

Notebook No. 232 - Leverett

COUNTY

Baraga: 1-2, 31

Gogebic: 2, 16, 20-21, 34-35, 50, 51-56, 62

Houghton: 2, 31-32

Iron: 32-34, 61-62

Ontonagon: 2, 21-31, 35-51

OTHER STATES

Wisconsin: 8, 13, 16-20, 56-61, 62-64

I N D E X T O
L E V E R E T T ' S N O T E B O O K
N O . 2 3 2

Page 1.	September 25, 1909	Covington to Perch. Train to Lake Gogebic and Thomaston. Walk to Bessemer Junction and Ironwood.
Page 3.	September 26, 1909	Drive north from Bessemer down Black River Valley.
Page 6.	September 27, 1909	Ironwood to shore of Lake Superior and back to Triplets.
Page 11.	September 28, 1909.	Triplets north to Lake Superior and back. Then south to Montreal. Train to Thomaston. Channel north of Thomaston. Walk to Wakefield. Train to Ironwood.
Page 16.	September 29, 1909	Ironwood on C & NW south to Mercer and Powell and back.
Page 20.	September 30, 1909	Ironwood to Wakefield. Walk to Thomaston and Lake Gogebic.
Page 23.	October 1, 1909	Lake Gogebic - Bergland - Matchwood and Norwich Mine.
Page 27.	October 2, 1909	Norwich mine to Ewen, Train to Kenton.
Page 31.	October 3, 1909	Kenton south with Mr. Spargo to Paint River and Elmwood.
Page 34.	October 4, 1909	Elmwood to Watersmeet. Features near Watersmeet.
Page 34.	October 5, 1909	Watersmeet along Military Road past Paulding and Bruce to Rockland.
Page 39.	October 6, 1909	Rockland to Victoria Mine - Norwich Mine and Ontonagon.
Page 44.	October 7, 1909	Ontonagon westward to Porcupine Mountains and Union Bay and south to Nonesuch Mine.
Page 47.	October 8, 1909	Nonesuch Mine to Lake Gogebic - Ewen and Choate.
Page 50.	October 9, 1909	Choate - Robbins - Watersmeet.

Page 51. October 10, 1909. Watersmeet to Gogebic Station
on C & NW R.R.

Page 53. October 11, 1909. Gogebic to Lake Gogebic resort
and back. Train to Marenisco
and back to Watersmeet.

Page 56. October 12, 1909. Watersmeet south to Monico, then
to Rhinelander and Rhinelander
east on Soo Line to Pembine
Junction and south to join Weidman
at Ellis Junction.

Page 59. October 13, 1909. Ellis Junction - Pembine - Laona
Junction north to Long Lake -
Saunders.

Page 61. October 14, 1909 Saunders - Iron River - Watersmeet.
Notes on Northern Pacific R. R.
west from Duluth.

Library.

NOTES OF JOHN EVERETT

U. S. Geological Survey

September 25 - October 21, 1909

notebook 232

September 25, 1909 - Morainic Features near Covington and Perch, Mich.

Covington, Michigan. Altitude - 1562'. I go west along railway and follow the sag that runs west from Wren Lake across Secs. 22 and 21. It is only 6-10 rods wide and is an open channel all the way. It looks like a border drainage. There is a chain of drift knolls on its north side where the ice probably stood. It bears SW from the railway in Sec. 20. There are prominent rock ledges in south part, Sec. 21, rising to nearly 1600' A.T. with a bold bluff on north side 60' high which shows ice rounding at top. I did not go up to the top but saw it from track. Another high rock hill lies south of the railway at the east part of Sec. 25, T48N, R35W. The railway cuts its NW slope where it turns SW and the ledge here has striae bearing about south. There is a variation of 3 or 4° each side of a N-S line as they are not uniform in bearing. They are fine scratches on a polished surface. The hill rises about 75'-100' above the level of the railway which here is about 1460-70' A.T.

At Perch River the hardwood tract reaches only $\frac{1}{2}$ mile north of this railway on west side of the stream but runs down nearly to the mouth on the east side. There is a level topped sandy tract west of the stream north of this rolling hardwood tract.

I am told that pine extends into Secs. 15 and 16, T48N, R35W, northeast of Sidaw onto a sharply morainic tract. The hardwood is in strips alternating with the pine on part of this moraine near the bend of the Sturgeon.

East of the north flowing part of the Sturgeon in the NE part of T48N, R35W, there is a cedar swamp out to where the rise is made into the pine plain.

The moraine from Covington westward to Perch has gentle swells 10-20' high and not so great number of boulders as around and east of Covington and on the hill south. The channel that leads west from Covington which is so lined with boulders in Covington is not so to the west.

Features near Kenton

I take the 10 A.M. train at Perch westward to Lake Gogebic through the district over which Professor Wood and I walked about a month ago. It will be necessary to examine the region north from meridian of Kenton west. The gently undulating tracts of red clay and the island-like highlands on them from Kenton westward to Matchwood need study.

Outlet of Lake Ontonagon

I continued from Lake Gogebic to Thomaston on train. It now seems doubtful if the outlet of Lake Ontonagon was close to this railway. Whether it passes north or south of this railway in its course to the Presque Isle River is not determined. Near where it cuts across from Presque Isle to Black River. It is probably that the passage across to Black River is north of the railway, perhaps some miles. From Thomaston there is a slope down to where Black River comes through the north range of hills east of Abitine. It appears to be as high land south of Thomaston to edge of the range as at the (Stutin?) so the outlet of Lake Ontonagon is not likely to go through there. At the place where Black River comes to the railway, there is a bluff of disintegrated rock that had thin partings of siliceous pebbles and also beds of pebbles. It all dips sharply eastward 30° and is exposed up to about 75' above the river.

It is rotten from top to bottom - like arkose or geest. It is of a reddish tinge where of fine-grained material.

