the contour map. We come to the 790-foot beach at a clearing in northeast part of Section 7. Aneroid 29.285 at 11:20 a.m. It is about 80 rods southwest of section corners. The beach runs south from here near the line of Sections 7 and 8 as indicated on the map, keeping near the 780-foot contour, but probably 790 feet A.T.

Aneroid 29.315 at Mr. Thomas Noyette's in east part Section 6, at 11:40 a.m. Mr. Noyette's well is 22 feet and water stands 5 feet below surface. Temperature by pumping, 46° . Aneroid 29.315 at town line, corner Sections 5 and 6, 31 and 32, at 12:45 p.m. = 740 feet; 29.250 20 rods east of Section corners 4, 5, 32 and 33, on crest of the 790-foot ridge at 1:10 p.m. This trends west of north. East of this is a steep ascent, after passing the slough back of the beach, to where aneroid reads 29.225, or 810-815 feet A.T. This is 15 rods west of the 80-rod

post. Aneroid 29.220 at strong gravel ridge 40 rods west of middle of Section, line Sections 4 and 33 = 820 feet \pm . This trends west of north here. Aneroid 29.205 at quarter post on a broad, stony ridge 40 rods \pm wide, perhaps gravelly, = 835 feet; 29.190 on ridge about 75-80 rods east of the quarter post. This is gravelly and may be the 845-foot beach.

Aneroid 29.170, 860-865 feet, at a strong beach = 860 feet \pm , about 40 rods west of section corners. This stands several feet (10-12) above land each side and is 15-20 rods wide. It seems likely to be the high beach traced yesterday -- the 860-foot beach. Aneroid 29.170 at corner Sections 3, 4, 33 and 34 on top of another ridge that runs south along east side of line Sections 3 and 4 to where I crossed it yesterday. I sketch them in about as Mr. Sebastian thinks they trend. There is a broad, bouldery ridge near middle of section line of 3 and 34 on which aneroid reads 29.160. Aneroid 29.205 = 835 feet \pm on gravel ridge at Bower's and McMullen's camp in northeast part Section 3, about 200 paces from Section corners. Aneroid 29.205 at a ridge parallel with this on the section line at town line. This runs north-south for $3/4$ mile north and $1/2$ mile south = 835 feet \pm . Aneroid 29.290 at highest cut bank above Nipissing = 730 feet; 29.380 at lower and more cut bank = 650 feet; 29.410 at top of granite ledges in Section 35 under the Nipissing beach = 625 feet \pm ; 29.425 at base of bluff by swamp -- Algoma Mills beach at 610 feet \pm ; 29.455 at north channel of St. Mary's River at 3:20 p.m. There is a sandy strip from the river back to the foot of the ledges, but above the ledges, stones are very numerous clear up into the hardwood ridge and across it.

The Canadian shore north of Sugar Island is an escarpment of rock to a height of 300 feet or more, lying back only a mile from the river. On the west side of Garden River where it comes out into the St. Mary's

valley is a gravelly terrace 200 feet or more above river level (800 feet by Lake Survey chart). It may perhaps be a delta at a high level connected with some of the beaches noted on Sugar Island at 792 feet. I cross to the Canadian side and take train at Garden Station at 4:00 p.m. for Sault Ste. Marie, Michigan. Aneroid 29,425 at Garden Station = 606 feet. The next valley west of Garden River is similarly terraced up to 100 feet \pm above the river. The high rock bluff fronts St. Mary's River west of the mouth of this stream also, with bare rock ledges nearly to the top. This range runs on westward and drift hills set in south of it as we approach Sault Ste. Marie, Ontario. They are much lower than the rock hills. Aneroid 29,400 at Sault Ste. Marie, Ontario = 632 feet. The Nipissing bluff is about 1/8 mile north of this station and rises 30 feet \pm above its base. The base is considerably above the level of the station. Aneroid 29,410 on international bridge; 29,435 at Sault Ste. Marie, Michigan = 615 feet.

August 16, 1905. 7:45 a.m.

