

Notebook No. 242 - Leverett



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NOTES OF FRANK LEVERETT

U. S. GEOLOGICAL SURVEY

NOTEBOOK # 242

November 14, 1911 9:30 A.M. An. 28680 at Florence.

On train Florence, Wis. to Powers, Michigan

I take train east to Powers, Michigan. The drift is decidedly red in Florence but this may be due to the Iron formation which is mined here.

An. 28650 at Commonwealth. The town is south of here on a hill 30' \pm higher. Hardwood and boulders and gently undulating till east of Commonwealth. An. 28630 at a siding one mile east, on general level of the tableland of gently undulating till. This altitude is maintained to within $\frac{1}{2}$ mile of east line of T.40, R.18.

A descent of 100 feet is then made in about a mile to a pine plain, and soon to a still lower plain at Spread Eagle. An. 28780 at Spread Eagle Station.

There is a moraine immediately west of the station and on the east side of Spread Eagle Lake. The railway cuts 25' into knolls $\frac{1}{4}$ - $\frac{1}{2}$ mile east of the station. This extends about to river. There are cuts in rock from $\frac{1}{2}$ mile NW of the Menominee River.

An. 28850 at River bridge.

There is gravely land with nearly plain surface except basins for a mile east. But near Antoine bouldery hills set in that are likely to have a rock nucleus. Over $\frac{1}{4}$ mile southwest of the station is over 100' high. A mile WSW is 300 feet reaching 1500' contour. An. 28820 at Antoine at crossing of CM & St. Paul R.R. About 1175' one mile from Iron Mountain Station on that R.R. 28835 at Iron Mountain Station = 1160. There are large sunken areas below Antoine station and Iron Mountain due to _____ (?) _____ of Iron Ore.

Rock hills are prominent around this city. The station here has same altitude in a plain south of the track east of the city. North of track hills are over 100 - 250 feet higher. In less than 2 miles a moraine is entered and descent begins through it to Quinnesec. An. 28935 on a plain entered $1\frac{1}{4}$ miles west of Quinnesec station. This plain extends south beyond the limits of vision. But there is a rock range close by on the north clear to Quinnesec.

An. 28940 at Quinnesec - 1050 on outwash plain. A moraine of which (?) in this outwash sets in immediately east of Quinnesec less than $1/8$ mile from the station. The surface is gently undulating. Only a few boulders. Drift, is cobbly. Cuts are 10-15' for $1/2$ mile. Nearly plain then for a mile when a strong bouldery moraine is entered that has sharp knolls 20-50' or more high. There is a high tract a mile south probably rock ridge. And a still higher one $1/2$ mile north. But between those ranges is the hummocky glacial topography.

The railway descends through this to Norway. An. 29030, 944' at Norway Station. 30' cut just west. A swampy plain to south of track is 10-20' below station. The business part of the old town is in it. The town is being moved farther east in order to mine here. No descent to Curry crossing.

Lake south of track east of here extends to Vulcan. An. 29060, 932' at Vulcan $15'\pm$ about lake level. Very prominent rock range $1/2$ mile north. Less prominent one $1/4 - 1/2$ mile SE.

Topography along railway east from here is of subdued morainic type. It is not very bouldery however.

An. 29120 on Sturgeon River bridge. Drift is stony, with boulders a foot or more in diameter in first cut east of the river. An. 29100 by lake on north side of track, 5' above water surface, just west of Loretto.

An. 29100 at Loretto. Almost $1/4$ mile north at (?) altitude

is 30-40 higher, and still high NE 1/4 mile. The railway is in a swampy valley -- 1/4 mile \pm wide at level of Loretto Station.

A pine plain soon appears on the south side of the railway at this level, but on the north is higher land with boulders in cuts. There seems to be a moraine east of this plain setting in about 2 miles east of Loretto. This I presume is the "Waucedah moraine of Russell", for it is fully developed to Wancedah. An. 29090 at station 894' in a valley 5' above a swamp. Iron is mined from a hill 1/8 mile west of this depot. The village is south on the moraine. Morainic or drift knolls 20' \pm high are found among larger hills with rock nucleus.

See notes last June on this region. Hills begin to take on a drumlin form a short distance east of Waucedah, but well shaped drumlins are found but little west of Hermansville, there being a somewhat hummocky surface on the elliptical knolls and hummocks between them west from Cedar.

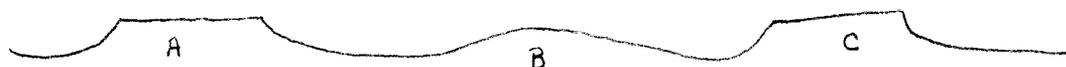
An. 29000 at Cedar Station about 975 A.T. Limestone outcrops immediately east at about the altitude of this station. Drumlins of various heights from 10-15' up to 40-50' lie between Cedar and Hermansville. There is a esker on west side of the mill pond by Hermansville running NE from the track.

An. 29070 at Hermansville = 887 on Soo Line at about same altitude as C & NW Station. There is rock near surface in this vicinity on which Russell observed glacial striae.

An. 29100 at Powers = 866' A.T. at 11:30 A.M.

I find that the till in the drumlin on which Powers Village stands has a pink tinge. The stones in it are largely limestones and the surface is thickly set with them. Blocks 2 - 3 ft. in diameter occur. In the present condition of the cuts they are some what displaced from the original position yet with but one exception they are nearly horizontally placed. One block on the wagonroad on the crest of the ridge in a

shallow excavation on SE side of road is on edge. Russell claimed that many of the slabs stood on edge and from this he inferred they were not laid down in the process of building of the drumlins by slow accretion but were in a till sheet that was formed by the dropping down of the material in a pell mell condition without the plastering process. The drumlins, he held, were then sculptured from this till sheet. In some cases he noted drumlins with flat tops as if the sculpturing had not extended far enough to destroy all of the original till plain surface -- thus:



In this A and C represent incomplete drumlins formation and B complete.

An. 29015 at Powers at 2:15 P.M. On train Powers to Escanaba.

I take train into Escanaba, and sketch in drumlins that lie near the railway. On Cleveland Cliffs _____ (?).

An. 29100 at Wilson. --

Till ridge a mile west of Narenta on east side of Bark River 15-20 feet above swamp. An. 29200 at Narenta.

An. 29210 at East side of Swamp.

Morainic topography with knolls 15-20' high from $3/4$ miles east of Narenta _____ (?) valley of Ford River. An. 29220 at Ford River in cut 6-8 feet deep.

29230 on bridge 15' above stream.

29220 on plain east that was crossed by Lake Algonquin (See notes June 1911)

29215 at a beach $\frac{1}{4}$ mile west of Pine Ridge. Dunes at Pine Ridge 20' above track.

29225 at first track east of Pine Ridge ($\frac{1}{4}$ mile \pm)

29280-85 at base of dry sand ridge.

29300 in swamp 2 miles west of Escanaba.

29305 at Escanaba depot 605 \pm

29325 At Ludington Hotel = 590' \pm

I took car to Gladstone after supper.

November 15, 1911 -- Gladstone, Michigan

Trip on railway north from Gladstone to Trenary, Michigan. On An. 29335 at Soo Line Station = 612' A.T.

I take train to Rapid River--There is a beach by the roundhouse north of the depot at about 615' that rises north along the base of high bluff that lies back a mile or so from shore of Little Boy de Noc. It is close by the Soo Line Station at Gladstone. The railway is in a swamp from near Gladstone to within $1\frac{1}{4}$ miles of Masonville. There gravelly and sandy ridges are crossed there being several before reaching the stream that comes into the bay south of Masonville (Day's River). The profile shows an altitude of 615 on these borders south of Day's River.

Masonville is 595', and in a swamp. A low bank at west edge of the swamp 20-30 rods west of the railway near Masonville runs just above 600 feet and is apparently a shore line. 29430 at Rapid River at 10 A.M.

For notes on flowing wells and glacial features and shore lines in Delta Co., see 1905 notes.

The swamp on Rapid River extends west of R.R. but not to Wagon road in Secs. 17 & 8. This swamp is below 600' as far north as the south part of Sec. 8.

My aneroid reads 615' -- 29405 at road crossing in Sec. 5, T.41, R.21W. and 620 at township line. A range of hills 75' \pm higher lies $\frac{1}{2}$ - $\frac{3}{4}$ mile west of the railway here.

The altitude is 635 \pm at station on line Secs. $\frac{29}{32}$, T.42, R.21W. The hills are less prominent west from here but set in at $\frac{1}{2}$ mile \pm .

An. 29380 at Rapid River bridge = 639' by profile.

An. 29360 at edge of higher land $1/2$ - $3/4$ mile north of river = 655 \pm .

The railway ascends a small tributary of Rapids River with a flood

plain 30 rods \pm wide to a tableland in NW part of Sec. 17 standing 710-720' A.T. Cuts show sandy material to depth of several feet where the railway emerges from the valley onto the tableland near line Secs. $\frac{8}{17}$.

Algonquin Shore 766

An. 29285 = 715' \pm This seems to be the bed of Lake Algonquin. An. 29280 at Ten Mile Spur on this plain just north of here is a low ridge 3-5' higher and 8-10 rods wide running WSW-ENE, sandy and at altitude 766' \pm . Probably near the highest Algonquin shore. Profile reads 761 where I suppose we are 29270 = 270' \pm at a small till knoll about a mile north of Ten Mile Spur, and probably at border of Lake Algonquin. Cut is 8 feet deep in Stony till. North from here is knolly land. (Get altitude of this cut from Soo Line River and the location by Sections.)

An. 29250 at Ozier Station - 788 by profile An. 745. So this highest shore of Lake Algonquin is likely to be nearly 766 feet here.

I think the till here has a reddish tinge. 29235 at Ducettes Spur (about 847' by profile)

Doubt as to Algonquin Waters north from Ten Mile Spur.

Scattered knolls 10-20' high all through here. 29190 at Minor Spur near line Secs. 5 & 8, T.43, R.21W. - 848.

An. 29180 on bluff west side of Whitefish River at township line= 862 feet. The land rises gradually westward here and a short distance north sharp knolls appear on east side the river within 40 rods of the bluff. An. 29180 at Cliffs Station.

An. 29200 at rock cuts about $\frac{1}{2}$ mile north on west side of track $\frac{1}{8}$ - $\frac{1}{4}$ mile south of a western tributary of Whitefish River in NE $\frac{1}{4}$ Sec. 30, T.42, R.21W. at junction with Whitefish. We cross to east side of Whitefish River here.

An. 29175 at Trenary = 865' by profile at 11:15 A.M. It seems very unlikely this area from near Ten Mile Spur northward was submerged at level of Lake Algonquin. I can see no signs of wave action on the country and the drift knolls are so sharp in contour, I doubt if they are waterlaid.

An. 29180 at Trenary at noon - 864 A.T.

The bluffs rise abruptly 20-25' above the level of the station which is in Whitefish valley.

An. 29140 at E-W road by a school house $\frac{1}{4}$ mile south of Spur 370 probably corner Secs. 5, 6, 7, & 8.

An. 29130 at Spur 370.

There is an undulating surface here but not sharp hummocks. It is a till tract with a few small surface boulders, pink till. Ascent is very rapid north of here. The aneroid nearly 29100 in less than a mile. The profile gives 922 at about this place near north end of line Secs. 5 & 6.

An. 29115 at stream on line Secs. 31 & 32.

There is considerable cleared land west of the railway in Secs. 30 & 19, T.45, R.21W. It has a few knolls 20-30 feet high but is partly undulating elsewhere.

An. 29100 at north edge of a farm in SE $\frac{1}{4}$ Sec. 19 just south of a stream. Undulating surface north to a camp about 3 miles south of Eben Junction. An. 29075. This is Louds Spur on line Secs. 7 & 8. Much nearly plain surface north from here with a _____ (?) _____ northward ascent. 29040 at west base of a drumlinoidal ridge 20-23' high less than a mile south of Eben Junction.

North of this is a N-S drumlinoidal knoll 40-50' higher than railway. 29160 at its west base just south of Eben Junction.

Algonquin shore about 900' near Chatham (see page for June 11, 1912)

29215 at Chatham = 866

There seems to be a shore line by MP 19 on the Munising R.R. at about 900'± A.T. (notes 1912). It cuts into drift knolls along S side of track and turns SE into the timber keeping near the railway to where that turns east to Chatham. I can see it further east on east side of the small valley near line Secs. 32 & 33. It runs eastward across Sec. 33 passing $\frac{1}{2}$ mile ± south of Chatham. The railway cuts rock ridges just west of Chatham and rock is at surface around Eben Junction at level of depot. The ridge $\frac{1}{2}$ mile west of Chatham is about 885 feet or more and is 10 feet or more above the surrounding lands.

Peach Trees in Northern Peninsula

Mr. Geisuer (?) says a German woman in Marquette has the oldest peach trees in the northern peninsula - Mrs. J. Selander, 224 W. Ridge St., has some peaches, - there are a few trees in Houghton. Some have grown and ripened near Ontonagon on Copper Range, but now are winter killed.

He thinks apples and plums would thrive all along the Lake Superior Shore. Cherries will do well on sandy land. Old cherry trees set out by Missionaries were reported 50 years ago in district around L'Anse.

Algonquin shore about 900' near Chatham.

The Algonquin beach follows the south bluff of a small stream that passes $\frac{3}{4}$ mile south of Chatham. It passes into Sec. 3, T.45, R.21W. about $\frac{1}{3}$ mile east of the road that runs south from Chatham. The shore is a distinct cut bluff 20 ft. ± in height and stands about 910' A.T.

There is an island immediately east of Chatham on south side of the Munising R.R. in Secs. 34 & 35. The cut bluff at its west end is in the east part of the village and is about 20 ft. high. On the north face of the island there is greater relief because of Calciferous Creek Valley being close by.

Border of Lake Algonquin in Wester Alger Co.

Mr. Geisurer (?) says there is a small oval shaped island in north

part of Sec. 25, T.46N., R.21W. with larger axis NW-SE.

Mr. Geisurer (?) knows the course of this highest Algonquin beach from Chatham NW into Marquette County. It leads through Secs. 33, 32, 39, 20, & 19, T.46, R.21W. and Secs. 13, 14, 10, 9, 8 & 7, T.46, R.22W. to where Mr. Gordon and I traced it in 1905. In T.46, R.22W, there is an escarpment facing north and the beach is along the base in the face of this escarpment. Mr. Geisurer (?) does not know its course so definitely southeast from Chatham but it is usually less than two miles east of the AuTrain Whitefish sag as far south as the county line of Alger County. The bluff is less definite and bold in that part which faces east and especially in the narrow AuTrain Whitefish Strait.