Drift filled gap in range

I follow the train line to Bessemer Junction and then go south on the spur into Bessemer. This leads through a drift filled gap $\frac{1}{2}$ mile wide in which I see only one slight rock outcrop at edge of a small stream that runs through it from east part of Bessemer. The drift is stony but not well assorted. There is slight appregation in knolls.

Between Bessemer and Ironwood

I go along the railway (C & NW) from Bessemer to Ironwood. The stream a mile west of Bessemer runs through a much smaller gap in the high range NW of Bessemer than the drift-filled gap through which the spur of the LSC & A RR runs. It seems to have had but little drift filling. There is considerable swampy land along the railway from this creek west to Ironwood. A few knolls 10-20 feet high occur in which there is a clayey drift with occasional boulders. On rounding the ridge two miles east of Ironwood in Sec. 13, slate is cut into.

Trip down Black River from Bessemer - September 26, 1909

Ironwood, Michigan - 9:45 A.M.

I take train on Wisconsin Central Railroad to Bessemer. Very bouldery, nearly plain till in NE part of Ironwood. A few knolls 10 feet \pm . I set aneroid at 1500 at Ironwood. It read 1465 a mile west of Bessemer in the creek valley and 1490 at Bessemer.

I get horse and buggy here and drive out north past North Bessemer.

The altitude is 1170 at North Bessemer and 1260 on bluff of Black River north of the ledges. There is a clayey plain from here to center of Sec. 20 that descends to 1220 feet within a mile north of the DSS & A RR and holds this level for two miles. I then pass through a narrow strip of gravelly, knolly land in north part of Sec. 20 and points reach 1250 feet. Within $\frac{1}{2}$ mile I am on a plain at 1200 at South Wye and descending gradually northward across Sec. 17. This has a little more loamy and sandy soil than on the plain to the south. At the north side of Sec. 17 the road is close by the river and nearly 60 feet above it. The aneroid reads 1190 but I doubt if the altitude is so great.

Where the road turns northwest into Sec. 8, it is in a very cobbly flat that may prove to be a line of westward drainage. There seems to be no boulders but many coarse cobblestones. I stop to feed at Eight Mile Creek in Sec. 8, T48N, R46W. It has a narrow valley 30-40 feet deep with cobbly bluffs. North of it are hills higher than the plain I have come through, reaching 1225 feet ±. Aneroid 1155 feet at Eight Mile Creek at 1240 at about 30 feet below upland plain south.

Features on Mud Creek Valley

Sit at 1110 at beach at 3:30 P.M. Moraine is 1250-1275 feet. Plain outwash 1270-1290 nearby but 1170 a mile southwest near northeast base of rock hills. 1250-75 on drift knolls and NE base of rock hills. 1230 or more at east side of rock bluff and little below level of outcrop. This is near line of Secs. 5 and 32. 1200 in gravelly place south of Eight Mile Creek in Sec. 8. North part of Sec. 8 has drift knolls reaching 1225-40'. Probably reading here is a little too high as lower barometer is coming in. Deduct about 25'.

From Eight Mile Creek I crossed undulating drift for a mile or so that may be moraine. While the gravelly plain near Eight Mile Creek is outwash, there seems to have been a good chance for westward drainage along ice edge to Mud Creek, a tributary of Montreal River.

The rock hills in Secs. 6 and 31 rise much above this country south probably exceeding 1350'. There is heavy hardwood forest in them and their outline is smooth as if not capped by morainic drift. There is a swampy tract north of the hills between there and the moraine that the highest beach of Lake Duluth is cut into.

Strong moraine north of Iron Ranges

The moraine is in Secs. 19, 20 and 21, T49N, R46W and may touch southwest part of Sec. 16 and south part of Sec. 17. The hummocks are sharp and bouldery. It is the best moraine topography seen north of the Iron Range today. It is likely to be this continuation of the Sexon-Wisconsin belt. Its natural eastward continuation for Black River seems to be on north side of an east tributary across Secs. 22, 23, 24, T49N, R46W and Secs. 18, 17, and 16, T49N, R45W to the bend of Presque Isle River and thence eastward to southwest end of Porcupine Range. Dr. Lane reported in letter received a year ago, that there is a strong re-entrant at the Porcupines with outwash from bend of Little Carp Run into the Presque Isle drainage. I think it is T50N, R44W or north edge of T49N, R44W.

Highest Lake Duluth shore

The shore of Lake Duluth probably lies within 3 or 4 miles of the Lake Superior shore from Black River eastward to the Porcupines. On the Porcupine Range that lies north of Carp River, it is scarcely a mile back from Lake Superior.

I drive back to Bessemer and took evening train on Wis. RR into Ironwood.

September 27, 1909 - 8 A.M. - Trip north from Ironwood on east side of Montreal River

Ironwood, Michigan. I take wagon road north from west part of town past east side of cemetery and race track and rise to a col near north side of Sec. 16 in which there is heavy glacial plaining with striae S 5° W. The aneroid reads 1470' here or about 30 feet lower than Ironwood. The knobs east and west read 1550-1600' north of the first ridge. There are drift knolls 10-20 feet high in Secs. 9 and 8 and north part of Sec. 16. The aneroid reads 1400' at a summit on line of Secs. 4 & 5 with knobs east and west 1750' or more. There is considerable drift on the slopes east of Montreal River north side of hills and among them. The ledges are not so bare here as near Bessemer or near Kimball.

The DSS & A RR was crossed near south end of line of Secs. 32 & 33, T48N, R47W at altitude of about 1195'. The stream $\frac{1}{2}$ mile north is about 1180'. The plain north is 1220' at brow of bluff. It is a very flat clay plain south of the creek. This surface is uneven perhaps from erosion. I go west on line of Secs. 29 and 32 across peaty bogs separated by a low ridge of loamy sandy material, narrow as a esker and only 6-8 feet high running north-south. The reading of aneroid is 1200-1210' across this ridge. On turning north, I rise in about $\frac{3}{4}$ mile to 1250' and then cross over a sharp knoll that reaches 1300'. It is only a few acres in area. There is a marshy plain tract around it. though now closed with brush north or south. About the middle of line of Secs. 19 and 20, I begin a rapid descent from about 1250' to the edge of a swamp at 1170' that sets in northern part of Secs. 19 and 20. This is a sort of terrace on south side of Mud Creek,

this creek being bordered by a swamp $\frac{1}{2}$ mile wide that is only 1150'. The creek here is a dead stream held up probably by beaver dams. The water is several feet deep at the bridge on line of Secs. 17 & 18. This was perhaps in line of border drainage when the ice sheet covered the high country north of Mud Creek. This and Eight Mile Creek seem likely to form a line of westward drainage.