Aneroid 29,650 at the level of St. Mary's River = 585 feet A.T.; 29,615, or 620 feet, on Algoma Mills beach, 1 block north of Algonquin Hotel, Sault Ste. Marie, Ontario. I go north on Tarentorus Road. Aneroid 29,590 at Canadian Pacific railroad station at 8:00 a.m. = 632 feet; 29,575 at base of Nipissing bluff = 675 feet; 29,545 at top at summit curve = 675 feet. The pebbleless red clay is all that is exposed here. Boulders do not appear on the top but are plentiful along the base and south of the bluff. Aneroid 29,520 at south bluff of first ravine north of bluff 1/2 mile \pm . About 1/2 mile farther north and 1/8 mile north of a road running east, the surface begins to show waviness, the waves or swells being 3-5 feet high but it seems to be entirely lake clay

of red color like that to the south. The altitude here is about 700 feet. Aneroid 29.500 where change to wavy surface begins. (The topographic map has 720-foot contour). About 1/2 mile farther north, I come to a beach line, and here boulders set in on the south side of the beach. Aneroid 29.465 at base of cut bank = 745 feet \pm ; 29.450 at top. This is near 760 feet.

Aneroid 29.430 at forks (= 780 feet) where Great Northern wagon road leads northeast from the Tarentorus. There is a faint, gravelly ridge about 20 rods from forks northeast that runs up along east side the Tarentorus Road. It probably correlates with the one at 790 feet on Sugar Island. Aneroid 29.470 at the 745-foot shore on Great Northern Road about 40 rods southwest from where road turns east. There is a silty, looser-textured deposit below this beach than the ordinary red clay and it seems not to be bouldery. The boulder level here, as on the Tarentorus Road, sets in at 745 feet and extends up to top of the drift ridge. I return southwest along Great Northern Road to the Tarentorus Road. Aneroid 29.420 on the beach or bar northeast of road intersection; 29.430 = 775 feet at road intersection at 8:00 a.m. I go north on Tarentorus Road and find the beach becoming very strong near a cemetery 1/4 mile north. Aneroid 29.420 on crest = 785 feet. There is a large gravel pit in it here which has bedding that shows it was built up from the west side, for it is extended eastward across beds that dip east. It is a stony ridge for only 40-50 rods northwest of this road. This stony part is 12-15 feet high and 20 rods \pm wide. After passing this beach or bar, I descend to a clay plain on which there are no boulders.

Aneroid 29.455 where a road leads east from Tarentorus Road to Great Northern, about a mile north of the forks. It seems probable that the

boulder-strewn tract I have crossed is a weak moraine. The clay land extends about 1/2 mile north of this road. Sandy land there sets in. Aneroid 29,450 at the border. There is clay under it at 10-15 feet, exposed in ravines and in this are a few boulders. Surface boulders set in just north of cross roads along base of a cut bank that crosses Root River here. Aneroid 29,410 at level of base of cut bank. This seems to be a 920-foot beach. The bank is about 30 feet high. Aneroid 29,445 at Root River at bridge. There are ledges of rock here in bed -- a reddish quartzite rock. A short distance up, (40 rods \pm) is a cascade over the rock, several feet high. Just below this, a gray stony clay, laminated to some extent, forms the west bluff of the stream. Aneroid 29,340 = 860 feet \pm on tableland of gravel north of here on east side of river about 60 rods south of a railroad crossing. The altitude at railroad is 893 feet. This is terraced on side toward river at a level 15 feet lower, or 845 feet A.T. \pm .

I go east 1/2 mile and then take road north through a gravelly tract on which there are a few boulders. The aneroid shows remarkably rapid change. Aneroid 29,290 at railroad on north-south road; 29,305 1/4 mile north at Root River; 29,290 at base of gravel bluff a few rods north; 29,250 at top. I keep on ascending a terraced slope about 1/8 mile. Aneroid 29,200 on top, 1,000 feet \pm , if no weather change has occurred.* This may be the Algonquin beach. The ground drops off back of it like a beach. It trends east-northeast - west-southwest and is about 20-30 rods wide having, in places, a double crest. Aneroid 29,215 on flat north of this ridge at 10:15 a.m. I drive northwest 3/4 mile to a farm house at

*Lawson made this high beach 1,015 feet in this vicinity.



base of the granite ledges. Aneroid 29,200 at base; 29,070 at top = 1,130 feet \pm if there is no weather change. There are points to the west $1/2$ - $3/4$ mile that may be higher. Aneroid 29,190 at base of rock hills at 12:30 p.m.; 29,175 on crest of Algonquin beach at 12:45 p.m., where it read 29,200 two hours ago. Altitude 1,000 feet \pm .* Aneroid 29,240 at top of bluff north of Root River;** 29,265 at base, 913 feet. This bluff may be the work of the lowest Algonquin beach.*** If so, the level is 100 feet lower than for the highest Algonquin. Aneroid 29,250 at gravel pit station $1/4$ mile east of this wagon road = 925-930 feet. The top beds, to depth of 5-6 feet, are horizontal, but the beds below have an eastward dip of 15 to 30 degrees more or less. This is on a beach on south side of the west flowing part of Root River, the highest points being 6-8 feet higher than the track. Aneroid 29,290 on lower plain south of the railroad track.