East of the AuTrain Whitefish Strait, the shore is close by the low part of the strait in Secs. 31, 30, & 19, T.45, R.20W. There is then a bay up past Joe's Lake into Secs. 16 & 9. But north of this bay the high moraine at only $1-1\frac{1}{2}$ miles east of the AuTrain rises above the Algonquin Level.

Shore of Lake Algonquin eastward to Wetmore

The Munising R.R. cuts across points of this high moraine east from Dixon in Sec. 32 - 33 and again in Secs. 34 - 35. But in Sec. 36 only the SE corner is up to Lake Algonquin level, the shore being in north part of Sec. 1. It crosses the south line of the Munising R.R. east of Stillman Junction and runs eastward past Wetmore at a distance of about a mile south of the DSS & A R.R. from Munising Junction past Wetmore. Thus by Mr. Geisurers (?) aid I have filled in such gaps as occurred in my mapping of this highest Algonquin shore.

I took a train west at 5:00 P.M. to Little Lake and then south on the C & NW R.R. to Escanaba.

I made notes on this part of the C & NW line last June.

I took train from N. Escanaba to Pembine, Wis. on Soo Line R.R. on evening of November 15.

December 23, 1911 - Ann Arbor, Michigan

A boring was completed today for Mr. Miller in south side of Geddes Avenue between Oxford and Oswego Streets, that reached a blue shale at 298 feet. The surface altitude is about 938 feet, so rock surface is 640 feet which harmonizes well with other records around Ann Arbor. The water has a head 138 feet below surface or 800 feet A.T. which is about 125 feet lower than in neighboring wells more remote from the Huron River bluff. This suggests a lowering of head at the Miller well by escape into the Huron.

Most of the drift is a hard grayish till. There are some beds of fine sand containing water but the sand is too fine to screen. A greenish clay was struck at about 200 feet which looked like a swamp subsoil. It is several feet thick. Some water was found at 204 feet that had a head 138' from surface but in sand too fine to screen well. Pieces of wood were found at over 200 feet. This boring was carried a few feet into the shale.

Later -- Tests made in pumping showed a clogging up of the pipe with fine sand. So it was decided to abandon the well and draw out the pipe.

Levels run by L. G. Hornby, April 7, 1912 from center of Oxford Road at east end of South University Ave. show 26 feet rise. This road intersection seems to be 913.5 by Muldrows levels. In that case the well mouth at Miller's house (now DKE Tret ?) is 939.5 and the surface of the shale 641.5 feet, there being 298 feet of glacial drift (The ground at front of Glover's house west of Oxford Road is 919-920 feet. The altitude is only a little above 920 contour anywhere west of Oxford Road probably not over 923 feet.)

Levels by city engineer of Ann Arbor make the center of sidewalk intersection at NW corner of S. U. Ave. and Oxford Road 912.89 feet A.T. This is within a foot of the level of the center of street where Hornby began leveling. That is about 913.5 feet. The hydrant at Oxford and

Geddes is 914' by city Engineer levels.

Extent of Lake Agassiz shown on map in H. Doc. 27, 61st Cong.

A contour map of northern Minnesota accompanying House Doc. 27, 61st Cong. 1st session, furnishes supplementary data on the extent of Lake Agassiz to what I obtained in the field in 1911.

The lake seems to have extended to the south edge of the swamp in the central and within part of T.152, R.30W, that I traversed in the trip NW from Kelliher. Probably the south border of the swamp in Secs. 11, 15, 16 and 17 is the shore of Lake Agassiz. The altitude is only 1244 at center of Sec. 32, T.153, R.30W, where a sand ridge crosses the turnpike. The altitude at the south edge of the swamp is 1260-70 feet. The beach seems to come into the old Chippewa Reservation from the east in Sec. 11, T.150, R.32W. The 1240 and 1250 contours being in that section. The 1240 contour here is relatively close to the 1250 and separated widely from the 2130 foot contour and it seems likely the lake level here is at about 1240 feet judging from its height 1245' at Redby.

The shore seems to be WNW from Sec. 11 to the line of Tps. 150 & 151 near corner of Secs. 5 & 6, 31 & 32 where Hay Creek comes through it. This is 5 - 6 miles ESE from where I saw it in vicinity of Redby.

About 12 miles west of the meridian of Redby the shore seems to be trending south of west across the reservation line, near the line of Beltrami and Clearwater counties. The course is then nearly westward along or near the reservation line from Sec. 24 to Sec. 19, T.150, R.36W. It there turns southward along or near the range line between R.36 & 37W., to Clearwater River and the corner of Tps. 149 and 150, Rgs. 36 & 37W being not far from the 1230 foot contour. The map shows a low bluff running westward across the northern edge of the northern sections of T.149, R.37W. with a slight southward embayment in Sec. 3. Pine River crosses this low bluff and emerges on the plain only 1-1½

miles below Gorwick Station. From Sec. 3, T.149, R.38W. the bluff turns NW into Sec. 33, T.150, R.38W. and then runs west across north part of Secs. 33, 32 and 31 and continues westward past gully near the line of Secs. 25 & 36, 26 & 35, 27 & 34, 28 & 33, 29 & 32, T.150, R.39W. where I have already noted it in the field.

The road to Redby from Gully in Secs. 26 & 25, T.150, R.39 and Secs. 30, 29, 28, 27, 23, 24, T.150, R.38W is on a beach or gravelly ridge which in places rises above the 1220 ft. contour. There is a tract several feet lower lying south of it and extending nearly to where the bluff like rise occurs that I have interpreted as the highest beach of Lake Agossiz.

At the line of Koochiching and Beltrami Counties on T.153, Secs. 18 and 13 is a beach noted by Mr. Ogaard, County Surveyor of Koochiching County, that is only about 1245-50 feet. It is not likely to be the highest beach of Lake Agassiz for it is only 18 miles WNW from the beach noted in the railway in Sec. 1 & 2, T.152, R.27W and that is 1297 feet. The isobase seems likely to run from one of these points to the other. In that case the beach at the county line is 50 feet below the highest stage the lake reached there. The shore of the highest lake stage a few miles south would probably be lower on account of the differential uplift.

There is a definite swamp border running through the northern part of T.152, R.28W. from Sec. 12 to Sec. 7 and continuing in a westward course to Sec. 18, T.152, R.29W. This is the same large swamp that I entered a few miles northwest of Kelliher and which there had a bluff-like border south of it.

The map shows what seems to be a beach north of Red Lake in Sec. 23, T.155, R.36 at 1251'. It is a narrow bar with N-S trend, standing on an area above the 1240' contour and close to its west edge. This

area covers 3-4 square miles. Another area above 1240' is 6-9 miles north and extends from Sec. 26 to Sec. 9, T.156, R.36W.

These areas are south of "Beltrami Island" for that lies in Tp. 159, Rs. 33, 34, 35 & 36W. It is 1250 to 1310 feet A.T. I am in doubt if any of Beltrami Island stood above the highest Lake Agassiz shore. There are narrow strips standing above the 1290-foot contour that seems likely to be old shore lines or bars of Lake Agassiz. One in T.159, R.33W., Secs. 18, 19 and 20 with a trend NW-SE. Another with similiar trend in Secs. 8 & 9, T.159, R.35W. A narrow beach like ridge in Sec. 2, T.159, R.35W. has a trail along its long axis E-W and is above 1280. North of Beltrami Island in the SE corner of T.161, R.35W. is a narrow ridge looking like a beach that trends NE-SW and rises above 1240 feet. It runs NE across Sec. 31 into Sec. 30, T.161, R.34W. in a strip scarcely 1/8 mile wide. This is only 12 miles south from the shore of Lake of the Woods.

Imlay Outlet

Notes from Taylor

| | | | |
|---|----------|--------|-----|
| 1½ miles north of Almont | 796' | uplift | 40' |
| East of Imlay | 790-795' | uplift | 50' |
| Nine miles north of Imlay | 790± | uplift | 60' |
| 1½ miles S of North Branch | 785' | uplift | 64' |
| Distance _____ (?) _____ | 24 miles | | |
| Fall originally | 35' | | |
| Present fall | 11' | | |
| Upper Maumee Beach at Almont | 840' | | |
| Upper Maumee Beach at Imlay about | 850' | | |
| Upper Maumee Beach at Goodland Church about | 855' | | |

Beaches in Northern Sanilac Co.

Upper Warren 25' above Wayne beach - 748' Wayne has 3 _____
with vertical interval of only 5-7' in series. Altitude 725-718.
Wayne beach 2 miles north east of Ruth on Pere Marquette R.R. is
740'.

Series from Lake Huron East in North Sanilac Co.

1. Bluff of clay and sand 40'
2. Sandy ridge at 625'
3. Gravelly ridge at 650-55' Elkton
4. Broken ridge at 670' and stronger at 673'
5. Weak ridges at 680, 685 & 695. (4 & 5 Grassmere beaches)
6. These faint washed down ridges 718, 720, 725 probably Wayne.
7. Two closely set fairly stony gravelly ridges at 730 & 735'.
8. Strong highest ridge at 748' (7 & 8 Warren).

Levels in Imlay Outlet by L. G. Hornby

L. G. Hornby and I ran levels from Imlay north through Secs. 17 &
8, Imlay Twp. Along the main road and then east to a ditch in the swamp
near west end of line of Secs. 4 & 9, Imlay and took sight north across
Sec. 4 to the summit in the swamp where waters divide below Belle River
and Mill Creek drainage.

| | |
|---|---------|
| Grand Trunk R.R. base of rail in front of depot | 826' |
| Street crossing in front of Cleveland Haven (?) | 829.97' |
| Crossing on South side E-W street 4 blocks north of Cleveland. | 830.24 |
| Belle River surface of water | 805.4 |
| Road forks near center Sec. 8, Imlay Twp. | 856.9 |
| Ridge east of the diagonal road about 50-60 rods from forks (possibly a Maumee beach?) | 859 |
| Bed of ditch in Imlay outlet on line of Sec. 4 & 9, Imlay Twp. | 804 |
| Surface of peat by ditch | 807± |

Bridge on line Secs. 4 & 9

808.43

Surface of peat a mile north looks to be not more than 808.43 for the level at 812.43 strikes top of fence posts a mile north at 4 ft. \pm above bog. From the ridge at 859 (possible beach) slightly NE to a white frame church $2\frac{1}{2}$ miles \pm distant level strikes within 5 ft. of top of roof or fully 20 feet above the ground. This is near the highest part of the ridge east of the Imlay outlet. No place in the ridge appears to be above 840'.

Levels and deposits in Imlay outlet near Imlay City, Michigan.

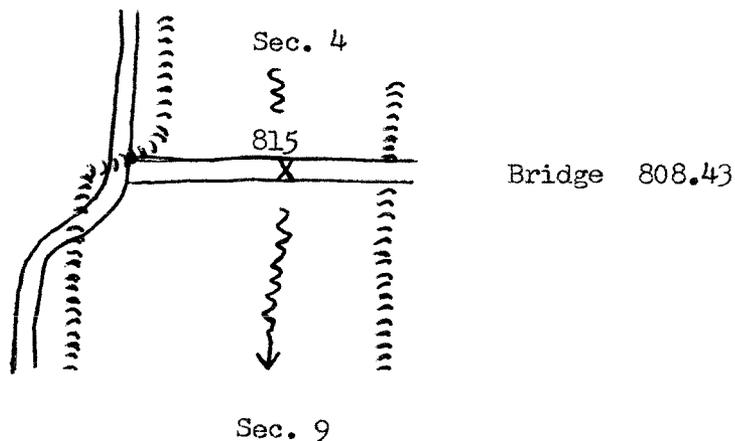
We returned south to Belle River in north edge of Imlay and leveled east on a wagon road.

Belle River 8054 ft. Crest of ridge $\frac{1}{4}$ mile east 828 feet. Belle River bed 798-799'. Muck Surface in Imlay outlet 803'. Belle River surface at bridge 801.3'. Bridge is 805' at level of wagon track on floor.

It appears from this that the swamp in the Imlay outlet is 12 feet lower here than $1\frac{1}{2}$ miles north + and 13' lower than on the divide.

I am told by _____ (?) that in a huckleberry marsh on north side Sec. 4 at the divide a pole could be rammed down 10 feet or more without striking solid bottom. So it is probable that the ditch in Sec. 4 which is near west edge of the swamp is not over the place where the channel has been filled the most. It may strike a sandy bar while a deep peat filled channel passes by here further east than this ditch.

The deep peat of the Imlay outlet cannot be more than $\frac{3}{8}$ mile wide on line of Sec. 4 & 9, for the space between moraines on opposite bluffs here is scarcely $\frac{1}{2}$ mile and this ditch 30-40 \pm rods from the moraine on the west.



April 9, 1912

On train Imlay to Port Huron and Port Huron to Minden .
L. G. Hornby and I ran levels from Imlay depot 826' to Belle River at
Grand Trunk R.R. bridge and find 27.11 ft. descent making Belle River
798.89.

We take train from Imlay to Port Huron. There is a narrow till
ridge east of the Imlay outlet, and east of this a swamp nearly as wide
as the Imlay outlet and not much difference in altitude. East of this is
a gently undulating till tract to the great swamp west of Capac. That
Swamp lies south of the railway.

The bouldery tract east of Emmett is a very conspicuous feature, but
not morainic. The Whittlesey beach near Goodells is inconspicuous.

The swamp west of the Port Huron moraine is well defined. From Port
Huron we take train north to Minden in northern Sanilac County. The
Algonquin beach is conspicuous near the Black River cutoff. The Warren
beach is very conspicuous west of Northstreet.

From Atkins to Amadore the Port Huron moraine has very gently undula-
tions. Near Palms it is more strongly morainic. Minden is on the east
slope near east edge of the morainic system. Swells 5-10 high occur for
 $1\frac{1}{2}$ miles east. There is then a nearly plain tract to the road that leads
SE into Charleston. Here sandy land sets in west of the upper Warren beach.

We begin leveling about 80 rods west of the beach and run a line to Lake Huron. The land for nearly $\frac{1}{2}$ mile west of the beach is no higher than its crest.

Levels of beaches in Northern Sanilac Co.

I took a Kodak view looking along the upper Warren beach SSE toward Charleston. The main Warren beach is the only definite one. The lower two weaker ones mapped by Taylor are only 1-2 ft. high and hard to trace. They are sandy.

The Wayne beaches on all worked down to a barely detectable strip of gravelly soil 10-20 rods wide with almost no relief.

The highest Grassmere beach is a definite sand ridge 3-5 ft. high and 20 rods or less in width. A second ridge a few rods east of it is not so definite what Taylor classed as Grassmere ridges further east are clayey and more likely to be glacial features. About $1\frac{1}{2}$ - $1\frac{3}{4}$ miles west of the lake a bouldery strip was crossed that has very gently swells. It may be a waterlaid moraine. It lies east of the lowest of Taylors Grassmere beaches.