I cross over a moraine north of Mud Creek that lies south of a creek that runs west southwest through south point of Sec. 6. The aneroid registered 1250-60' - high points in the moraine. The moraine has a gentle swell and sag topography and is not very bouldery. The ice seems to have pushed in here from the NW for there is a high range of rock hills to the north in Secs. 31 & 36, T49N, R47W and T49N, R48W reading about 1400' A.T. while to the northwest there is no higher land than the moraine so far as I can see. I read 1215' A.T. at Mr. Triplett's house in southwest Sec. 6, T48N, R47W at 1:20 P.M. about 10' above the stream.

Bluff at border of Lake Duluth

I go west on a road that leads to a settlement on the shore in Sec. 32, T49N, R48W. For two miles I am on gently undulating land with swells 10-20' or less in height. Sandy loam soil and only a few boulders. It has a fine maple forest. The aneroid reads 1250-1275'.

Near line of Secs. 2 and 3, I come out to a lake bluff at the base of which the aneroid reads 1240' (probably more than 100' too high). The road runs westward along its base. The bluff rises in places abruptly 40-50 feet. The road follows it fully a mile. In places, the bluff has a recess with a bar built across, thus:

DULUTH BROOK

I next come to a high tract of rock that runs $\frac{1}{2}$ mile or more north of the road. It formed a projection in the old lake, Lake Duluth. The road crosses it in a distance of $\frac{1}{2}$ mile rising to 1290' (probably 1190' or less) but points north on, perhaps 50 feet higher. It then comes back to the track on west side of the hill where it runs north-south into a recess between this hill and one to the southwest, a mile or so.

Limits of Lake Duluth

At reading 1200 I come to a Keweenaw conglomerate outcrop about 30 rods south southeast of an old camp. From here I can see to Bayfield and several of the Apostle Islands, also the projection on the shore northwest of Coeder (?). The shore of Lake Duluth southwest from here for two or three miles is not more than 2 miles back from the shore of Lake Superior for high rock hills are at about that distance back from the present shore.

Lower Shores through Duluth

Between the conglomerate outcrop and the camp is a slight beach at 1150 and at the camp a definite shore at 910 at south side of buildings a bank 6-8 feet high rises abruptly there. The road here turns northeast and runs along the base of the steep bluff. I pass a conglomerate at 1070'. I come out into red clay tract with reading 1000-15' at south edge within $\frac{1}{8}$ mile of base of steep hill. It is deeply trenched by ravines. There is a slight cut bank at 915, where I enter green timber. My course thus far has been a burnt timber.

Shore features Montreal to Black River

I read 805 at bend of Lake Superior at 3:50 P.M. or 203 feet too high. The shore from here east to north of Black River is determined by high hills which in general are about 2 miles back from the lake.

There is a break on the ridge several miles east probably where Mud Creek heads. The north slope of this high range is very smooth. I see no moraine. Probably this moraine is developed only in recesses between the high hills as in the one I came through.

Lower shores on the Duluth

Returning I sit around at lake level 602' and read 615' in bank of till and 630' at about 20-30 rods back at top of a slope. 715' at base of bank and 730' at top of edge of green timber, one mile from where I left the shore. Time 4:23 P.M. Thick till extends up to about 850' with very little sandy coating. Surface is slightly irregular aside from drainage - like a waterlaid moraine - Till is red and sandy covering about 850' and base of rock bluff at 875'. A greenstone on edge, at 895'. Shore line at old camp 2 miles from lake

910'. Time - 4:47 P.M. Slight beach at 930'. Top of conglomerate 1000'. Lake Duluth beaches at 1035', 1070' and 1090'-95'. Drift knolls above 1100'. Points 1/4-1/3 mile north northeast reads about 1150'. Nothing higher near here. Much loose conglomerate material but no ledges until above 1100'. Points near east side of this hill may reach 1200' for the road rises to 1140'.

Duluth shore 1115' - Limits of Lake Duluth at about 1110' A.T.

The east side high beach reading 1115' at 5:12 P.M. Basin 15' lower at place where east-west and north-south trending shore intersect. The reading is 1125' in upper beach at 5:33 P.M. Level should be same as when I first came to it about 1100'. I change the aneroid here to read 1100'. The border of this moraine and lake takes a northeast course from here. The moraine rises about 30-40' above the lake level - on the line of this road - It has scarcely run the 10' undulating. I read 1110' at Mr. Triplett's at 6:15. The plain along the northwest

side of this creek by Mr. Triplett is probably below Lake Duluth level. It is about $\frac{1}{2}$ mile wide. Probably Mud Creek also is on this lake bed as far east as this road crossing - I am told by Mr. Triplett that the water at Mud Creek is 30 feet deep where the road crosses on line of Sec. 17 & 18. There is dead water across both these sections with considerable depth but a fall sets in near the range line. There is also a good current down to Sec. 17 from the headwaters. There is a small lake at the head of the creek in Sec. 26, T49N, R47W.