Aneroid 29,305 at east-west wagon road, south end of road I am on, at 1:15 p.m. = 870 feet \pm . I drive east and come in view of a rock cliff that sets in east of the gravel pit. It is little higher than the beach, but apparently not up to the level of the highest Algonquin. This comes out to the north shore of St. Mary's valley about a mile from where I turned east. Aneroid 29,300, 875 feet \pm at base of rock cliff at 1:30 p.m.; 29,250 at summit in road = 920 feet \pm . Ledges south of the road are 30-40 feet higher, or 950-960 feet. This sag is filled with beach gravel, probably

*Lawson has 4 ridges at 400.4, 404.8, 403.3 and 413.9 above Lake Superior, or 1,002 to 1,015.5 feet A.T., Minnesota Geological Survey, 20th Annual Report, p. 281, 1893.

**Probably Lawson's 365.3 or 967-foot beach.

***Lawson makes it 311.2 feet above Lake Superior, or 913 feet.

same beach as at the railroad gravel pit. I continue to where a road comes in from the north and am at east edge of ledges on this west to east line, the distance across being scarcely 1/4 mile. I look across a river valley here which has high rock ledges on east side down to a point a mile farther south than this. There are foothills of drift on the point east of river between it and the St. Mary's that extend out 1/4 mile \pm , and stand perhaps as high as the level I am on next to the rock bluff, 875 feet \pm . The bluffs are 100-150 feet higher. There is glacial or Lake Algonquin filling north of here in a recess extending a mile or more north of this road. The Algonquin beach seems to bear north of east from where I crossed it into this river valley. It then swings south and blocks mouth of an eastern tributary about 1/2 mile north from this road. I think it then follows the St. Mary's bluff to Garden River valley.

I return west to the end of road running north. Aneroid 29.310 at 2:00 p.m. where it read 29.305 about 45 minutes ago. I continue west, rising just west of the railroad crossing to top of beach, 6-8 feet above railroad track, or 900 feet A.T. Aneroid 29.285. The railroad is 893 feet. Aneroid 29.330 at top of Root River bluff north of east flowing stream = 860 feet \pm ; 29.390 at base of bluff = 810 to 820 feet; 29.425 at stream by bridge = 785-790 feet; 29.385 at top of bluff on south side about 5-10 feet lower than foot of bluff to west. I see a red jasper conglomerate boulder here. I also saw one yesterday in north part of Sugar Island. The cut bank runs west-southwest from here, standing about 820 feet A.T. (aneroid) at base. I continue south to road leading west and seem to be just below the 790-foot beach. Aneroid 29.420 at 2:25 p.m. I take road west and have the 790-foot beach close by and the 820-foot beach about 1/4 mile north. I take first road leading north. Aneroid 29.410 at

base of cut bluff = 790 feet; 29.375 at top on railroad track = 820 feet \pm . This bank trends slightly south of west. It is about 60 rods north of the east-west road. There is another 60 rods farther north. Aneroid 29.330 at top. The cut bluff, as well as the beaches, is gravelly sand -- very few coarse pebbles; in places, fine sand. About 60 rods farther, I come to a bouldery ridge running east-west and standing 5-6 feet above border tracts. Aneroid 29.310 on crest = 880 feet \pm . From here north to base of Algonquin beach, 3/8 mile, is a boulder-strewn plain. Aneroid 29.300 at foot of first bluff = 890-900 feet; 29.260 at top = 920-930 feet. I continue over a series of parallel ridges up to the highest -- a strong, gravelly ridge. Aneroid 29.180 on crest = 990-1,000 feet A.T. The rocky bluffs are within a mile north and wild and rugged in aspect. There is also a rock ledge just west of this road and the gravel is banked up against the ledge to a height of fully 10 feet above the ridge on the road, or to 1,000 feet A.T. or more. Aneroid 29.200 on second ridge = 980 feet \pm ; 29.210 on third ridge = 970 feet \pm ; 29.220 on fourth ridge = 965 feet \pm ; 29.235 on fifth = 950 feet \pm ; 29.250 at top of cut bluff; 29.290 at foot, where a road runs east, = 900 feet \pm . There is thus about 100 feet between the highest beach and the foot of this cut bluff. The beaches contain boulders and cobble stones at top, but pits in them show considerable fine gravel. The boulder pavement for 100 rods or more south of this cut bluff is probably a beach feature. Aneroid 29.330 on the 860-foot beach, 60 rods north of railroad track; 29.375 at the 820-foot beach at railroad track; 29.410 at base of cut bluff, probably the 790-foot beach; 29.420 at cross roads 40 rods south.