The starting point had an assumed altitude of 200 ft. The correction is 550.54' A.T. The highest Warren is $201.27 + 550.54 = 751.81$. Third Warren is $183.99 + 550.54 = 734.53$.

| | |
|--|--|
| Highest Wayne | 176.95 + 550.54 = 727.49 |
| 2nd Wayne | 171.46 + 550.54 = 722.00 |
| 3rd Wayne | 170.47 + 550.54 = 721.01 |
| 4th or a low ridge | 166.82 + 550.54 = 717.36 |
| Corner Secs. | |
| 1,2,11,&12 | 153.20 + 550.54 = 703.74 |
| Grassmere beach is | 152.63 + 550.54 = 703.17 |
| 2nd Grassmere | |
| is | 148.66 + 550.54 = 699.20 |
| Ridge 80 rods W. of <u>(?)</u> line | 137.40 + 550.54 = 687.94 |
| Range line (682.41) | 131.57 = (1 ft. below road center (?) section) |
| Grassmere 30 rods east | 132.04 + 550.54 = 682.58 |
| Lowest Grassmere 20 rods west of middle of line Secs. 6 & 7 | 122.29 + |
| <u>(?)</u> ridge 30 rods east of middle of line Secs. 6 & 7 (bouldery) | 55-.54 = 672.83 |
| | 116.6 + 550.54 = 667.14 |

April 10, 1912

We start at Lake Huron 580' at 1 mile north of Forestville and run west to last night's terminus and find a correction of 550.54 so the highest Warren is 751-752 ft. at this line.

The storm beach of Lake Huron is 588'. Top of bluff 626.5 feet. The lowest Elkton occurs here.

The highest Elkton at cross roads 3/4 mile west of lake is 655.81'. The 2nd Elkton is 652.08.

Bouldery ridge 30 rods west of shore road on line Secs. 6 & 7 = 638.12. Till sub soil and soil. Doesn't seem to be a beach.

Lantern Slide

Lantern slide was made of a Kodak north of Forestville. Trees are on Nipissing flood plain. Broad terrain is Algonquin. Fine meanders (?) Nipissing.

The lake is at a low stage 580' or less. So a wide boulder pavement is visible between high and low water. I took two Kodak views of the Main Warren beach.

1. On east slope looking south. (Lantern slide made)
2. On flat west of beach looking east along road.

Well Data

In NW corner Sec. 4 Delaware two wells only 10 rods apart struck rock at very different depths. One at 16 ft., the other at 80 feet. The Marshall sandstone in each case. Other wells in SW part Sec. 33, Sherman Twp., Huron County enter sandstone at about 60 feet, and get an excellent water. The altitude at wells in NW corner Sec. 4 is about 765 feet. The section corner by our levels being on lower ground at 760.15.

The same altitude in the section corners is found 70 rods north of the county line. A descent then begins northward.

Warren beach 756' at Ruth, Michigan

Upper Warren beach ridge just west of corner Secs. 28 & 29, 32 & 33, 755.32.

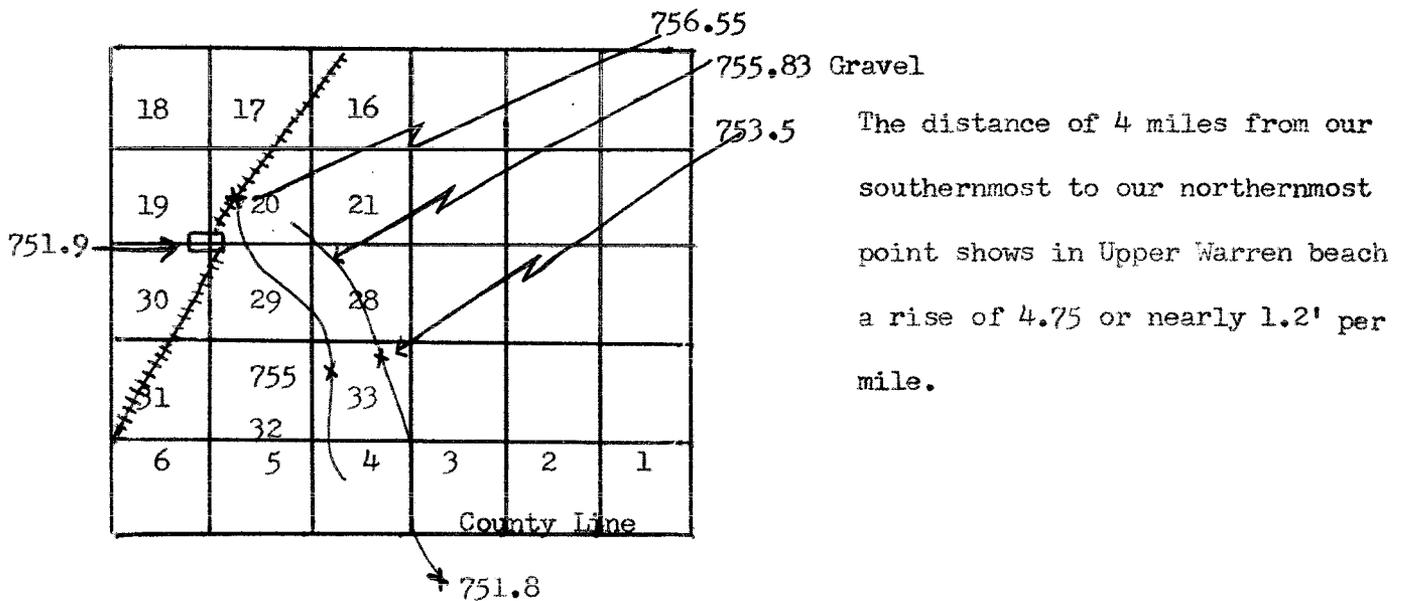
The sandy main ridge 120 rods east of section corners is scarcely 2 feet lower - by level - or 753.5 ft.

The outer beach sets in $\frac{1}{4}$ mile south of this corner in the road at 755.97.

Just south of corner Secs. 20 & 21, 28 & 29 we cross the main Warren beach at altitude 755.83. (An inner member here in front of a dwelling NW corner Sec. 28, 756.74.) It is so gravelly here that a pit has been opened for road ballast. East of Ruth $\frac{1}{2}$ mile the Warren beach is 756.17.

Ruth Station is 757.9. Beach 40-50 rods NE is about 757'. A beach $\frac{5}{8}$ mile NNE on east side R.R. is 1.35 lower than depot or 756.55 ft.

At Ruth shore features are weak. The strong ridge that runs from Charleston NNW drops off at a stream in NE corner Sec. 29 and does not set in strength for a mile or so north of Ruth.



Lantern Slide

I took a Kodak view (No. 6) when at middle of line of Sec. 28 & 29 looking east past the Warren beach. Building beyond the beach are hidden by it nearly to their roofs. (Lantern slide made for University).

I returned to Port Huron on afternoon Pere-Marquette train and there by Electric car to Detroit and by M. C. Train to Ann Arbor.

I wrote to the County Surveyor of Lapeer County, Mr. Sickensteel (?) of North Branch, for data on ditch levels farther north than our survey from Imlay along the Imlay Outlet but he is unable to give anything that can be referred to the datum I used (Grand Trunk Station at Imlay) or to the level of the depot at North Branch or of the railroad bridge or the stream on the Imlay outlet south of North Branch.

I wrote to the postmaster at Harbor Beach for the gage reading on Lake Huron for April 10 but obtained no reply.

June 9, 1912 - Escanaba to Gladstone

Levels near Gladstone, Michigan

I leveled up on north side of Escanaba River near a tannery. There is a red laminated clay with surface 14' above present water level or about 595' exposed in a pit north of the tannery.

The ground back of this is a terrace at about 29' above the lake or 610' A.T. The base of a cut bank west of the Electric line by the tannery is about 610-12'. This seems to be the Nipissing level.

The top of bank track of this is 50' above Lake Michigan or about 631' A.T. This has a broad flat that is crossed by the Soo Line R.R. directly west of the tannery. It is 638' by R.R. profile at 339.3/4 M.P. which is by the higher shore. North of this is a terrace at 965-97' above Lake Michigan only a few rods with 678+ A.T. Then is a slight cut at 690. The land back of this rises to 718 1/3' but is a sand dune. The plain is 695-6' here.

There is a high point a mile north 720± with sand 25' at top. Gravelly sand from 695 down to 630'. Red silt at 625-30' out crops.

The Soo Line track here is 610-12 feet. The aneroid reads 600 at the lake. (This is by M.P. 341) So here corrected 19'.

The Soo Line Station at Gladstone is 612' and sandy bars east are 614' all Nipissing.

The base of bluff west is about 614'. I level to top of bluff at the stairway leading up to west Gladstone read? and make it $612 + 18 \times 5 \frac{2}{3} = 714'$. This is by a reservoir and only about 6-8 inches lower than the cover? on it. Hobbs levels here are 716.6. There are sand ridges NW a few rods that reach 725' but pebbly material is 715'. West Gladstone is 713' by C & NW levels (716' by Hobbs levels) is on the level of the Algonquin delta.

A shore line $\frac{1}{8}$ mile west is by hand level 30 feet lower or 686' A.T. There is a broad flat west of this nearly to the river.

See Hobbs notes on line west past West Escanaba Station in note book 237, page 70.

With H. W. Reade in vicinity of Escanaba

The plain drops to about 700' near center of NE $\frac{1}{4}$ Sec. 30. One fourth mile south of West Gladstone and holds about this altitude past Bay Siding to about the center of the SW $\frac{1}{4}$ Sec. 31. There is a drop south of there to a lower plain 635-40' A.T. There is only a narrow strip at 680'. The high plain extends fully $\frac{1}{4}$ mile west of the C & NW R.R. near Bay Siding and extends to the Soo Line R.R. in SE part of Sec. 31, T.40, R.22W.

From Escanaba, I went with H. W. Reade down the shore to the mouth of Ford River. There is a tract of red till in Sec. 14, T.38, R.23W. bordering the bay and standing 20-25'± above it. Along the shore there are ledges of limestone both in Sec. 13 & 14. No rock is exposed where

the bridge crosses Ford River in the village. The soil is sandy over much of Sec. 15 in vicinity of the mouth of Ford River.

But upon rising above the Nipissing beach about $\frac{1}{4}$ mile NW of the bridge in Sec. 16 red till with boulders sets in and extends west on south side of Ford River to the highest Algonquin beach in Sec. 6, T.38, R.23W. The till is undulatory and bouldery like a subdued moraine.

There are a few sand ridges on it, but only a small part is sand covered.

From Ford River south on C & NW eastward on east side of Ford River, there is a nearly continuous coating of sand and also several sharp sand ridges. Clay is found at a shallow depth, so the land is rather wet where flat.

The soil is much lighter on the north side of Ford River in Secs. 4, 5, & 6, T.38, R.23 than on the south side on Secs. 5, 6, 7, 8 & 9 and north half of Secs. 16, 17, & 18. Further south is lighter soil than clay a spotted sandy loamy gravelly area.

June 10, 1912 - Escanaba, Michigan

With H. W. Read and D. A. Brotherton near Escanaba, Mich.

I go with H. W. Read and D. A. Brotherton over a large part of Tps. 39 & 40, R.23W to determine how much error my published map of the northern peninsula contains in these townships. Mr. Brotherton is county surveyor and aided us in locating our positions. The Escanaba River seems to have entered Lake Algonquin at the bend near SE corner Sec. 35, T.41, R.23W. and spread out a delta clear to the Days River in south part of T.41, R.22W and in Secs. 25 & 36, T.41, R.23W. and in the district east of the Escanaba River valley in T.40, R.22W.

There are abandoned river channels in Secs. 11 & 14, T.40, R.23 and a channel leading from Ford to Escanaba River in Secs. 30, 29, 28, 22, 23 and 24.

There is nearly plain till in the NW part of T.40, R.23, partly swampy. The ridge that I mapped in 1911 in Secs. 26, 27, 28, 29 and 30 has rock up to within 30 feet of its highest points. I passed an outcrop on this S-W road west of the Catholic church on line of Secs. 28 & 33 with striae being nearly N-S. It seems improbable that Lake Algonquin crossed much of the swampy land in Secs. 31, 32 & 33, T.40, R.23W. or in Secs. 4, 5, 6, 7, 8, 9, 17 & 18, T.39, R.23W. There are knolls in the NW part of Sec. 16 that rise above the lake but the rest of that section was covered by it. The shore is on east part of Sec. 4 & 9 and crosses NW corner of Sec. 3.

The bearing of Striae in Sec. 1, T.39, R.23, we find to be $S4^{\circ}W$ magnetic where I read $S.10^{\circ}W$. last year with a poorer compass.

Much of the sandy area NW from North Escanaba has clay at such slight depth that the soil is moist and hardwood timber flourishes on it.

I made considerable change in the extent of the Algonquin delta as a result of this trip. The published map shows more delta than my field map owing to its not getting enough moraine on it NE of Newhall.

June 11, 1912 - Escanaba to Little Lake Chatham

Algonquin cut bank 900' at Chatham

There is no beach near Chassell. But the knolls $1\frac{1}{2}$ miles south of Brampton are surrounded by a well washed plain at about 745 feet. Probably the plain at Brampton is practically at Lake Algonquin level at 740 feet. Chatham is 867 ft. A.T.

North of Chatham about $5/8$ mile is a high tract with undulating surface which may rise above the Algonquin beach. It seems to be over 900'. It has a steep wave cut face on its north side 20' high. I level from the depot at Chatham to the school house with hand level and find the water table 902'. The base of the cut bank east of the school house noted last year as a possible beach is about 20 ft. lower or 900'.

There is some undulating ground 900-905' high west of this and only a few rods NE of the school house. It does not look like beach material being comprised of laomy drift with coarse angular blocks. There is similar drift in the excavation in road in front of the school house. The top of bank back of the school house is about 920 ft. The altitude is not much greater any where to the east and part of the ridge is 910-15 ft. The ridge does not keep above Lake Algonquin level for more than a mile east from Chatham. I followed the railroad east two miles and then went south to the county road and then east to Dixon where I took the train to Munising.