Information given by Mr. Triplett

I stop one night at Mr. Triplett's. He says the road west gets only 80 rods north into Sec. 1 and then comes back to corner of Secs. 1, 2, 11, 12 and then is close to line at 2 and 11, 3 and 10, and then goes northwest to center of Sec. 4 at the old camp. There is a gap in the range northeast of Mr. Triplett's in east side Sec. 31 and west side Sec. 32 filled in with sharp drift knolls. The water parting in it is near corner of Secs. 29, 30, 31, & 32. The drainage along border of Secs. 31 and 32 being southward to the creek that leads past Mr. Triplett's westward from center of Sec. 5. East of this gap is a high range covering much of Secs. 27, 28 and southeast part of Sec. 29 as well as Secs. 32 and 33. Another gap on the range occurs at head of Mud Creek in Sec. 26. In general, however, the range is present 1-2 miles back from the lake across T49N, R47W. Its edge is scarcely a mile from the lake on the range line between 47 and 48W, T49N. Mr. Triplett says a strip of knolly drift runs southwest along north side of Mud Creek to the Montreal River, keeping back $\frac{1}{2}$ mile or so north of the creek. There is considerable blueberry marsh in Secs. 9 and 10, T48N, R48W with knolls scattered through it and the

same conditions are found southwest from there to Montreal River. Probably Lake Duluth extended into that region back of the hill I saw in Sec. 5.

Mr. Triplett says a flat tract runs from this bend of Mud Creek at the farm and sawmill in Sec. 11, T48N, R47W eastward to Black River in Sec. 8, T48N, R46W.

Readings on return trip - probably more reliable - Data on shore lines

September 28, 1909 - At Mr. John Triplett's - Sec. 6, T48N, R47W I set aneroid at 1120'. I go north across the range and find it has a moraine on its crest which here is 1350-75' A.T. The road has its highest point at 1360'. The knolls are 20-25' high and inclose basins and are bouldery strewn. There are scattered knolls on the south slope.

I come to brow of Lake Duluth bluff about a mile from Lake Superior and the aneroid reads 1180' at top and 1115' at base of this cut bluff. It is very steep so that the road runs diagonally down it. There are no ledges outcropping here and I saw none on crossing over the hill. There is a strong shore at 1050-60' with bluff 20-30' high. The next well-defined bluff at 990-95' with bank 10' high. The next at 920' is where a gully has washed out sand badly. This may be the Algonquin beach. The next on 810-15' is by a spring brook coming from the west. I now enter the rich till with little or no sand capping. A.T. 760' is base of a cut bank 8' high a well-defined shore. There is a high bar 20 rods north at same level. Capping the brow of a cut bank where base reads 735-40'. I read 705 in brow of bluff on Lake Superior and 640 at waters edge 805 A.M. I set aneroid at 600 and return. The sandstone at the lake shore line rises only 6-8 feet above the water. There is a clayey red till above it. The sandstone dips steeply northward. I see no striae as it is much water

worn by the surf.

First tract 1/4 mile south of shore 700-705 at base of cut bank. 718-20 at bar in crest of bank. Same at base of cut bank 40 rods south. Next shore 40 rods south 740 at base 750 at top. The road here runs eastward 10-15 rods to a ravine and then runs south across it and in 20 rods come to the spring brook at base of shore 765'. Some masses of Keweenaw conglomerate just north of this place in road. Ill-defined bank probably above 820' about 40 rods from this spring brook strip rise back of it up to 840'. Base of bank at the washout in road reads 870' - Algonquin - This is opposite the clearing west of line in Sec. 25. An ill-defined beach 30 rods south at 905' at base.

About 20 rods further 935' at base of a well defined bluff. Opposite south edge of the clearing in Sec. 25, the bluff is 10-15'. Is it Algonquin? 980-85' at base of a bluff with rather steep slope but not like the ones above for steepness. 1000-05' at base of a steep bluff 30-35 feet high. Top at 1035-40'.

Highest Duluth shore

At the upper shore there is a flat at 1070' and a notch on bluff back of it at 1085'. The bluff then rises very steeply to 1125'. I am here above all shore work. This shore is less than a mile from Lake Superior. Time 8:55 A.M. The ascent is very steep up to 1215'.

Moraines & border drainage

I pass over a morainic slope and come to a narrow sloping plain with morainic knolls south of it - possibly the plain is due to border drainage. It is 15-20 rods west and reads 1260 at south side next to a morainic ridge 15-20 feet high. Knolls border its north edge and rise 5-10' above it. I read 1325 on crest of moraine where I read 1360 coming north. The highest points in sight are 1335-40'. The descent

in the south is rather steep down to 1200' near line of Secs. 31 & 6. The crest is near center of Sec. 31. I read 1125' at John Triplett, Sr. at SW corner Sec. 6 is 1095' where it read 1110' last night. It is probably fully 1100'. On the morainic ridge SE in Sec. 7 it reaches about 1150'. The place SE of the ridge in east part of Sec. 7 reaches 1105-10'. The NE part of Sec. 7 and SE of Sec. 6 are strongly morainic and the same level, but to go to corner of Secs. 5, 6, 7 & 8 is abandoned terrace more hilly than the sand across Sec. 7.

Profile gives higher altitude. Dr. Lanes lower ones. (Why the +9?)

I read only 1060' at Mud Creek. 10:35 A.M. Probably 20-30 feet too low. The south edge of the low swampy land near $\frac{1}{4}$ part of 17 & 18 reads 1070'. There is then a rise to a plain at 1100-10' as on the north side of Mud Creek. This extends along and across 17, 18, 19 & 20 and is swampy at south side. There is then a gradual ascent in about $\frac{1}{2}$ mile over a plain to altitude 1135' at base of a steep rise interrupted on its slope by a little gully coming in from the SE that has a spring brook at 1155' and top of steep ascent 1185'. Surface is then plain for $\frac{1}{3}$ mile rising to 1210' at base of the sharp drift knoll near north edge of line of Secs. 29 & 30 on which the reading today is 1230' at 11:20 A.M. I read 1175' on the plain south of this knoll and 1175' at corner Secs. 29, 30, 31 & 32 where road turns east. Turn 11:38 A.M.