I take road west and find the 860-foot beach at first cross roads is scarcely 1/4 mile north of this road and the main bluff is in front of it. A ravine just west of this cross road shows silty sand, laminated, and pale

grayish-yellow color. Aneroid 29.420 at railroad track on this east-west road = 780 feet \pm . Within 40-60 rods north, a bluff rises to 860 feet \pm . Aneroid 29.340 on the 860-foot bluff. The Algonquin beaches are 1/2-3/4 mile north on this road and trend south of west. Aneroid 29.450 at ravine west of this road. The bluffs are fine sand with layers of pebbly material. Aneroid 29.400 on west bluff. The 820 and 860-foot beaches are close by on the north until I pass the first cross road west of this creek, then they begin angling across the road as I continue west. Aneroid 29.400 at cross road west of creek; 29.330 at 860-foot beach. It stands 15 feet above a narrow plain south of it on which this road runs just east of a creek where the road turns southwest. I catch a view of the Algonquin beach about 1/4 mile north. There are ledges of rock exposed along the creek below it. Aneroid 29.410 at 790-foot beach at base of bluff where road changes from southwest to south, at 4:10 p.m.; 29.450 at brow of creek bluff on north-south road. This bluff is fine sand down 25-30 feet. A little red clay is there exposed and a line of springs appears at the junction. Aneroid 29.495 at creek bed; 29.485 at top of red clay; 29.450 at a cemetery on west bluff = 745 feet \pm .

I take road west here and find a well defined beach leading from near the edge of the cemetery which is probably the 745-foot beach noted this morning and the equivalent of the one at 740 feet on the east side of Larke Hill southwest of Sault Ste. Marie. This is a cut bank here, 15-20 feet high. Aneroid 29.435 at top; 29.400 at the 790-foot beach; 29.340 on next well defined beach near point where road changes from northwest to north. West from here 1/4 mile are rock bluffs. Aneroid 29.325 at bank 40 rods north = 860 feet \pm . This road leads up into a tract filled deeply with gravel in a gap between rock ledges. Aneroid 29.260 at next shore

line at foot of a cut bank. This runs into rock ledges 120 rods southwest of this road. Aneroid 29.210 on beach along top of bluff at a gravel pit. This also runs into rock ledges 120 rods southwest, but is about as high as the top of the ledges. Aneroid 29.195 at highest beach in the series. There are 10 ridges here from the one at 29.210 back, the northern six being of same height == 990 feet \pm A.T. I soon come to outcrops of rock. Aneroid 29.170 at first outcrops. I soon rise to the gravel upland. Aneroid 29.070-29.100. The oscillation being only 25-30 feet, I see roche moutonnee surfaces at many points, but not striae. They have probably been weathered off. I continue fully a mile into this high country but see no increase in altitude after rising to the upland.

I turn around at 5:00 p.m. and take readings on return. Aneroid 29.070 at highest points on road; 29.170 at crest of Algonquin beach at 5:15 p.m. = 990 feet \pm ; 29.195 at gravel pit at top of steep bluff = 965-970 feet; 29.250 at base of steep bluff on a beach = 910 feet \pm . From top of this bluff, I could see a high tract south of Whitefish Bay about S40⁰W from here that looks to be above general level of that region and perhaps above Lake Algonquin. Aneroid 29.295 at a beach at base of gradual slope = 875 feet \pm ; 29.310 on 860-foot beach at a house; 29.320 on parallel beach south of house 30 rods just north of turn in road where it leads southeast; 29.375 at a sandy ridge where a byroad runs south = 820-foot beach; 29.410 at foot of sandy slope -- rather gradual slope, 60 rods \pm wide = 790 feet; 29.420 at top of cut bank east of cemetery; 29.445 at base, probably 755 feet; 29.455 at cemetery at 5:20 p.m. = 745 feet \pm ; 29.475 on plain south of cemetery that extends south beyond cross roads; 29.505 at cross roads 1/2 mile south = 710 feet \pm . This plain is sandy north of the cross roads but red clay is practically at the surface to the south. It seems to be pebbleless lake clay.