The Cleveland Cliffs Co. have developed the Water Power on Au Train River for electricity for a mill at Munising. It has put in 1911. They plan to dam above the Munising R.R. as high as Mud lake. This is perhaps 25' above the present dam north of the bridge.

| L. E. Adams Altitudes | | Above Lake | |
|-----------------------|---|---------------|----------|
| Chatham | NW corner Sec. 34, T.46, R.21 | 275 | 877 A.T. |
| | SW corner Sec. 34, T.46, R.21 | 301 | 903 |
| | SW corner Sec. 3, T.45, R.21 | 302 | 904 |
| | Black Creek bridge | 285 | 887 |
| | Black Creek Swamp surface | 280-81 | 882-3 |
| | SW corner Sec. 10 | 299 | 901 |
| | Base of sharp bank 1000' south | 307 | 909 |
| | West $\frac{1}{4}$ past Sec. 15 | 334 | 936 |
| | SW corner Sec. 15 | 303 | 905 |
| | Johnson Creek bridge | 303 | 905 |
| | SW corner Sec. 22 | 325 | 927 |
| | 500' north of SW corner Sec. 22 | 335 | 937 |
| | Esker ridge (see notebook 243 p.6) | 331 | 933 |
| | N. of $W\frac{1}{4}$ post Sec. 27 (natural surface 942' as ground down in road $W\frac{1}{4}$ post Sec. 27 is about 920') | | |
| | SW corner Sec. 27 | 310 | 912 |
| | 80 rods south of SW corner | 322 | 924 |
| | $W\frac{1}{2}$ stake Sec. 34 | 300 | 902 |
| | SW corner Sec. 34 | 286 | 888 |
| | SW corner Sec. 3, T.44, R.21 | 286 | 888 |
| | $W\frac{1}{4}$ stake section 10 | 274 | 876 |
| | Dexter Creek bridge (6' above creek level) | 245 | 847 |
| | SW corner Sec. 10 | 285 | 887 |
| | $W\frac{1}{4}$ past Sec. 15 | 279 | 881 |
| | SW corner Sec. 15 | 295 | 897 |
| | $W\frac{1}{4}$ stake Sec. 22 | 279 | 881 |

June 12, 1912 - Stillman Junction, Michigan

325 above Lake Superior or 927'. Aneroid reads 905 here and 915 on track at east end of _____ (?).

There is a cut bank here with base 3-5 feet lower than track or 922-924 feet A.T.

I go east to county road on town line and am there at base of the bluff that forms the north edge of the high gravel plain in the south part of T.46, R.19W. The border runs diagonally NE keeping $\frac{1}{4}$ to $\frac{1}{2}$ mile east of Munising R.R. to SE part of Sec. 20. There it turns east.

29475 at Sixteen Mile Lake at 9 A.M.

29425 on ridge $\frac{1}{2}$ mile northwest on sawdust covered road.

A knoll to the west of road 10' higher.

29415 on summit in road $\frac{1}{4}$ mile further northwest.

29440 on plain at base of what seems a cut bluff about $\frac{1}{8}$ mile farther.

29460 at point where a blind road heads south at a small clearing about a mile from Sixteen Mile Lake probably in NW $\frac{1}{4}$ of SW $\frac{1}{4}$ Sec. 2.

29450 at clearing and small meadow (blue grass) by a railroad grade.

29460 at intersection with the E-W county road probably near corner Secs. 34 & 35, 2 & 3, at 950 A.M.

It is $\frac{1}{3}$ mile east of MP 10 in a sag 15-20' below land $\frac{1}{4}$ mile west 29440 at MP 10 at 10 A.M. Knoll just west has fine sand horizontally bedded of red color. Then coating of pebbly material over the sand.

29420 on summit 50-60 rods west of MP 10' the highest point in this vicinity. Surface of lake on line Secs. 3 & 34 is about 20' below this high point and the rim of the basin is 15-20' above present water surface.

Within 80 rods west is ground 50' lower than the lake AN. 29500. The road descends to it through cobbly and sandy material.

There is a sharp knoll just east of MP 11 on south side of road 50' high. An 29440 at top.

29510 on railway track north of here opposite MP 11 of the county road.

29540 at MP 12 on R.R. in swamp at 10:35 A.M. This is about 80 rods east of here Sec. 32 & 33.

29640 at Au Train River under the railway bridge, I take road south from near Dixon.

29600 on Bohemian Creek Bridge in Sec. 13.

29580 at base of steep bluff in Sec. 24., 29520-25 at top.

29520 at school house 80 rods east of center Sec. 26 on a sandy plain.

29510 at old shore west of center Sec. 26

29480 at Alger location in SW part of Sec. 26 at 12:45. This appears to be above the limits of shore action. There are low knolls and a glacial topography not modified by water. The Soo line R.R. has a branch in here across Sec. 29, 28 & 27.

29510 at what seems to be a shore line at forks of railway $\frac{1}{2}$ mile ESE in SE part of SW $\frac{1}{4}$ Sec. 26.

The NE $\frac{1}{4}$ Sec. 35 has a system of gravelly esker-like ridges the highest of which rose above this lake level but the lower ones seem to be leveled off by wave action, yet the basins and sags among them were only partly filled.

I follow the railway east along north side of Sec. 35 and NW of Sec. 36 and came out into a plain at an E-W wagon road where aneroid reads 29.555 at 2 P.M. I go east $\frac{1}{3}$ mile and then descend 20' more to the broad valley that connects the Au Train and Whitefish AN 29.575.

29585 in a pasture? field
29610 at Mud Lake swamp in NE corner Sec. 36 at 2:30 P.M.

I take road south across Sec. 36 & 31 on the first terrace above the swamp AN 29580-85. This extends $\frac{1}{2}$ mile west of the road, so only 80-120 rods on west side of Secs. 36 & 1 are on the higher plain.

I go west on line of Secs. 1 and 2 about $\frac{1}{4}$ mile. An 29570 at base of first bluff on west edge of the terrace. This terrace has only an occasional low swell on it where the drift is exceptionally rocky. Usually it has a sandy soil but is timbered with Maple, hemlock, spruce, etc.

29535 on the higher terrace at corner Secs. 1, 2, 11 & 12, T.44, R.21W., at 3:20 P.M. 29520 832' A.T. at highest beach near center of Sec. 11 where angling road from NE joins E-W road. There is a dandy offshore bar a few rods from the bluff with a narrow depression back of it. On this bar the reading is 29.525.

There is a flat tract 100 rods wide along the creek in west part of Sec. 11 about as low as the highest beach. A drift ridge east of it just west of the beach is 15-20 feet higher. AN. 29500 on crest at 3:45 P.M.

Levels by Adams

29520 at the creek west side Sec. 11.

29470 at quarter post Secs. 9 & 10, which by survey by L. E. Adams is 877 feet.

The beach at center Sec. 11 is about 45' lower or 832 feet.

Corner Secs. 9, 10, 15 & 16 is 886 feet.

At quarter part 15 & 16, 881 feet.

At corner Secs. 15, 16, 21 & 22, Altitude 897 A.T.

Summit south of Johnson Creek near $\frac{1}{4}$ stake 927.

Johnson Creek bridge 906.

$3\frac{1}{2}$ miles south of Chatham 335, (927' A.T.)

$1\frac{1}{2}$ south of Chatham 310, (912' A.T.)

1 mile south 300' (902' A.T.)

Gravel esker north of Limestone P.O. 325 (927' A.T.)

Sand Hill a mile south (924' A.T.)

Altitudes of High Points Near Munising

There is a flat tract for $\frac{1}{4}$ mile south of cross roads a mile south of Chatham at 300-303 ft. above lake. It is a clayey sand.

The beach seems to be a few rods north of corner and several feet lower, probably about 890' A.T. This fits in with the altitude back of school

house in Chatham which is not near the 900' at base of cut bluff. I

go into Munising on the evening train. Data obtained from Mr. Gleason of the Forest School, Munising. Tableland with deep basins in SW $\frac{1}{4}$,

Sec. 4, T.46, R.19W. is 870+ with basins down to 790'. It has a sandy gravelly material, few if any boulders. Data were determined by

aneroid, checked by barograph.

In $SE\frac{1}{4}$ of Sec. 4 a few points reach 1030'. In $NW\frac{1}{4}$ Sec. 10 points reach 1010 ft. The south part of Sec. 10 is very high but has not been contoured. Swamp in south part of $NE\frac{1}{4}$ Sec. 9 is below 810 feet contour. It extends west to Perch Lake. The north edge of $NE\frac{1}{4}$ Sec. 9 is 1000 to 1030 ft.

In $SW\frac{1}{4}$ Sec. 3 points rise above 1000' west of the center of the section and in SW corner. The red clay near Hallston is chiefly in north half of Sec. 16 and NW part Sec. 15. Possibly it extends into east part of Sec. 17. But there is a sandy tract SE of Perch Lake for $\frac{1}{2}$ mile or more.

My trip from Stillman Junction to Sixteen Mile Lake was across a plain with few boulders. The moraine seems to be poorly developed in Secs. 1 & 2, T.45, R.20W., but is strongly developed in Secs. 3, 4, & 5, T.45, R.20W and in Secs. 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34 and 35, T.46, R.20W. Points in Secs. 3, 4, & 5, T.45, R.20 rise above Lake Algonquin and possibly some further north on east side of Au Train R. There are a few points west of the river also that rise above Lake Algonquin north of the Munising R.R. The most prominent one being in north part of Sec. 25, T.46, R.21W. It will be difficult to work out the Algonquin limits on east side of Au Train Valley as it is in an uninhabited region and section corners are hard to find.

June 13, 1912

I level up from beach a mile south of Chatham to the road intersection and find a rise of 17 feet to point 300' above Lake Superior. So the beach seems to be only 885' here. AN. 29370 at corners Secs. 33, 34, 3 & 4, Altitude 902'. I go west $\frac{1}{2}$ mile to the beach. Then I go south through the brush across Sec. 3 to the E-W road on line of 3 x 10.

AN. 29400 at this beach at 9:15 A.M. = 880'±. 29375 road 2 miles south of Chatham at 9:35 A.M. The beach seems to be over a mile east. There is a house and clearing 60 rods west that seems likely to be in NE corner Sec. 10. Just east of this house is a marshy swamp crossed by the road that seems to be slightly below level of base of the cut bank that _____ (?) _____ the upper beach of Lake Algonquin. The knoll at edge of the old beach is 20' high and 40-50 rods long but is only a few rods 15'± across. It has clayey reddish material with pockets of sand and a few boulders.

Much of Secs. 9 & 10 is swamp land only a few feet above the highest Algonquin beach. There are low gravelly and clayey hummocks in the swamp. Some of which near the road have been utilized for grading. They are 5-6 ft. high. They seem to be glacial rather than lake features.

About 1000' S of corner Secs. 9, 10, 15 & 16 is a steep bluff 20' high 307' at base. (Note: It doesn't appear possible that 307' could be correct - but this is what Leverett wrote.) It looks a little like a beach, but does not show continuity.

I take the stage to Winters P.O. (See p. 27 for altitudes along this road) The altitude here is 881' A.T.

Mr. Winters thinks the old beach that I found at center of Sec. 11 runs near west side Sec. 14. 29360 at Winters at noon. 29320 at Winters at 1:15 P.M. 29350 at end of road 3/4 mile east of Winters 1:35 P.M. Level till tract here but swampy to the northeast and slightly lower.

29375 at edge of swamp and probable old beach 1/8 mile west of corner Secs. 22, 23, 26 & 27 = 820'± at 1:50 P.M. There are knolls 1/2 mile west that rise above the beach. Knolls also abound on east half of Sec. 26 its entire length. They are less conspicuous in the west half. Perhaps some of them are below lake level.

29360 at camp in Sec. 3, T.43, R.21W.

29370 at end of rail on R.R. $\frac{1}{2}$ mile east of camp at a probably Algonquine shore.

29370 on terrace of Whitefish River in Sec. 4, T.43, R.21.

29400 at river level by old bridge site (now burned)

The terrace is rock and the ledges rise about 10' higher in places or 40'+ above the stream. The terrace happens to coincide with the old Algonquin beach but it has a rock floor so might instead _____ (?) a structural feature. The old shore of Lake Algonquin seems to come to the Whitefish River in Sec. 10 about a mile above where the river turns south. There its course is likely to be southward as indicated by Mr. Brotherton, county surveyor of Delta County, across T.43, R.21 about to corner of Secs. 33 & 34, 3 & 4 and then SW to where I noted it at 10 Mile Spur in Sec. 5, T.43, R.21W.

At 4:15 P.M. I start back toward Winters--

AN. 29400 at river by bridge.

AN. 29350 on highest rock outcrops. There is a very ill defined bluff back of here with low swells 5-15' high on a plain with basins among them. AN. 29330 in basins.

29315 - 25 on knolls. 29330 at R.R. grade in NE part Sec. 4 at 4:40 P.M.

29300 $\frac{1}{2}$ mile north where a road runs east about $\frac{3}{4}$ mile with considerable descent.

29285 at N.W. corner of a farm $\frac{1}{2}$ mile further north.

29275 on rock out crop at corners $\frac{1}{2}$ mile south of Winters.

29260 at Winters at street intersection = 381' A.T.

The shore line from latitude of Winters south is less definite than to the north. It is barely traceable.

June 14, 1912 - 6:50 A.M.

AN. 29120 at Winters crossroads = 881'. Rock is struck here at 8'. On the highest point 120 rods north 900' A.T. it is struck at 6'.

The limestone outcrops on a ridge 200 rods west of Winters at 895-900'. A thin-bedded limestone.

There is a red till all through this region as red as that in eastern Wisconsin near Fondulac but more stony and with many sandy pockets. It is looser textured. AN. 29130 at crossroads in Trenary about 857'. The station is 10' lower and is 865'. 29160 on limestone terrace on Whitefish River by the bridge 3/4 mile south of Trenary 7:50 A.M. The river is 6-8' lower.

MP 367 is 7/8 mile south of Trenary Depot AN. 29170. It is fully 20' above river. AN. 29140 at MP 366 at 8:22 A.M. MP 366 is only 3-4' below level of upland plain. Knolls a short distance west are 15-20' high.

29135 at county line MP 365 $\frac{1}{2}$ ±.

29140 at MP 365 at 8:45 A.M. on a level upland with the coating of sand over red till timber largely hemlock, but some maple, birch and poplar. The railroad here turns south near $\frac{1}{4}$ line of Sec. 5, T.43, R.21W. AN. 29140 at line Sec. 5 & 8 at 9 A.M.

AN. 29130 = 847 at MP 364 about 100 yds S of E-W $\frac{1}{4}$ line 10'+ of Sec. 8 above the plain. For $\frac{1}{4}$ mile north there are low hummocks. Time 9:11 A.M.

Flat from here to a stream with marsh meadow in NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 17. AN. 29160 at stream 4' below track.

Sharp ridge 15' high just south of stream trends E-W. Knolls are of red till with some sandy mixture.

AN. 29150 = 847' at MP 363 in cut 4' deep on till swell.

AN. 29170 = 825 at MP 362 at 10 A.M. A knoll just north of $\frac{1}{4}$ line of Sec. 20 is 840'. It trends WNW-ESE. There is another 50-60 rods north with E-W trend, both comprised of red till. There is a residence here by MP 362 and a spur for logging. 29185 = 807 at MP 361 at 10:25 A.M.