A mile east corner Secs. 28, 29, 32 & 33, 1200'. 1165' at Spring Creek on line Secs. 32 & 33. 1180' on terrace each side. 1200' at DSS & A RR, one mile west of Montreal at 1210'. Ditto at 12:25 P.M. It reads 1205' at MP 301 where it should read 1206' - MP 299 at 1178 +9 (1187?) is on the Spring Creek bottom. The tract is 4-5' above the striae - MP 297 at 1196 +9 = 1205 (?) is in a channel.

MP 296 at 1200 +9 = 1209 (?) also in a channel with bluff north of it so - 30' high. This is only a mile east of Bessemer, and opens at east into Black River valley.

Border drainage channel

This seems likely to be a line of ice border drainage westward when the ice sheet lay a little north perhaps with border at the line of knolls. I cross into near corner Secs. 19, 20, 29 & 30, T48N, R47W. This channel is scarcely $\frac{1}{4}$ mile wide and 25' \pm deep so does not stand for a high border drainage line.

Outlet of Lake Ontonagon near Thomaston

I take train from N. Bessemer to Thomaston. I leave the train at Thomaston and go north to Black River. The reading is 1345' by profile at Thomaston and 1260' at Black River. There are intervening points that read 1355-60'. Black River here is in a valley almost $\frac{1}{4}$ mile wide which it enters in Sec. 22, T48N, R45W through a narrower shallower valley from the south. The broad valley comes in from the east northeast and is occupied by a small tributary of Black River. Its bottom is marshy with wild rice and tamarack and spruce. I go about $\frac{3}{4}$ mile east from the ford on Black River so as to see this wild rice marshy bottom and it extends more than a mile above the junction of this stream with Black River. Its land is a black muck 40-60 rods across and this little stream meanders greatly in it. The channel has an island on it just east of the ford of only an acre or less about 30 feet above its floor north of which is a dry channel 20 rods wide and a terrace 10-15' above the channel 40 rods wide. This channel is thickly lined with boulders and so is the terrace. The channel south of the island and especially the combined

channel just east or above it is very thickly lined with boulders. I think this channel is likely to be the outlet of Lake Ontonagon from Presque Isle River across to Black River. It probably finds its continuation west from North Bessemer along the DSS & A RR in the channel noted from the train and which is occupied by Spring Creek from Sec. 36, T48N, R47W westward to the Montreal River. The descent of 75' (from its bend here by Black River north of Thomaston seems to be about 1275' or 15' above the stream) seems a natural amount in this distance of over 10 miles by direct line from Sec. 22, T48N, R45W to Sec. 36, T48N, R47W. It drops from 1200 to 1178' in the three miles along the railway from MP 296 to MP 299 and is not more than 1160' and perhaps not more than 1150' at Montreal River.

I have thus cleared up one important section of this outlet. It remains to trace the outlet to Presque Isle River from Lake Gogebic where it starts at an altitude a little above 1300' as shown by the beach at Lake Gogebic and at Bergland. The aneroid reads 1240' at Black River on my return after an hour. At 3:40 P.M., I read 1325' in upland south of the river. I read 1335' as correct altitude at Thomaston (Profile gives Thomaston 1345' and Dr. Lane 1334') Between Thomaston and Wakefield (Hotel is 1560' - Station 1554').

I take wagon road toward Wakefield. For a mile south it is across plain with only an occasional small knoll 10-15' high. There is a rise to 1350' a short distance 40-60 rods south of the railway but from there the aneroid indicates a gradual descent so it reads only 1320-25' about 3/4 mile south of the railway. There is then a rise past drift knolls 10-20 feet high up to about 1420' which is at the base of a rock range. The knolls are scattered and more than half the slope is smooth. There is a gravel pit in one low one 10-15' high. Larger ones near it are rich till. I read 1520' at Wakefield Hotel at 6 P.M. There is an outcrop on the eastwest street at

north edge of the village east of the main north-south street with striae north northeast-south southwest. About a block NE in a swamp is a low projecting ledge with striae S 10°-12°W. There is very little drift on the rock range north of Wakefield. It rises 100-150' above the station or 1650-1700' A.T. I take train at 8:10 P.M. Wakefield to Ironwood.

September 29, 1909, Ironwood, Michigan 1605' A.T. 8 A.M. - On train Ironwood to Mercer, Wisconsin

I take train south on C & NW RR to Mercer, Wisconsin setting aneroid at 1506' at Ironwood. Gannet has no altitudes on this line. There is a drop to 1470' at edge of Montreal River in Sec. 24, T46N, R2E. All the hills in Secs. 30 and 31, T46N, R3E, Secs. 30 & 31 have bare rock knobs except low ones 20' or less in height some of these occur in the low tract in which the road and railway run. They seem to be chiefly till. In some cases, low ones also on rock bases.

At Van Buskirk 1512' in Sec. 8, T45N, R3E the aneroid 1510' on ground not more than 10' above Montreal River. Bare rock ledges around here - The railway here turns SW across Sec. 17 through a forest chiefly hemlock and birch and soon rises to 1550'. It reads 1560' at MP 321 from Milwaukee MP 320 1575' in swamp. In this vicinity are drift knolls 10-30 feet high and I see no more outcrops of rock. MP 319 is survey stone in Sec. 32. Sand Rock Station 1624' reads 1640' at 317½ miles probably in Sec. 8, T44N, R3E. Scattered drift knolls 10-30 feet high with much flat ground among them. Very bouldery near MP 315 on low knolls. Pine Lake is 1625'. It is among knolls 15-30 feet high. MF 313 is about midway of lake N-S. Knolls still more scattered and tamarack swamps become extensive in T43N, R3E. Swamps are 1660-70'. The knolls are usually thickly strewn with boulders. Swamps occupy 75% or more of surface. Sandy plain is

entered in Sec. 23 on north side of a small stream but it is only $\frac{1}{2}$ mile wide. South of the stream in Sec. 26, T43N, R3E on very bouldery knolls and these extend to Mercer. The aneroid reads 1650' at Mercer (1662') 8:50 A.M. About 305 $\frac{1}{2}$ miles from Milwaukee. There is a sandy plain around the lakes south and east of Mercer at 8-10' over water level or about same as Mercer Station. It occupies the east and small part of Sec. 36, T43N, R3E on border of Sugar Camp Lake and extends across north part of Sec. 31 and south part of Sec. 30, T43N, R4E. East of Grand Portage Lake and it also is in the narrow strip between Echo and Grand Portage Lake northeast of Mercer. West of Echo Lake is a morainic belt in west half of Sec. 25 that continues west across Sec. 26 through which I came just before reaching Mercer. The plains are timbered with pine but the morainic tracts have hardwood with considerable hemlock. They are stony gravelly till. Probably this plain around Mercer is an outwash tract but it is scarcely a mile across from NW-SE.