At a church on top of Nipissing bluff 1/2 mile south of cross roads, aneroid 29.520, or 690 to 700 feet. There are a few pebbles 2-3 inches in diameter here, but they have probably been thrown there, for the road has been gravelled under the bluff. Aneroid 29.570 at base of bluff = 650 feet \pm . The bluff swings around to the south within a mile west of this road. I take road east and come to a creek in 1/2 mile. Aneroid 29.600 on bridge. This is just above the 620-foot contour. At next stream east of this contour, aneroid 29.605 at 6:00 p.m. I take a road leading south-southeast to the Sault and come to a bouldery strip about 1/2 mile from where I turn. Aneroid 29.610 at boulders. They cover swampy tracts and have swells 3-6 feet above the swamps. There is a lot of this bouldery material all the way to the St. Mary's River in west part of Sault Ste. Marie at an altitude 610 to 620 feet \pm . Aneroid 29.650 at river level at 6:30 p.m. = 585 feet \pm .

SERIES OF BEACHES IN VICINITY OF SAULT STE. MARIE

	<u>Feet A.T.</u>	<u>Lawson</u>
Highest Algonquin	1,000	1,015
Lower Algonquin beaches, all gravelly ridges on rather steep slope, on lakeward side of main beach, except in one place 5 or 6 miles northwest of Sault Ste. Marie, Ontario, where there are beaches back of the highest one that stand only 990 feet.	(985-990 (975-980 (965 (950	1,005 1,002 966
Cut bluff under the Algonquin series. (Also beach near railroad crossing of Tarentorus Road)	900	912
Gravelly beach on Sugar Island, but largely a cut bank north of Sault	860	
Weak, gravelly ridge on Sugar Island, also weak ridge or low cut bank north of Sault	845	
Strong gravel beach on Sugar Island and cut bank in gravel north of Sault	820	825

	<u>Feet A.T.</u>	<u>Lawson</u>
Gravelly beach of moderate strength on Sugar Island, but north of Sault largely cut bank in gravel. The 790' appears as a bar north of Sault Ste. Marie. This is cut also on Larke Hill southwest of Sault Ste. Marie, Michigan.	790±	(809 (776
Sandy beach east of Larke Hill and a cut bank north of Sault	(740 (740	751
Weak, sandy beach north end Sugar Island. This is chiefly a cut bank northwest of Canadian Sault where it is in sand. Not worked out well as yet.	704	
Main Nipissing beach at north end of Sugar Island by hand level. This is generally about 645-655 at base of bluff in vicinity of each Sault Ste. Marie (Notebook 203, p. 94) = 656 feet.	672	650

East of Pickford is a sandy beach and with it, in places, a cut bank at 640-645 feet. Back of this are sandy ridges at 665 and 675 feet ±. It is one of these, perhaps, that is to be correlated with the 672-foot beach at north end of Sugar Island unless the 672-foot beach on Sugar Island is a stone beach. It seems probable that the Nipissing started at the level marked by 672-foot beach at north end of Sugar Island but that most of the beach at that level has been removed by cutting at the 650-foot level. It ought to show in places where there has not been a cutting at the lower level as at town line running east from Pickford. (Notes August 12).

There is a beach at about 620 feet, probably Taylor's Algoma Mills beach showing along southwest side of St. Mary's River from Sault Ste. Marie, Michigan, southeastward. It seems to be present in Sault Ste. Marie, Ontario, north of Algonquin Hotel on Tarentorus Road. It has not been marked out on Sugar Island nor on the Canadian shore. The Algonquin beaches do not appear on the Michigan side near Sault Ste. Marie, for the country is too low to catch them.

U. S. LAKE SURVEY LEVELS

Iroquois Station (on a dune)	1,012 feet
Maple Ridge, Michigan, on east side C. & N. W. railroad, 36 meters from switch to charcoal kilns	959.21
Bay Mills	609.57
Brimley, 200 feet east of station, due north of frog for branch railroad	648.03
Gladys Station (near)	670.35
At Brush Point, 35 meters west of northwest corner of large brick house on south shore of St. Mary's River	603.721
Sault Ste. Marie, at court house (northeast corner)	617.626
Junction of Hay Lake and Rosedale Roads, 3 miles north of Charlotte River bridge	592.19
Barbeau, 330 meters east of post office in front of Alex Scole's residence	660.88
Kelden post office	601.5
One mile east and 1/4 mile south of Stirlingville	627.8
Fairview, southeast corner Section 1, T.43N., R.1E., 26 meters north of cross roads, 38 meters south of school house	687.247
Northeast corner Section 21, T.43N., R.2E.	680.8
One mile north of Gatesville, on north side county road	717.995
Gatesville, 133 meters north of road intersection at Gatesville	738.31
4 1/2 miles west of Detour, 327 meters east of from where road leaves edge of Caribou Lake	642.483
2 1/4 miles west of Detour on south side of road, 25 meters east of crest of hill	657.2

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