Corrected 762'

A knoll a few rods north is 816' and one 30 rods ESE 825'. 29190 = 788 at MP 360 at 10:55 A.M. There are numerous knolls in this vicinity

about 800' A.T., but $\frac{1}{4}$ mile east is a swamp not over 770 A.T. that possibly was covered by Lake Algonquin. It is in the SE $\frac{1}{4}$ Sec. 32, T.43, R.21W.

29205 on the swamp at 11:10 A.M.

Mile Post 359 is in the swamp 4' below track. The track is (?) sandy land for $\frac{1}{4}$ mile north is about 780'. AN. 29200 at MP 359 at 11:25 A.M. The sandy ridge between here and Ten Mile Spur that I considered the highest Algonquin beach is nearly 766' on crest being about 3' above the track. It runs west as far as I can get a view $\frac{1}{4}$ mile or more. Ten Mile Spur is called Spur 358, but is only $\frac{1}{4}$ mile south of MP 359. AN 29200 is the spur at 11:30 A.M. = 760. I go west along a tote road $\frac{3}{4}$ mile to a farm house, Joseph Smith, in Sec. 6 on a knoll. The road followed the Algonquin beach to here NE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 6. AN. 29180 on the flat south of the knoll at noon. The beach is sandy gravel, and stands 3-4' above the swamp.

The north edge of WSW $\frac{1}{4}$ of Sec. 6 has till knolls clear into the main wagon road. The shore of Lake Algonquin runs NW to Rapid River just north of the $\frac{1}{4}$ post of Sec. 6 & 1.

Further up the river are many drift knolls 29135 at W.34 on C & NW in NE part Sec. 1. Occasional till swells along west side of track for a mile south to W.29 one mile from Friday. AN. 29130 on a sandy ridge at W.29 at 2:00 P.M. Shallow cut in till past Friday station. AN. 29130 at Friday in cut 4' deep at 2:25 P.M. The till swell NE of here runs $\frac{1}{8}$ mile east of the track.

South of Friday the railway turns SW into a flat tract with sandy soil timbered with hemlock, birch, spruce, etc. There are low sandy ridges in it that may be the product of Lake Algonquin.

After crossing two small tributaries of Rapid River at W.22 & W.21 the railway rises to a till ridge near SW corner Sec. 13 where aneroid

reads 29130 or 10' above the sandy flat to the NE. This seems to be above Lake Algonquin though the surface is smooth and may have been wave washed. It has red till with scarcely any sandy coating. It is by a road crossing marked Camp No. 1.

In section 24 are a few low knolls clear out to the center from the NW corner but among them on sandy flats and low sandy ridges that may be the product of Lake Algonquin. The knolls rise only 8-10' above them.

There seems to be wave cutting on SE face of knolls near W.17 that I refer as the upper beach of Lake Algonquin.

SW from here there is dryer ground than most of that passed between Friday and here. The creek at W.16 has scarcely any swamp land bordering it.

29100 at Clausen (?) Station where wagon road turns south. Gentle till swells here, and south for $\frac{1}{2}$ mile. Flat in SE part Sec. 27 with sandy coating. 29115 at Sandy ridge 120 rods N of Brampton. 29110 at Brampton = 740 ft. 29100 - 744' at MP 127 about $\frac{1}{2}$ mile south of Brampton. Ditto at MP 126 - 743. The wave cut bluff noted in trip June 11 is a short distance SW of here which has practically this level at its base. The bluff is 20-25' and has bouldery drift. Algonquin beach here 745 \pm . From here south there is a marked descent. 29120 at Chaison = 730' A.T. Very little jack pine north of Chaison. Mainly poplar - and wet lands - large stumps probably pine.

29130 at West Gladstone = 716' \pm . (See Hobbs levels) The trip this afternoon along the C & NW R.R. did not show so definite a shore of Lake Algonquin as I anticipated. I feel confident, however, of a shore at level of the railway where it crosses the line of Secs. 27 & 34 about a mile SW of Claussen. There is a sandy gravel beach here and it runs south into Sec. 34. The railway rises into till swells. There is a

flat that it drops down to near center of NW $\frac{1}{4}$ Sec. 34, where the lake had a recess. From there the lake shore runs south to Tacoosh River through the west part of Sec. 34 and just west of center of Sec. 3. There is a high tract of hardwood timber (maple) east of the Tacoosh in Sec. 10, T.44, R.22W. But I am told it is only $\frac{1}{2}$ - $\frac{3}{4}$ mile wide and the land further east is flat and has birch, hemlock, etc. instead of maple. The Tacoosh is bordered closely by drift knolls at Perkins and for a mile east. There is considerable swamp along it in west part of Sec. 10. Lake Algonquin covered only the SE part of Sec. 16. It covered all of Sec. 21 except about 80 acres in the NW corner. Sandy gravel sets in near center of NW $\frac{1}{4}$ Sec. 21 and runs west into Sec. 20. From there it is said by Mr. Brotherton county surveyor, to run SW to the bend of the Escanaba in Sec. 35, T.41, R.23W. There is only a thin coating of sand and gravel over till in the NE part of T.40, R.22W. Where I came out to the Escanaba on June 10 near NE corner of Sec. 11 the till rises 30' above river level and is capped by 10'± of sand and gravel.

(Write to Chief Engineer of C & NW for altitudes of MP 126, 127 & 128 on the line near Brampton and for altitude of line Secs. 27 & 34 of Perkins, Claussen, Friday, Stegoth and Osier stations.)

(See notebook 234 p. 9 for these altitudes.)

June 15, 1912 - Gladstone, Michigan

I take train to Rapid River at 6:45 A.M. AN.29010 at Soo Line depot at Gladstone 612' A.T. AN. 29030 at Rapid River, I drive northwest. There is red till on the plains between Rapid and Whitefish Rivers east of Rapid River. Altitude 600'±.

AN. 29010 at Nipissing beach = 613'. AN. 28980 at top of bluff = 640'±. The bluff is sand with scarcely a pebble in it.

At Bills Creek on south bluff there is 25' of sand with few pebbles and below this is red laminated clay which extends below the _____ (?) bed, 25' lower or 590' A.T. This plain rises to 690' in the next five miles to Hay Meadow Creek. There is a higher one in view within $\frac{1}{2}$ mile east for 2 miles south of Hay Meadow Creek. North of Hay Meadow Creek it comes (?) to the Whitefish bluff near center of Sec. 24. The aneroid reads 725' where road runs onto it.

I am on this higher plain to Sec. 20, T.43, R.20W. It fills the space between Whitefish River and Hay Meadow Creek as far north as Sec. 5, T.42, R.20W. East of the creek in Secs. 4, 9 & 16 there is morainic land with sharp knobs and basins so the driver tells me. He is a woodsman who helped lumber this region. The drift is very sandy he says. The moraine rises northwest past a chain of lakes in Sec. 28, 20, 21 & 17, T.43, R.20. This road comes to it near line of Secs. 20 & 29. The aneroid reads 760' here at shore of Lake Algonquin, but I presume the actual altitude is 785 or more, for there was a barometric change equal to 20 - 25 feet in an hour while I was eating lunch in Sec. 29 at 18 Mile Creek. When I got there the reading in the plain south of the creek was 760' but an hour later it read 735 feet. The creek is 20' below the plain. There is jack pine plain just south of the creek for $\frac{1}{2}$ mile, but further south for two miles or more there is hardwood and hemlock with a few white pine.

The pine extends to the moraine in NE part Sec. 29. There hardwood sets in which runs north into Alger County. There was however some pine with the hardwood in Sec. 5.

The moraine has sharp knobs and basins and in places rise 75' or more above the highest Algonquin beach. It has a few boulders and cobblestones but is very sandy. It is prominent along the Whitefish bluff clear to the Alger County line and cross to a lake in Sec. 32, T.44, R.20W. There is only a narrow terrace of Lake Algonquin along the

west side of the moraine from Sec. 20 north to the county line.

In Alger county there is a plain along this road all the way from the center of Sec. 32 to south end of Trout Lake. There is a range of morainic hills on east side of Trout Lake, its entire length in Secs. 6 & 7 but it is less than $\frac{1}{2}$ mile wide.

The plain is about 50' above Trout Lake and the moraine 75 to 100'. I shall run levels across here from two miles north Winters P.O. I stop for the night at Mr. Tweedale's in west part of Sec. 6, T.44, R.20W. The aneroid read 760' here at 5 P.M. --- Probably 772' and 850' on the moraine east and 800' at the highest beach. The reading was 800-810' over a wide stretch of plain east of Trout Lake and south from there to Sec. 32. There are basins with small lakes in them in Secs. 20 & 29., that are 30' + below the plain. The plain has pine east of the moraine by Trout Lake but further south, it has hemlock and hardwood timber. The soil is sandy and I saw no boulders. Some of the slopes have a red loamy material under the sand, but not a laminated clay like that near Rapid River and Gladstone.

June 16, 1912 - 8:00 A.M.

AN. 29050 = 760₊ at Mr. Tweedale's in west part of Sec. 6 about 50' above level of Trout Lake - or 766' A.T. + 6' raised by dam.

I go north to the railroad in Sec. 25, T.43, (Note: This should probably be T.45N.) R.21 W. and find the altitude is in places 30' above Trout Lake where the road runs but the swamp connecting Trout Lake and Mud Lake is practically on a level with Mud Lake. Mud Lake is 768 and Trout 761.5. 29025 at base of bluff in south part of Sec. 25 near $\frac{1}{4}$ post. 29005 at top of bluff. The channel bounded by this bluff is surely a mile wide here. It is floored by limestone with an uneven surface, some points in it being 25-30' above Trout and Mud Lakes.

About 1/3 mile further west where the wagon road crosses the railroad is another bluff. AN. 29005 at base. This flat east of the high bluff is coated with sandy gravel. This west bluff is a very sandy till with cobbles and swell boulders.

AN. 28985 at top of bluff in SW $\frac{1}{4}$ Sec. 25. There is a plain of sandy gravel from here NW past the school house in Sec. 26, 80 rods east of center of section. AN. 28980 at school house. AN. 28970 at highest Algonquin beach in Sec. 26 near center.

I traced the shore through to August Forss (/) place in SE of NE $\frac{1}{4}$ Sec. 22. There is a sharp knoll south of Johnson Creek here that runs east into Sec. 23.

There are also knolls north of the creek along the wagon road for fully half the line of Secs. 14 & 23. The lake did not reach (?) on this road. In Sec. 15 and west edge of Sec. 14, there is a knolly ridgy tract with gravelly material in some cases but usually a red till.

I am told that much of Sec. 11 is knolly especially in the NE part. Possibly there is an island in Secs. 2 & 11 east from where I placed the shore.

I go west out to Rock River road 4 miles south of Chatham and then into Chatham and took evening train to Munising.

June 17, 1912

Munising to Wetmore by stage. A beach at about 700' sandy. A cut bluff by cemetary a mile NW of Wetmore at about 850' = Algonquin. Wetmore is 859' AN. 29145 at 6:30 A.M.

AN. 29285 at Seney at 8:00 A.M. = 730 A.T. Steady barometer with west wind.

I take stage north for Grand Marsis.

At SW corner Sec. 9, T.46, R.13W. the road leaves the section here and bears NNE, on a sandy ridge. From Seney to here it has been in a swamp with peat 2-4'. The aneroid reads 29300, 762'-9" = 753 at SW corner Sec. 9. Probably 20' lower than the road (?) altitude for there is a good fall in ditches from here to Seney 3 miles. Road profile in 1916 makes it 753'. AN. 29280 at East Branch Fox River in Sec. 9 = 763'. AN. 29250 in high sand plain on east bluff. This is 20' or more above the swampy plain that I crossed north from Seney. In south part of Sec. 4 the road descends into a dry hollow that leads SE into the swamp. AN. 29270 in the hollow. North of this there is a rise to a higher plain. AN. 29200 which had a heavy stand of white pine.

AN. 29195 at railroad crossing in Sec. 33, T.47, R.13W. at 10:15 A.M. = 860'. This high plain has an occasional cobblestone and a few small pebble in the sand. 29180 on tableland south of small stream near south end of here Secs. 21 & 22 = 875'±. 29240 at Creek = 815'±. 29170 on tableland at a clearing called the "Chicago Farm" in Sec. 15 at south edge of some maple forest. = 808. Road profile in north part Sec. 16. 29160 near north end of line of Secs. 15 & 16 = 890 at north edge of the stump land where road enters a strip of green hardwood = 890 by road profile at $\frac{3}{4}$ post Sec. 9 & 16. (Note Book 264, page 80)

The surface is undulating but sandy with no surface boulders.

29150 = 850' (corrected 930') at State Road Crossing at 11:30. This is on a sandy plain with mixed pine and hardwood.

29150 at 12:15 noon = 930' corrected.

I go west along R.R. grade and descend about 45' to the stream in north part of Sec. 5. There is only a narrow strip of marsh here 20 rods ±. Time 12:45. Altitude corrected 885 A.T.

A short distance west I enter a swamp of spruce etc., about $\frac{1}{2}$ mile wide. AN. 29190 = 890. West of this near the crossing of the county line the road turns NW on a lower sand plain than that at the State road crossing.

It is only a few feet above the swamp--AN. 29170 at 1:00 P.M. - 910. This is at SE corner Sec. 31, T.48, R.13W. Near the NW corner of Sec. 31, I rise to a tableland as high as it at the State Road crossing 930'. AN. 29150. It has a few cobblestones 4-5 inches in diameter. After passing a sand ridge near center Sec. 25, T.48, R.14W. I am in swampy land clear to Beaver. A beaver dam south of the station causes a large pond on east side of the railway for nearly $\frac{1}{2}$ mile north.

AN. 29195 (29175?) at Beaver at 2:20 P.M. = 910' corrected. AN. 29170 at Sand Ridge near Center Sec. 14 on the divide between Lake Michigan and Lake Superior. It is 6-8 ft. above the swamp and 15-20 rods wide. It contains only small pebbles near base. Altitude about 915.

In SE part of Sec. 11 is a low ridge with boulders and coarse cobblestones, the first noted in my trip from Seney. It seems to mark an ice border. Then is a flat tract north of it to the creek near East $\frac{1}{4}$ post of Sec. 11, but I see an occasional stone, in the brush. So I am north of the outwash. There are also low swells east of the track south of this little stream. AN. 29190 at the stream. It is a tributary of Sucker Creek.

About $\frac{1}{4}$ mile north I am on the tableland that was once cleared for a farm. "Manistique Farm". AN. 29170 \pm 915 \pm . It seems to have been leveled by wave action. There being no hummock on the highest part but a truncated appearance. I can see land of similar height east from here on east side of Sucker Creek in Sec. 12, and Sec. 1, T.48, R.14W.

I was at Beaver at 2:20 and Manistique farm at 3:20 P.M.