I follow the railway southeast and enter a stony moraine one mile from Mercer on Sec. 31, T43N, R4E with knolls closely aggregated and 20-30' high. The moraine runs east into Sec. 32 and seems to extend NE into Secs. 29 & 28, T43N, R4E. At MP 303 about $\frac{3}{4}$ mile NW of Manitowish I enter a swamp of spruce cedar, tamarack and alder and in places poplar. This extends to the Manitowish River and west as far as I can see. To the east there is some hardwood (maple, birch, etc.)

Manitowish is 1591'. This flat land runs up to the dam of the Chippewa Lumber Company seven miles out of Manitowish. The edge of the rolling land lies about 3 miles north of the river. The moraine runs west and Grant Lake and Lande Lake and south of these lakes about the Manitowish River in Secs. 21, 20 & 19, T42N, R3E. There is a

marsh about 3 miles wide south of Manitowish River where this railway crosses its north edge being $\frac{1}{2}$ mile north of Powell Station at a creek that runs across NW part of Sec. 26, T42N, R4E. Powell is near center of SE $\frac{1}{4}$. Another moraine seems in at Powell. The aneroid reads 1625 altitude 1595' at Powell at 1:20 P.M. I go SE across this moraine reaching its crest just beyond MP 297 in a cut 15-20' deep. It is bouldery gravelly drift. Its trend is NE-SW across Secs. 25, 26, 36 & 35, T42N, R4E. The SE part of Sec. 36 is of tamarack swamp marked "Lost Lake" and is at edge of the moraine.

I go only to MP 296. This is in broad marsh that crosses nearly all of Secs. 1 & 12, T41N, R4E in Iron County and extends many miles eastward. It is two or three miles wide. There is a hardwood rolling belt in its south side centered by this railway about Sec. 16, T41N, R5E in Vilas County. I do not have the county map to identify with. This belt runs E-W from several miles at least that is the trend of its north edge - I can see it for 2 miles east of the railway. The aneroid reads 1620' at MP 296 at 2:15 P.M. on track 4' above level of the ground marsh. The marsh expands eastward as the marsh drainage. This moraine on the north drainings east-northeast and then south to east.

Morainic features near Powell, Wisconsin

There is so much timber on the swamp west of the track that I am unable to see the trend of the moraine north of the swamp but east of the track it is in patches of knolls surrounded by swamps and the trend of the southernmost chain of knolls seems to be ENE - I read only 1630' on track at crest of morainic, 1 $\frac{1}{2}$ miles SE of Powell in a cut 15' deep.

At a ravine $\frac{7}{8}$ mile from Powell, the track reading is 1610' with

a fill of 15'. I read only 1610' at Powell at 3 P.M. It is 1595'. I am told at Powell by Mr. Sherman that the moraine that lies south of Powell runs eastward several miles along south side of the marsh and has numerous lakes along its course. Some of the lakes are summer resorts such as Spider & Manitowish Lake through which the river passes. I read 1610' at Powell at 3:35 P.M. = 1595'. I take train to Ironwood. The marsh sands 1600-05' on track, at south edge. Manitowish by MP 302 is 1605' (1591'). In moraine 1-1½ miles from Mercer southeast it reads 1650' in cuts 15-20'. At Mercer 1620' where it read 1650' this morning. Mercer is 1662'. A ridge on east side of track about ½ mile north of Mercer Station is sharp like an esker for length of ½ mile and trends nearly NE-SW. It is fully 30' high where the railway cuts it - then in boulders on its slopes. It seems to break up into hummocky land west of the railway. Land is gravelly and nearly plain north of Lunlten (?) River for nearly a mile and has few if any boulders. There I enter the land of small scattered knolls and extensive tamarack swamps which can turn to the Montreal River valley in Sec. 17, T45N, R3E. Aneroid reads 1650' at Parsons near MP 311. On reading Hurley, the aneroid reads 1515' or about 18' too high. (Hurley is 1497') Probably range of this ridge of Mercer is 1635' will be not far from correct. Mercer is 1662'. I am told by Steven Mchevitt, a cruiser of Ironwood, that a hardwood ridge lies west of the Presque Isle River from the land west of Tula northward with no chance for the Presque Isle drainage to cut across there. The valley I saw yesterday he says runs north as a continuous swamp and from Sec. 10 is drained northward to the Presque Isle. This northward drainage is through an extensive swamp toward its mouth the stream cuts down into a ravine and loses its swampy character. My surmise of westward drainage from near the bend of the Presque Isle

near Tula appears ill-founded. The drainage seems instead to make northward detour.

September 30, 1909 - 6:35 A.M. Ironwood, Michigan

Views from hill near Wakefield

I take train to Wakefield and then setting aneroid at 1553' at 1551' go north and ascend a rock ridge in $NW\frac{1}{4}$ Sec. 4, T47N, R45W from which I get a view of the country NE of Thomaston. I can see the hardwood ridge running north on west side of Presque Isle River near the range line of T48N, Rs. 44 and 45 W and the depression west of it running northward from the bend of Little Black River in Sec. 22 in which waters divide in a swamp in Sec. 10, T48N, R45W. It is evident that no valley comes into Sec. 22 from the east. This one trends NE-SW from east part of Sec. 15 to SW part of Sec. 22 but trends N-S in Sec. 10. There is a very elevated tract on west side of this N-S valley about 50° east of north (magnetic) from here. It may be in Sec. 9, T48N, R45W. It looks to be fully 5 miles distant. Possibly it is further possibly it is in S part of T49N, R45W.