29190 at a tributary of Sucker Creek in NW corner Sec. 1, by a farm house at 3:40 P.M.

29165 - 920 \pm at a summit in the R.R. grade. 120 rods \pm north of creek. This has a truncated tableland _____ (?) _____ like that at the farm. This is called "Sucker Hill" = 925 \pm .

I cross a muskeg for a mile and then came to red till knolls $\frac{1}{4}$ - $\frac{1}{2}$ mile west of range line. AN. 29150 on highest one = 940 \pm .

29175 where R.R. grade crosses the range line at 4:20 P.M. = 910' \pm .
29150 - 940' a bouldery till ridge 1/3 mile north on new range line road.
The surface here is more undulating than on Sucker Hill and the tableland
by the county farm and more clayey. It is a typical swell and sag moraine.

Another knoll 60 rods further north sandy 29150 = 935.

There is a tableland south of the creek near quarter post of Sec. 24 &
19 = 930. AN. 29160 at 4:45 P.M. The creek has a swamp 50-60 rods wide.
AN . 29195 in swamp at 4:50 P.M. AN. 29150 - 935 on hill 60 rods north of
swamp - 5 P.M. There is a high range of morainic land running from here
east southeast along the north side of Sucker Creek to the bend in the SE
part of T.49, R.13W. as noted in 1905. My trip today seems to have been
into the great reentrant angle where the outwash apron reaches its farthest
north. Mr. Pierson who is grading the new road from corners of Sec. 13, 24,
18 and 19 south to the railroad grade says the railroad grade is 2' higher
than the section corners just noted. The county surveyor, L. E. Adams, ran
a line of levels across here to establish the grades.

The swamp near $\frac{1}{4}$ post of Secs. 19 and 24 was only 4' of slush and soft
ground below this is a hard bed on which to build the road.

I stop for supper at the road camp in east part of Sec. 24 at 5:00 P.M.
Mr. Pierson says there is a sandy plain free from boulders around Sucker
Lake like that by State Road crossing and it runs through from the crossing
to this lake.

29160 - at 6 P.M. where it read 29150 at 5 P.M. = 935 ft. 29190 - 910'
at cross roads corner Secs. 13, 24, 18 and 19. This is 6' below the R.R.
grade 1 $\frac{1}{2}$ miles south, where railway was 29175 at 4:30 P.M. = about 915 feet.
29190 at the highest cut bluff 20 rods south of $\frac{1}{4}$ post of Secs. 13 and 18,
where I read about 875 in 1905, 900 - 910 tonight. There is a better defined
one 10' lower close by the $\frac{1}{4}$ post. AN. 29200 = 890 to 900. Just north of
section corners 12, 13, 7 & 18 is a cut back 10' high.

AN. 29240 at base - 855. 29270 at base of cut bank 50 rods south of $\frac{1}{4}$ post Secs. 7 and 12 = 835 - 40. There is a bar 20 rods further north by dwelling. Only 20 rods south of $\frac{1}{4}$ post is a gravelly bar. North of it is a steep drop to 29280 = 830'.

About $\frac{1}{8}$ mile north of $\frac{1}{4}$ post is a cut bluff. AN. 29310 at base = 810. The flat runs north to corner Secs. 1, 12, 6 & 7. AN. 29315 = 795 on brow of bluff. There is a small till ridge here with a swamp south of it. It is coated with a little cobble and gravel, probably beach material. It runs $\frac{1}{2}$ mile east and a mile west along section line 1.

About 15 - 20 rods north of section corner. AN. 29335 at shore line = 780'.

At a sand ridge 60 rods north of section corners. AN. 29360, 755-60. The ridge is 12-15'. 29410 at base of steep bluff in edge of Grand Marais nearly 80 rods north of section corners = 700-705, 29470 at Nipissing beach on west edge of Grand Marais about 645 A.T.

Mr. William Leighton, Supervisor of Grand Marais, says the Summit Station on the old Manistique R.R. is about 297 feet above Lake Superior or in round numbers 900' A.T. He thinks the Sucker Hill summit is a few feet higher or about 915 - 920 and that seems to be more washed. There is no clear indication of Wave work on the moraine in Secs. 19, 30, 24, & 25, along range line 3-4 miles south of Grand Marais - but perhaps the knolls do not happen to stand near an old level of the lake but were submerged.

June 18, 1912 - Grand Marais, Michigan Leighton Data

29580 at 4:30 A.M. at room in hotel - about 640' A.T. 29590 at 6:00 A.M. at room in hotel - about 640' A.T.

Mr. Leighton says there is excellent soil in T.49, R.14W. from the Grand Sable banks southward and these banks or dunes only extend $\frac{1}{2}$ - 1 mile back from the Lake Superior shore. The easternmost one is near center of Sec. 1, that has conspicuous height. Grand Sable Lake is held up by the

sand dunes.

There is a strip of excellent land in T.48, R.14W. running from NW to SE across it from its NW corner. It is rather level loamy land with hardwood timber. It has few if any boulders. The soil is richer than near State Road crossing. It is about two miles wide. Mr. Leighton says the roughest and poorest township in eastern Alger county is T.48, R.15W. It is a knob and basin tract with very sandy drift. He thinks there are few boulders. The only bouldery land in T.48, R.14W. so far as he has noted is along the north edge. Those near Manistique County farm are as far south as any. The knob and basin tract extends south into T.47, R.15W. a short distance.

Mr. Leighton thinks there is no good farm land in T.48, R.15W., but the bordering townships on north and east and west has strips of very good land.

Lake terraces and beaches at high altitudes are a conspicuous feature in all the townships that front on Lake Superior from Grand Marias to Munising.

There is a sandstone on the shore from the east part of T.49, R.15W. westward to Munising.

Rock outcrops occur along line of Secs. 7 & 8, T.49, R.13 and on the adjoining farms for over a mile back from the shore. I go west from hotel to the high dune rise center of Sec. 1.

29650 at Lake Superior at 7 A.M. = 602'.

29490, 755-60 at top of dune near center of Sec. 1, T.49, R.14W.

29610 at Nipissing beach = 645' A.T. at 7:30 A.M. 29625 at room in Wabash Hotel at 7:40 A.M. Note change from 29580 at 4:30 A.M. 29630 at Lake Superior level at 8:00 A.M. Readings are to be made at the Life Saving Station every half hour from 8 A.M. to 12 noon to check my barometer.

I take the stage to Seney at 8:10 A.M. AN. 29670 at crossing of old R.R. grade 2 miles east at 8:30 A.M. This is on a low plain 16-18' above

Lake Superior or 620 \pm . The Nipissing beach is cut away east of Grand Marais for some distance so the bluff rises from about 620' up to 670' \pm . 29695 at Lake level at 8:40 A.M. = 602'. 29640 at Nipissing shore near center of NE $\frac{1}{4}$ Sec. 9, at 8:50 A.M. = 645 ft. A.T.

29570 on a bar of sandy gravel at top of bluff about 30 rods from where the road turns south on line of Secs. 9 & 10 = 715'.

South from here is a plain with hardwood timber mixed spruce, birch, maple, ash, etc. 29570 at base of cut bluff 15 rods south of $\frac{1}{4}$ post Secs. 9 & 10 = 715'. It is 25-30 ft. high and very steep. Time 9:00 A.M. (See page 44 for Grand Marais readings) 29530 on plain near $\frac{1}{8}$ post 80 rods north of corner Secs. 9 & 10, 15 & 16 = 760.

29530 at base of low cut bluff about 40 rods further south = 760. There is a gradual rise south of this through gently undulating land.

29490 on higher plain = 800. 29470 at a low gravelly sandy bar = 820. 29470 = 820 at corner Secs. 15, 16, 21 & 22, T.49, R.13W at 9:15 A.M. This plain had large pine trees scattered through the hardwood.

29460 at old camp site one mile north of Sucker Creek at 9:30 A.M. = 830. 29455 = 835 at sand ridge $\frac{1}{2}$ mile north of Creek near corner of Secs. 27, 22, 33, 34, T.49, R.13W at 9:35 A.M. 29460 at base of dunes are north side Sucker Creek. The dunes are 30' \pm 835 = 865. 29470 on Sucker Creek bridge 6 ft. above stream. This creek has a valley $\frac{1}{8}$ mile wide with bluffs 12 - 15' above stream. Time 9:45 A.M. = 825'. 29460 at base of sand ridge $\frac{1}{4}$ mile south of Sucker Creek = 835.

29450 at old R.R. grade near line of T.49, & 48 at 9:54 A.M. = 845'.

29430 at base of sand ridge $\frac{1}{2}$ mile south of Lower line = 865. About $\frac{1}{8}$ mile further is a bluff like rise. 29415 at base of 10:07 A.M. = 880'.

29350 at top of ridge. It is sandy drift with an occasional cobblestone = 935.

29385 is a sag south of the ridge = 900 \pm . The surface is gently undulating and drift sandy with few boulders or cobble stones.

29340 at 10:20 A.M. near 1/8 post Secs. 9 & 10 = 940. 29315 at 10:30 on summit near corner Secs. 9, 10, 15 & 16 = 965'. 29300 on a nearly plain tract near middle of line Secs. 15 & 16 = 975±. Sags here are more conspicuous than swells. (Old lake level? Not a well defined shore. Is there shore line here at 975?)

29290 on high tract near corner Sec. 15, 16, 21 & 22 (30 rods north of corners). Time 10:10 A.M. 985±. 29300 at N. base Prospect Hill = 975±. 29245 at summit on line Sec. 21 & 22 near middle, 10:50 A.M. = 1020 ft.

29305 at south base where road comes back to section line 980±.

29285 at 11:00 A.M. near south end of line of Secs. 21 & 22 (30 rods north) on a drift. Knoll 10-15' high, = 995.

29320 on flat land 1/2 mile south = 955±. Occasional swells south 8-10' higher are 970'. 29325 at Muskeg Swamp = 950'.

Sand ridge 10' high on south side of swamp = 960±. This is near corner Secs. 27, 28, 33 & 34. There are sharp knolls in Secs. 33 & 34, the highest 80 rods north of county line. AM. 29255 at 11:30 A.M. = 1010±.

AM. 29255 on plain south about 1/8 mile north of county line 950±.

29340 on plain at State Road Crossing 930' A.T. 1/2 mile south of county line at 11:40 A.M.

The old lake shore seems likely to be at border of the moraine, just north of the county line at 960 feet. Lake waters probably covered the swampy area bordered by a sand ridge a mile north of county line at 960'. There is morainic topography in Secs. 34, 35, & 36, T.48, R.13W. and it may extend slightly into Sec. 1, T.47, R.13W. On the knolls north of State Road Crossing, I saw several boulders. The drift is very sandy all over this moraine where this road crosses.

12:00 Noon Barometer Readings at Grand Sarais

| | | | |
|--------|------------|--------|------------|
| 29,410 | 8:00 A.M. | 29,440 | 11:00 A.M. |
| 29,410 | 8:30 A.M. | 29,430 | 11:30 A.M. |
| 29,440 | 9:00 A.M. | 29,430 | 12:00 A.M. |
| 29,440 | 9:30 A.M. | 29,400 | 2:00 P.M. |
| 29,440 | 10:00 A.M. | 29,350 | 4:30 P.M. |
| 29,440 | 10:30 A.M. | | |

State Road Crossing 29,330 at 1:00 P.M. = 930 \pm . 29340 at south edge of hardwood green timber about 2 miles south of county line = 910' estimated correction. 29450 = 810' at small streams on Sec. 22. 29385 in upland south of creek at 2:00 P.M. correct altitude = 870.

29400 at crossing of R.R. grade in Sec. 33, T.47, R.13W. at 2:15 P.M. = 860' (road profile). 29460 on east bluff of East Branch Fox River at 2:40 P.M.

29485 on Bridge of East Fox 10' above stream. In SW part Sec. 4, T.46, R.13W. = 763'. 29500 at sand ridge at north edge of swamp 3 miles north of Seney near corner Secs. 8, 9, 16 & 17 at 3:00 P.M. = 753' by road levels profile = 753. 29510 at Seney at 3:45 P.M. = 775 where it should read 730'. Since noon there seems to have been a falling barometer at rate of 15/1000 inch or more per hour. (Grand Marais 29400 at 2:00 P.M. 29350 at 4:30 P.M. (See preceding page for barometer reading at Grand Marais at 2:00 P.M. and 4:30 P.M.) This makes a reading .060 too high at 4:30 = 54'. So corrections at 3:45 is about .040 = 35'. 775 - 35 = 740' for Seney. Seney is 730'.

It seems probable therefore that the Grand Marais and the barometer I used have had similar fluctuations, i.e., conditions in the interior are the same as at the lake. On the way south through Secs. 9, 10, 15 & 16, T.47, R.13 I had a view of hardwood forest with a very even top to the trees that looked to be in the NE part of T.47, R.14. It may be an extension of the good soil reported by Mr. Leighton of Grand Marais to run SW into the SE corner of T.48, R.14. Perhaps the soil is like that of the hardwood forest in north part of T.47, R.13W. which has considerable leafy (?) but is sandy at a few inches depth and has only small pebbles and few of them and I doubt if there is any moraine in T.48, R.14W. except on north side and none at all in T.47, R.14W. In T.48, R.15W., there seems to be a sandy moraine as noted on p. 70. I took an evening train from Seney to Soo Jc. and Sault Ste. Marie. The trip from Soo Jc. being after dark.

June 19, 1912 - Sault Ste. Marie, Michigan

EXPOSURE ON NORTH SIDE OF ST. JOSEPH ISLAND

AN. 29370 = 608₊ at Canadian Pacific Station. I take train for Disbarats, Ontario. The railway is in a sandy pine plain from near east side of Sault Ste. Marie, Ontario to Echo Bay at NE end of Lake George.

A single chain of granite knobs is cut through between here and Bar River. There being sandy plain west of the railway elsewhere north of Bar River. Rock hills are eastward about 3 miles SE of Bar River or a mile NW of Desbarats Lake drained by (?) River. The hills are low and the railway gets up only about to 650' A.T.

At Desbarats the railway is about 600'. A bench mark 1/3 mile west is 609.04. Striae here on a low rock ledge bear about N-S but vary several degrees in trend. (Magnetic variation here is about 4°^W of north -- 4°^E of south.) Boulders of red jasper conglomerate are present, but the granites are very numerous. There is a strong beach of cobbly gravel at north end of the marshy tract. South of Desbarats at 600-605', Campement D'Ours Island south of Kensington Point is a high island with nearly (?) forest of over 1000 acres. It is occupied by United States summer residents, from Chicago and elsewhere, and devoted largely to sport. The altitude is probably 200' above the St. Joseph Channel. The boats pass around its north side. There is a sandy gravel beach about 70' above the river level, on the north side probably Nipissing, Sandstone covers a large part of the island and the highest part is capped by limestone.

The north edge of St. Joseph Island has syenite exposed near waters edge under the sandstone.

RECONNAISSANCE ON ST. JOSEPH ISLAND

June 20, 1912 6:40 A.M. Hilton, Ontario

AN. 29435 at hotel = 595' A.T.

AN. 29470 at hotel 7:40 A.M.

AN. 29420 at Nipissing Beach = 650'

AN. 29400 at top of bank on Hilton Road. The bluff is much higher a short distance east. Sandy flat for 40 rods. Then a (?) 29335 at beach in front of a stone house Mr. Hamilton's (Old Eddy farm) storm beach. This is the Fort Brady beach. The Battlefield beach sets in at the crossroad $7/8$ mile from Hilton. 29300 at base of cut bank by first telephone pole south of crossroads at 8 A.M. = 750'.

The road east south east is called the base line and it follows this beach the storm beach east along this road is about 8 ft. higher.

We go to a gravel pit just south of the Hilton town plat. Back of this Fort Brady beach. It has 20' or more of gravel and cobbles probably glacial. We then go east along the south line of the town plat and pass the Battlefield back at west end of a sharp (?) point with swamp south of it.

AN. 29300 There are weak ridges back of it and a stony beach at 29260 = 785'. 29240 in plain near SE corner town? plat. The corner is near the brick (?) 29260.

29235 at H. A. Duncan clearing = 810'. There is a beach here found by waves coming in from the south.

We go SW to the Base line across a plain that is very extensive to the south and east. It is about 800' A.T. The aneroid reads 790' $7/8$ miles east from the Hilton Road. I go east to P. Line Road and then south across a sandy plain for $\frac{1}{2}$ mile to a gravel bar 15' above the plain that was formed by waves from its north side. Though higher than land to the south.

AN. 29245 on this bar at 9:45 A.M. This is probably the same lake

level as that near the Duncan clearing or 810+ A.T.

29310 at brow of bluff facing south about $\frac{3}{4}$ mile south of Base Line = 750-55 ft.

29335 at Fort Brady beach on slope 20-30 rods south.

29365 = 690+ at north edge of a Swamp Spruce, cedar and tamarack. There is a clearing and good meadow in it east of road. About 50 rods south, the road cuts a bouldery knoll and descends to the level of the Nipissing beach. 29380 time 10 A.M.

29390 at small creek in swamp. There are bouldery gravelly cobbly knolls each side of it by the road and (climbing?) 10'+ along the swamp. On the south I continue to rise to the turn of the road $1\frac{1}{2}$ miles south of the Base Line AN. 29350. Here at base of a cut bluff facing north probably the Fort Brady beach. Time 10:20 A.M.

29320 at another cut bank 40 rods back of this one but much weaker. There is a gravel bar in front of it AN. 29315. Probably Battlefield beach. In the next 30 rods I rise over a succession of bars to where aneroid reads 29285. These may all be Battlefield beaches. The highest may be 765'-70'.

29280 at small creek $\frac{1}{2}$ mile south of turn in road = 770+.

South of this creek is a very bouldery plain for nearly $\frac{1}{2}$ mile to the base of "The Mountain" Jasper Conglomerates are numerous.

29240 at a shore line south side of flat? = 810'+. 29215 = 830+ at top of bank back of this beach. There is a literal boulder pavement between here and this high bluff 50 rods south.

29190 = 860+ on gravelly bars near base of the mountain by Mr. Shipmans. His barn is one of these furthest south. His house is on a slope 10-12 ft. higher.

29010 = 1020 at brow of bluff. The surface here is flat as in lake bed, but there is undulating land $\frac{1}{4}$ mile south. There is no definite shore where this change from flat to undulating land occurs. The soil in the undulating land is laomy sandy till with a liberal supply of surface



boulders mainly small ones 1-2' diameter.

I continue ascending nearly to the crossing of the P. Line Road and Richards Landing road - AN. 28985 at summit on P. Line road = 1045' \pm . This commands a view of water to the south of the island.

29000 at road intersection 40 rods further south at 11:30 A.M. Carterton P. O. Stop here for dinner with George Fish. 29085 at same place at 12:45 noon.

29100 at east end of lots 10 & 11 at 1 P.M. The land here is flat and sandy and opens into the lake plains to the south. East and north are morainic knolls.

29085 at edge of "Mountain"

29160 at highest Algonquin shore - storm beach. 29175 at first sandy bar 10-15 rods from where wave work ceases. Probably low water level of highest shore. Time 1:10 P.M. The shore trends toward the sun or slightly west of due south. Compass S 20°W. There is a series of gravelly bars to the SE from here crossing the road just as they do the target range on Mackinac Island. I am told by Geo. Fish that a well at school house $\frac{1}{2}$ mile NW of his place, 125 ft. deep, was entirely in sandy drift. No one in this neighborhood had drilled into rock so far as he knows - I go west through fields in lots 10 & 9 P. to the Pline? road. AN. 29025 on road near line of lots 8 & 9 P. at 1:40 P.M. I go SW on Pliver road to the Algonquin Shore. 29100 on a place by cemetary that suggests an old _____ (?) _____ plain for drainage into Algonquin.

Directly west $\frac{1}{2}$ mile \pm is Salters Hill the highest point on the island 1135' \pm . The line between lots 5 & 6 runs over it.

29115 at Town Hall at 2 P.M. near line of lots 4 & 5.

29135 at line of lots 3 & 4.

29170 at highest Algonquin beach 20 rods S. The lake in lots 3 & 4 is now drained. It was held in at the SW by this highest Algonquin beach. There is a narrow strip of moraine in its SE side. Less than $\frac{1}{4}$ mile

wide. The descent is very rapid across lot 3 from the highest Algonquin. Probably 100 ft. in 80 rods.

29115 at Town Hall at 2:30 P.M.

AN. 28960 at highest point on Salter Hill = 1070 by aneroid - Perhaps top of tower was 1135?

29110 at cemetery in sandy plain bordering north side of outlet of Mountain Lake at 3 P.M. This seems to be 50-60' above highest Algonquin, and so does the plain crossed in line of lots 10 & 11.

29020 at crossroads by George Fish at 3:30 where it read 29000 at 11:30.

Mr. Fish outlined for me the position of the highest Algonquin shore for the entire circuit of the Algonquin St. Joseph Island.

AN. 29020 at road intersection by Fish's crossroad or Carterton P.O. at 4 P.M.

29080 at school house $\frac{3}{4}$ mile north west on road to Richards Landing where well 120' did not strike rock. The highest land near here is 60-80 rods NNW of Carterton P.O. and reaches a level only 10' below Salter Hill. It is 95 ft. or more above this school house.

Continuing WNW towards Richards Landing I rise to about 75' above school house in $\frac{1}{4}$ mile.

AN. 29000 at road summit a mile WNW from Carterton P.O. At 4:20 P.M. This commands a distant view to the west over a much lower county covered by Lake Algonquin. This high altitude continues along the road to the line of M & N lots with AN. 29000. The road then skirts the north side of a great gulch that opens into Lake Algonquin $\frac{1}{4}$ mile ESE of Hilton Road.

29160 at storm beach on this road 50-60 rods ESE of Hilton Road.

29170 on upper gravel beach 30 rods from the Hilton Road.

29185 at the Hilton Road intersection at 4:45 29200 at a lower beach just south of north line of lot 12 of L & M Blind Line on Hilton Road. The road then descends abruptly to AN. 29255. 29280 at line $\frac{1}{4}$ mile from

where Hilton Road turns _____ (?) _____ eastward. This is at a weak beach 6-8' high very sandy.

29400 at Hilton Lake at 5:40 P.M. It is probably held by the Fort Brady beach at each end. There is a moraine 50-75 ft. high on north side of lake with hummocks and numerous large boulders.

AN. 29350 at summit in wagon road $1/3$ mile + from the lake. 29390 at boggy swamp a few rods north. I now enter a more sandy tract without boulders for $1/8$ mile north to a higher plain where boulders set in at place where road branches off WNW. This road runs NNE 29350 at road intersection. There are large slabs of limestone here as well as jasper conglomerate, iron ore, quartzite, and granite.

29330 where road turns WNW.

29315 on a cobbly beach north of road running NW - SE. Dwelling and barn on it. Probably Battlefield beach. There is another 15-20 ft. higher back of it with parallel trend.

Just before the road turns NNE it crosses in lower one 29340. The road runs over this and then on as 29315 within $\frac{1}{4}$ mile NNE and then descends over this before reaching the little stream $1\frac{1}{2}$ miles south of Hilton. AN. 29375 at stream. The road then rises to 29340 beach which is strongly developed for 60 rods SE of this road and for $\frac{1}{4}$ mile or more NW as a cobbly bar with lower ground north of it. AN. 29350 north of the bar. This beach is crossed at the cemetery near south limits of Hilton village $3/4$ mile from the lake, 29340.

29360 at front of cat bluff by Base Line.

29380 at beach by Stone dwelling east of road sandy gravel.

29400, 15 rods north by _ _ _ _ _ dwelling on west side of road.

29450 at top of Nipissing bluff.

29465 at base of Nipissing water level.

29490 at lower _____ (?) _____ it of road near P. O.

29540 at line of St. Joseph Channel 582' at 7:00 P.M.

ALGONQUIN ISLANDS ON GRAND MANITOULIN

Tunnel Mountains north of Desbarats Lake can be reached from Richardsons on north side of lake by a trail. There is a cave in this mountain on side toward the lake. The rock is quartzite. Mr. Fremlin (?) of Hilton thinks it high enough to catch the highest Algonquin beach, but as it is a rocky knob it may be difficult to ascertain the upper limits of water action. There are knobs on Grand Manitoulin Island near Sheguiandah Bay and east of West Bay that are high enough to catch the highest Algonquin shore - one being 435 and the other 540 above Lake Huron as indicated by the Lake Huron chart of U. S. Lake Survey. The Cloche Mts. on the mainland north of this east end of Manitoulin also rise much above Lake Algonquin close to the present shore.

FEATURES OF COCKBURN ISLAND

Cockburn Island also has a ^{summit} permit 480' above Lake Huron called Mc Quaigs Hill that would be an Algonquin Island. It is less than a square mile. Drummond Island was probably entirely submerged. Mackinac had a small tract above Algonquin level, but Bois Blanc did not.

I found a man at the hotel who has been on Cockburn Island and he tells me Mc Quaigs Hill has a steep wave cut bluffs around it like the Algonquin Island southeast of Hilton and that this tract above lake Algonquin level is less than a square mile. There is a Scotch settlement on the SW side of the hill and clearings extend to its base so it is easily accessible for leveling.

June 21, 1912 Hilton, Ontario 6:45 A.M.

AN. 29670 at Lake level 582' A.T.

AN. 29700 at Lake level in Desbarats.

AN. 29680 at Desbarats Station at 8:00 A.M. = 600+

AN. 29650 at MP 107

AN. 29640 at MP 108 opposite MP 108 by Desbarats Lake. about 600-605'.
The lake is

ON TRAIN FROM THE SAULT TO TROUT LAKE, MICHIGAN

2:15 P.M. Sault Ste. Marie, Michigan.

AN. 29760 at depot = 608 \pm . I take train for Trout Lake.

AN. 29695 at Nipissing beach about 1 1/3 miles north of Brimley wagon road = 650 ft. Bouldery swells from near Dafter to the swamp SW of Cottage Park Station. There are sandy strips to the Kinross moraine. Sandy ridges on muskeg and willow swamps.

Kinross station in cut 15-20 feet deep with sandy gravel and a few boulders. Surface morainic.

Sandy ridges in swampy land for a mile SW of Kinross. There's clay and clayey till as noted on 1905 past Rudyard and Fibre 29620 by old mille site near MP 462 south of which is an Algonquin Island.

FEATURES NEAR TROUT LAKE, MICHIGAN

It looks to be 2-2 $\frac{1}{2}$ miles from MP 461 and country is cleared off most of the way up to it.

At MP 459 there is a rock cliff about 1/2 - 3/4 mile distant and a clearing all the way to it. The altitude a mile south is more than 100' above the railway or fully 900' A.T. At MP 458 there is level land for a longer distance south 1 $\frac{1}{2}$ miles \pm . Sand ridges and swamps set in here and continue past 457.

High hardwood tract south of 456 all clear. Dick RR Station opposite its highest probably is distant less than a mile and good road to it. Excellent for running levels. 29520 at Dick near MP 455. Highest Algonquin can easily be found here for the highland rises about 900'. At 4:54 29500 - 859.6 at base of limestone cliffs. These extend west past MP 453 also 29500 - 859.1. Summit on tract at 453.6 is 869.6' A.T. West from here is a burnt tract with sand ridges and swamps - to Trout Lake. Sand ridges north of tract 40 ft. high near MP 451 or 890' A.T. Trout Lake is west of MP 450 - Alt. 837 ft.

AN. 29520 at 4 P.M. -- Gannett makes Trout Lake 830'. I walk back along track and go to the higher sand ridge between MP 451 & 452. It is 890-900' on crest. There is nothing so strongly ridged in view toward the north but material is surely muskeg (?). There is some marsh south of track interspersed with sand ridges 10-50' high. The swamp east of MP 452 is 853'±. There is a long stretch of level track 857' which stands 3-4 ft. above the swamp. Immediately east is a rise to the limestone escarpment which stands 925'±. The sandy land extends south beyond the DSS & A R.R. east of Trout Lake. The ridge north of Soo Line Track runs west some distance beyond Trout Lake.

South of the lake is a hardwood tract with heavier soil.

June 22, 1912 Trout Lake, Michigan

6:40 A.M. AN. 29640 = 837' A.T.

29450 on brow of limestone cliff by MP 453

29485 at base of steep cliff

29495 at North edge of narrow shelf

29515 at base of next cliff - a few rods north is a cliff much bolder.

29520 at top

29550 at base at storm beach

29570 at ordinary beach (see notes Oct. 4, 1916 with F. B. Taylor)

29585 at a bar of sandy gravel 40 rods south of R.R.

29620 at railroad at summit = 869.6'

There possibly was wave action up to fully 40' with storms 10' higher or to 920'.

The high limestone tract south of MP 453 reaches 1020' and has pot holes in the surface. The ledges are swept bare as if by wave action, yet there may have been water action on border of the ice sheet or under the ice to produce the effect. I level from the summit on R.R. 869.6' south and reach top of first bank sandy at 7 sights = $5 \frac{2}{3} \times 7 = 39 \frac{1}{3} + 869 \frac{2}{3} = 909'$ A.T.

Two sights higher there is a sort of bare perhaps a storm beach = 920'+.

(Note: 5 2/3' must have been vertical measure between Leverett's eye level and heel level.)

I go to the cut at summit 861' A.T. between MP 454 & 455. The top of cut is 868-70'.