Straie N-S

There are some traces of the glacial growing on this knob in Sec. 4, T47N, R45W where I stand to get this outlook and they turn nearly due N-S with perhaps $1-2^{\circ}$ east of south in some cases. The aneroid here reads 1570' turn 8:50 A.M. I read 1390' at Thomaston where I should read 1334'. Time 9:30 A.M. The ridge on west side of the Presque Isle River north of the railway is very smooth and has much standing water in it although it reaches 1380'. It is a red clay waxy and stiff on which water will stand until evaporated. I am told at Tula that at 15-20' where is a change to harder somewhat cemented till that had to be blasted in recording wells at a sawmill 60 rods SW of the station.

Outlet of Lake Ontonagon near Tula - Esker

The Presque Isle is said to be bordered by high rock bluffs a few miles below lake to near where it bends westward. The country is very elevated on both sides the river in that vicinity. Possibly the cutoff westward into Black River is south of this high country. About $3/4$ miles east of Tula a sharp gravel ridge of esker type runs N-S across the railway. It has been used for railway ballast for $1/8$ mile or more south of the track and a few rods north. It is 20-25' high and only 12-15 rods wide. There is a length of over $1/2$ mile in view taking both north & south of the track. The swamp bordering Presque Lake River is almost 10' below the level of the bridge or 1290' A.T. The river has only a low beach 3-4' high and no bluff of definite erosion type at the border of the swamp on the west. The river is practically a dead stream at this place with pond lillies and reeds.

East of the river on south side of Mud Creek is a sandy plain at 1300-02' but the Mud Creek swamp is about 1293-5'. At MP 279 where the track is 1301', it stands 4-5' above Mud Creek swamp south of the railway. The width of the swamp varies but is nowhere less than $1/2$ mile and in places is $3/4$ mile. There is not a definite continuous bluff on its borders on north side next to the railway. The south side near where it enters Presque Isle River has a beach 6'± high cut in the sandy plain. MP 279 is at the bend on the railway in NE part of Sec. 24, T48N, R43W. MP 278 is near north edge of the swamp $1/2$ mile ± from the creek. The tract here is $3\frac{1}{2}$ -4' above the water level and stands 1307' - water level 1303'. There is high land $1/3$ mile north of the railroad below MP 278 and 279 rising 50-75' or more above this swamp. This highland runs south across the track

for $\frac{1}{2}$ mile each side of MP 277 and extends $\frac{1}{2}$ mile south of the track at an altitude 1320-1345'.

Head of outlet in a swamp west of Lake Gogebic on Lake Ontonagon

There is a tract of swamp running south to the railway midway between MP 276 & 277 which is 1315'. High land east of it rises to 1345' and extends about $\frac{1}{2}$ mile south of MP 276. There is an extensive swamp to the south with altitude not over 1315' and probably not over 1310' that is drained both eastward to Lake Gogebic by Merriwether Creek and westward to Presque Isle River by Mud Creek. I come down to it just east of MP 276 and it is 5' lower or 1297' at west edge. The ground at MP 275 is 2' below track or 1300' and is dry sandy ground. This extends with very little rise westward $\frac{1}{2}$ mile beyond MP 275 where a rapid rise is made into the hardwood tract. This hardwood is till of red color rather stoney. There are land swells or knolls in it 10'± high as well as the general of almost 30-40' above the bordering swamps. Merriwether Creek about reading between MP 274 & 275 is 7-7½ feet below the track and the beach is about 1300' here as nearly as I can tell by looking along it to MP 275 at 1302'.

Course of outlet of Lake Ontonagon

Just west of MP 274 is a strip of red clay with birch and hemlock timber standing 1300-1302' near the track. But MP 274 is in a swamp 4-5' below track. The track is 1298'. Just east of this swamp the creek comes across the track from NW-SE across rocky riffle and gets onto a bog only a little above lake level.

I am told by Emmett Swinof Lake Gogebic that there is a continuous cedar swamp across from Merriwether to Mud Creek a short distance south of the DES & A RR. It is but little higher than MP 375

or 1295'. He doubts if it is 10' higher. It seems likely now that Lake Ontonagon discharged across this swamp to Presque Isle River and then took this circuit around to Black River noted this morning.

South limits of plain covered by Lake Ontonagon

Mr. Peter J. Pruhs, a landlooker of Lake Gogebic, tells me this flat land extends south on west side of Lake Gogebic to the rock range that comes to the lake in Secs. 19 & 20, T47N, R42W. There are very few drift knolls on it. The topography is ground moraine rather than terminal moraine. The same is true for several miles south of the east side of the lake. Then a strongly ridged belt of glacial drift sets in about opposite the rock range of the west side, and this runs eastward passing several miles south of Matchwood and Ewen. The high land north of the DSS & A RR west from Lake Gogebic as far as the range line has rock in it nearly to top and has been explored for copper but very little has been found. It drops down into low country east of Presque Isle River in Sec. 12, T48N, R44W. I am sure that Lake Gogebic is nowhere over 80' deep.

October 1, 1909 - Lake Gogebic, Michigan (Ballantine Station) -
Beach of Lake Ontonagon 1317' at Lake Gogebic Village

I level up from the railway to top of a sandy ridge by the school house and find it 34-35' above the station or 1314-18' A.T. (The station is 1283') I also level along a road north from this station east of the school house with same result. Here there is a narrow bar on crest of bluff about 3' above land back of it. The material in it is rather angular and though resembling a beach in form, it may prove to be glacial. North of this a few rods is another ridge

of same height in crest of bar that is full of boulders and coarse cobblestones and seems to be glacial. East of station a few rods and back of the water tank is a bouldery place on brow of this bluff so I am not certain of beach action at so high a level. Possibly storms washed up over the brow and the ordinary stage was a few feet lower.