AN. 29610 at 861' at 9:30 A.M.

I cross a swamp to hills south of Alexander. AN. 29570 in rock tableland = 930.

| | |
|--|------------------|
| 29630 at Storm Beach on face of cliff | 875 |
| 29650 at bar north of cliff | 855 ⁺ |
| 29665 on sand bar | 840 ⁻ |
| 29685 at base of a cut bank | 820 ⁺ |
| 29690 on beach in front of it | 815 ⁺ |
| 29710 at edge of sandy plain 1/2 mile or more south of Dell P.O. | 800 |
| 29700 on bar 1/4 (?) | 810 |
| 29745 at Dell P.O. | 796.6' |

W. Hayward of Dell P.O. outlined the extent of high limestone hills in T.44 R.4 & 5 and in T.43, R.4 & 5.

TRACING ALGONQUIN SHORE NEAR TROUT LAKE

I level with hand level south from Dell starting at 797 and find the large gravelly sand bar 120 rods south is 830 feet.

11 sights = 5 2/3 x 11 = 62 1/3 feet to base of cut bank noted on way in = 859 1/3 ft. The bank back of it is 71 feet or 868 feet A.T. This seems to be a strong beach probably a storm beach.

The highest beach is 15 sights + 2 2/3 ft. = 15 x 5 2/3. 85 + 2 2/3 = 87 2/3 or 885 ft. A.T. This is 22 ft. below the top of the bluff near where it turns from east to SE course. It is much higher farther west 907' at top of the old lake bluff.

The highest point on the hill is 9 sights or 51 ft. higher - 958'. Some sand dunes rise to about 970 ft. 40 rods SW from here. I take train to spur 454 Haff P.O. Track here is 859.

In seven sights, I am on rock shelf = 7 x 5 2/3 = 39 2/3 or 898 ft. AT.

There is a cut like a storm beach on edge of bluff below this at 887'. There is also a good beach at 17 ft. above Haff Station or 876' A.T. Highest Algonquin. Studies in 1916 makes highest Algonquin at the 876' beach. 15 sights or 85' brings to top of a rock cliff - 944. There is then a gradual descent of 26 feet = 970 to a sandy ridge which runs east across this trail from a tableland to the west 985 - 990' high.

AN. 29500 here at 975' A.T.

AN. 29530 at intersection with the wagon road about $\frac{1}{2}$ mile from Haff Station. Same at E-W county road 30-40 rods further south. I follow this road west to the high upland 29450 - 1020'. The ledges are bare up about 1000'. Above this is some till but mostly sand. There is only an occasional boulder.

HIGH SHORE ACTION NEAR OZARK, MICHIGAN

Southwest from the intersection with a N-S road heading to Ozark is a cliff rising to 1030 ft. or more. It stands up like an old shore on all sides with bare ledges on its face. It covers only a few acres. The ground at its base is 1010-1015 ft. (Barometric)

A mile south I come to dunes 20 ft. high. AN. 29465 - 1000' at top 29490 on plain south by crossroads.

About $\frac{1}{3}$ mile farther south is a strip of low sand knolls 5-10 ft. high running E-W to the edge of the high land. AN. 29500 here or 970+ A.T.

South of this is a small farm with good clay loam to sandy loam soil and limestone blocks scattered over it. There is a bare limestone reef south of the house running nearly E-W and standing 4-5' above the land south.

South from here is a farming district with fine clover meadows and sandy loam soil with patches of clay loam and numerous limestone blocks. There are scarcely any granite or erratic rocks of large size but the clayey till contains a few small ganites, greenstones etc. There are small knolls of clear sand about a mile NE from Ozark and near here east of the road a bare limestone reef with ENE-WSW trend. 29535 on the reef, where it comes to this

N-S road.

29530 at crossroads 1/8 mile further south. 29520 on a limestone ridge covered with 2-5' of drift crossed 50-60 rods south of cross roads. About 100 rods further I pass an E-W chain of sand ridges mainly east of road but one link of the chain west. AN. 29550 = 935 at road. The ridges are 10-15' high and run slightly south of east more than $\frac{1}{2}$ mile and west 60 rods.

From the high country I overlook a lower tract to the west to hills near Hubbell or Rex, noted in 1905, that rose above the highest lake land.

29,555 where road turns west to Ozark. The edge of Lake Algonquin is probably a mile south from here where a low swampy tract sets in.

OZARK, CORDELL AND MAPLE ISLAND IN LAKE ALGONQUIN

29565 at boarding house on hill near Ozark where I stayed overnight in 1905. The features on this high tract are very puzzling. There looks to be lake action to the highest levels 1020 \pm . It is possible that in the disappearance of the ice small lakes were held in such places as this with ice surrounding them. The features southwest from here near Pt. Epoufette suggest ice on the Lake Michigan side to hold water up to such a high level. There was probably ice north of the outwash plain also. 29560 at boarding house at Ozark at an hour later.

29580 at old shore of Lake Algonquin

29585 = 853 at Ozark Station at 6:50 P.M.

The sandy plain NE of station is 5 ft. higher, a pebbly sand.

Probably the storm beach washed the rocks bare at a level only 10' below the P.O. and boarding house or 15' \pm above the station or 865 to 70' A.T., Mile Post 23 is about 1/8 mile SE of Ozark, Alt. 851 and perhaps 2' lower. It is 6 feet below the sandy plain at the station. Probably 10-15' added to this Mile Post altitude will represent the highest Algonquin.

29560 at Ozark at 7:25 P.M. = 853' \pm

29590 at Trout Lake = 837 A.T., 7:33 P.M. Ozark about 853.

Algonquin beach there about 865-70'. The results of today work are the proper delineation of extent of three islands of Lake Algonquin which may be termed Ozark, Cordell, and Maple Islands. Maple Island extends from Maple Geodetic Station south past the lake that lies in Secs. 9, 10, 15 & 16, T.43, R.4W. on the east and south side of the lake. I had a fine view of it from the Cordell Island. It is still covered with ample forest. While the other two islands are nearly denuded.

Cordell occupies scarcely a square mile for it drops rapidly southward to a swamp in Secs. 31 & 32, T.44, R.4W. Ozark Island extends from the south part of Secs. 20 & 21, T.44, R.5W. to center of T.43, R.5W. a distance of $5\frac{1}{2}$ miles and is from 1 to $2\frac{1}{2}$ miles wide. It is highest at the north in the NE part of Sec. 29.

THE ALGONQUIN BEACHES NEAR OZARK

The Algonquin beaches at the north are much better defined than at the south and a larger series is present because of the abrupt drop to low ground. At the north end of Cordell Island bars are projected southwest into the swamp at several levels. Marking successive lower lake levels. They are of sand with numerous small slabs of limestone.

The divide between Carp River and Pine River west of Cordell Island is a beach at 830 feet. The swamp south where I crossed near town line of 44 & 43, Secs. 2 & 35, 1 & 36 is about 800'. There is a flat sandy tract from Cordell to Maple Island in Secs. 32 & 33, T.44, R.4W. which is drained both to the Pine and Carp. It seems to be about 830' but I did not go onto it. There is a wide stretch west of Cordell at about 830 feet with low sandy ridges and some swamp.

It now seems probable that the Algonquin shore is very nearly 875' at the north end of Ozark Island, and about 860-865' at the south or a rise of about 3' per mile in the length of the island.

The high sand ridges continue from Trout Lake WNW for $1\frac{1}{2}$ miles crossing the D.S.S. & A. R.R. $\frac{1}{2}$ mile NW of the RR crossing of Soo line. There are 2-4 ridges all steep and winding and reading 890-900' A.T. They seem likely to have been formed as bars in the higher stage of Lake Algonquin and project from the high limestone Ozark Island from Secs. 20 & 29 across Secs. 19 and 30, T.44, R.5W. and Secs. 24, 25, 23, 22, 21, 15 & 16, T.44, R.6W. to an elevated maple forest in Secs. 17 & 20 that also has sandy ridges in it which probably are nearly up to the level of Lake Algonquin at its highest stage. The flat tracts there are only 860-870' as shown by the D.S.S. & A. profile across Sec. 16, so they were submerged to a depth of 10' or more. One must go west to Rex or Hubbell to find tracts above Lake Algonquin except perhaps an occasional knoll such as the ones near Caffey P.O. noted in 1905. The railway cuts a ridge at MP 444.7 that rises above 875' and may have been a bar in Lake Algonquin. See notes in 1905 as to whether it is rock.

June 23, 1912 - Trout lake = 837 A.T. with Lloyd T. Hornby

AN. 29600 at 10:15 A.M. I take train to Strongs. The Altitude at Strongs is 836. It is near MP 31. Sand ridges here are 841-45 feet (corrected) Lloyd Hornby ran levels from the depot northwest on Salt River road.

There is a valley north of the village about 810' and north of this a sand ridge at 855-60'. Altitude where wagon road crosses to west of a plank walk about 1 mile from Strongs is 855' on a plain. Mr. Turner reports flowing wells at Strongs to be 203'+ and about 3' into rock. There is a blue slush free from grit under the surface sand, clear to the rock.

Features near Strongs

Altitude at turn in road opposite Turner's (?) mill is $888.76 + 2 = 890.76$ at 1.76 above ground = 888 on a weak shore. There is a wave washed plain from here where road runs northeast.

Near center of NW $\frac{1}{4}$ Sec. 20 a height of 900 is reached on low sand ridges but the plain is about 898.

At line Secs. 17 & 20 it is about 895'. Altitude close to 900' clear across Sec. 17. At camp $SE\frac{1}{4}$ of Sec. 8 it is $901' + 2 = 903'$. A ridge NE from here 50 rods \pm is $905' + 2 = 907'$. Low Algonquin beach crossed at 909' corrected. Base of Strong beach 927-929 corrected, near corner 4, 5, 8 & 9. Top of beach 938-940. Highest shore 947-949' corrected. Moraine to north 30-50' higher.

The features here as at Marquette indicate a main beach 20' below the highest wave action. There are here some shallow draws between the highest ridges and a well defined sag along edge of the moraine. But there is not cut bluff along the moraine. The moraine lies along the town line of T.46 & 47, R.5W. and includes the chain of lakes in Secs. 32, 5 and in Sec. 35 of T.47, R.6W.

There are scarcely any boulders and few cobblestones in the plain south of the moraine. The material is coarser and stones more numerous in Secs. 8 & 9, than in 17 & 20, T.46, R.5W.

The results of today's leveling indicate that the shore line that crosses the D.S.S. & A. in a NE-SW direction 3 miles east of Rexford is the same as the strong beach north of Strongs (933 corrected, at base of east bluff). The plain around Rexford probably had a temporary shallow submergence. Look up altitude of the bluff east of Strongs in Sec. 27, T.46, R.5W. where cut by D.S.S. & A. R.R.

There is a large sand ridge a mile east of Strongs with swamp east of it to the bluff just noted.

June 24, 1912 Straie

We returned on evening train to Trout Lake and then went into Sault Ste. Marie and over to St. Joseph Island. The Straie by Desbarats Landing bear $S 10^{\circ}W$. Magnetic.

At Hilton levels began at 582' lake level, and run south to Hilton road at Post Office. There is a limestone reef at 603'.

Faint Beach 618

The road intersection is 618' and seems to be at a faint beach.

Nipissing Beach 648

Nipissing low water was about 645'.

The base of steep bluff is 648'.

Top of bluff is 661'.

Weak Beach 696

Weak sandy beach at each side cemetery - 696'.

West side of cemetery and church yard - 700'.

Fort Brady 727

Base of Fort Brady beach by Stone House 714.8. Top of Ft. Brady beach in front of stone house by east telephone pole 727'.

At crossing of base line on Hilton Road 753'. Base of Battlefield beach just west - 757'.

Middle Battlefield Beach 781.7

Top of bluff on a sandy ridge by a churchyard gate and cemetery = 781.7 in center of road. Gravelly to the level and sandy to 783'. Sandy ridge at west edge of cemetery 781.8. At gravel pit on north side of road $\frac{1}{4}$ mile beyond cemetery 774 ft.

Cobbly bar $\frac{1}{2}$ mile from base line 780.4. Battlefield beach southwest of ravine $\frac{1}{8}$ mile at base of cut bank (?) 782. Top 789. Third Battlefield beach base of cut bank 797.6. Top of bank 803'.

Highest Battlefield 801.6

Same beach where it faces west and is a cobbly bar running south across road 801.6. _____ (?) _____ at bar by Mrs. Bishops 784.7. At turn in road south of Mrs. Bishops 797.4. Here a descent to Hilton Lake sets in. At place where road leads NW from Hilton Rd., 779.2 at base of bar 5' high on Hilton road just NE of other road and on other road a parallel one.

Lowest Battlefield 756.3

At edge of Mrs. Bishops house sandy pine plain 756.3. This is the lowest Battlefield beach.

Beach or cut bank on hill north side of Hilton lake 753. Hilton Lake 720' or at Fort Brady level, corresponding to beach at Eddy farm. 811.5. at east edge of tableland south of Hilton Lake, at intersection with L & M line of east side lot 15 = 814. At beach 15 rods at low sandy gravel ridge a few rods south 816'. About 15 rods north of line of lots 14 & 15 is a fine beach of sandy gravel at 829.3. It is a foot higher than the lot line to South. There is another beach or gravel bar near the line of 13 & 14. Altitude 848.8'.

This is about 1/8 mile in front of a storm cut bluff of simiar altitude at base.

Levels near to highest Algonquin beach on St. Josephs Island

Altitude 857 at base. Strongest bluff in whole Algonquin series. Wave notch in face of bluff at 886' by line of 12 & 13. Beach or bar at top of bluff - 899. Base of bar 40 rods WSW - 904'. Top of bar near line of lots 11 & 12 - 917.6. Another on edge of lot 11, alt. 919.8. Next bar is midway of lott 11 = 926.3. Intersection with 10 Line Road 913.12 is a shallow draw.

Two bars on Hilton Road in Lot 10 are 929-930 ft.

On 10 line road first bar is 929.7. Next one on 10 Line same altitude. Base of cut bluff of highest Algonquin 930.86 ft. Top of cut bank 940.2. Highest Algonquin in Lot 10 south of road 934.56. Top of cut bank by road 940.22 ft. Probably the ordinary level of lake at the highest stage with about 930 feet. A.T.

(I inserted below from data by Cleveland Cliffs Co. on Mud Lake to Trout Lake in the Au Train - Whitefish valley or lowland).

Data by Cleveland Cliffs Iron Co., J. E. Jopling, Chief Engineer by C. J. Stalcel (?), Asst. Engr., Mud Lake - 768'.

Top of rail on Munising R.R. bridge over Au Train River 786.41'.

Trout Lake west of center Sec. 6, T.44, R.20W., 761.5'.

This seems to be raised by a dam to about 768'.