At Bergland back of MP 270 the bluff rises only to 1310' and then is low ground for $2\frac{1}{2}$ miles covering most of Secs. 21, 22, 28, 29, 32, and 33, T49N, R42E. It has considerable clay in soil of $\frac{1}{2}$ mile or so north of the lake. The first half mile is very sandy. There is a flat tract east of the section line road in SW part of Sec. 33 at 1320'. There is a river about 30 rods north of town line and in its south bluff are sandy beds and fine gravel with a northward dip. There is no ground much above 1320-25' in these sections along the border. I can see clear to north end of the section line.

Lake Ontonagon about 1310'

I return to Bergland and go east across outlet of Lake Gogebic which is very sluggish here, but becomes rapid a mile or two below, I am told. The swampy land extends a mile further east or to MP 268 at altitude about 1285' or 6' above lakelevel. East from here is a rise to 1310' or $\frac{1}{2}$ mile over a red clay ridge with smooth slopes. There is scarcely any sandy material in its crest, and boulders are common in the soil. It is not yet clear that Lake Ontonagon reached to 1310'.

Features on plain east of Lake Gogebic

The hardwood tract east of Lake Gogebic is very gently undulating and stands higher than the pine forested tract to the east. Its

altitude however seems to be but 1280-1300 feet over much of the east border of Lake Gogebic in T48N, R42W and north part of T47N, R42W. The tract east of it that was pine covered, drops down to about 1250' within a mile of its west edge and is only 1220-30' in vicinity of Matchwood. It has a stiffer red clay than the hardwood but is fully as undulating. Many small knolls 5-15' high and occasional basins several feet deep with peaty bottoms. Boulders are rare on this pine tract but more plentiful in the hardwood.

I take road north from Matchwood at 1:30 P.M. and rise to 1250' at a summit near north side Sec. 14. There is undulating land across Sec. 11 with height 1210-40'. The line of Secs. 2 and 11 reads 1215'. The hardwood tract east of here on Secs. 5, 6, 7, and 8 looks to be at least 50' and perhaps 75' above the general level of country west or 1250-75' A.T.

I read 1190' at turn of road $3\frac{1}{2}$ miles N of Matchwood at 2:30 P.M. 1205' at line of 35 and 36 where road turns north. I read 1190 at one mile north line of 25 and 26 about $5/8$ - $3/4$ mile further north I descend a bluff-like (rather gradual, however) slope and read 1170' at base and 1160' $\frac{1}{4}$ mile farther near $\frac{1}{2}$ part of Secs. 23 and 24. There is much higher land about $1\frac{1}{2}$ miles east than here, but it is not timbered with hardwood. It seems to continue the high land from the hardwood north from south part of 31 and 32 across Secs. 29 and 30 into Secs. 19 and 20, T49N, R40W. If Lake Duluth came in here, it was scarcely two miles wide at the north end of this high land and not over 3 miles if it extended back on this road to the bank I have just passed.

Matchwood to Norwich Mine

I am not at all certain that it came to this bank for it is hardly probably a narrow strip of water in here back of the trap

range would have wave action enough to cut a bank of this height. It may be only a local thing. I am not able to detect it for more than $\frac{1}{2}$ mile each side of this road.

While making these notes near corner Sec. 23, 24, 25 & 26, the aneroid in 20 minutes has changed from 1160 to 1145' reading. I continue north and soon read a drop of 10' to a swampy flat at 1135' from which there is a gradual slope for $\frac{1}{2}$ mile or more to 1100' near corner of Sec. 13, 14, 23 and 24. Here a more rapid descent to West Branch of Ontonagon River sets in. At $\frac{3}{8}$ mile north I read 1070' at north edge of a terrace which I have been on for $\frac{1}{8}$ mile. I now begin descent across a gradual slope for 30 rods to bank of river a few rods from the bridge 1080'. I read 1025' at the river at 4:15 P.M. The reading is 1100' at mouth of the Norwich Mine.

Gap in range near Norwich Mine

From here I go west $\frac{1}{2}$ mile or more to the gap in range north of river utilized by the road to Ontonagon. It is only $\frac{1}{4}$ mile across and filled with little hummocks of red till. I go north on it past center of Sec. 2, T49N, R44W and then come to a strong beach.

Beach at about 1100'

The knolls reached 1130~~25~~5' by aneroid but this beach is only 1105' on crest and the flat land north is within a few rods 10' lower and continues descending. The beach trends NE-SW and is comprised of well rounded gravel. It stands 2-3' above ground immediately back of it on SE side here near the road. It keeps near the road for 30 rods south. Red clay is found above it and black rich gravelly soil just below it. From north edge of this red clay, I go south 600 paces to reach the crest on the wagon road and on return, it

reads 1140' here. The divide is very flat for 350 paces and then begins steep descent to the terrace on Ontonagon River at 1100'±. Whether this flat divide is a place over which Lake Duluth waters passed is not clear as I am uncertain of barometric altitudes. There is no sand on it or other evidence of lake action at about this level. The red clay knolls seem to be morainic. They may stand for lake edge at time Lake Ontonagon was outflowing westward from Lake Gogebic though the altitude is much below that outlet.

Features near Norwich Mines

I ascended a rock bluff west of this road in SW part of Sec. 2 and 8 and got a view to the north of rock knobs near corner of Secs. 28, 27, 21 and 22, T50N, R41W which rise to 150'± above the low ground through which the road to Ontonagon east of them passes in east part Secs. 26 and 35. East of this road is a recess of a mile or so with N-S running east in among the rock ranges and north of this other high tracts. This recess is apparently in Sec. 36 and high tracts in Sec. 25 on the section east of it. I am told that the north side of the range of hills is at Agate bluff 4 miles from the river and the road touches its slope. The hill rises only about 50' above this road and is rock. This is in Sec. 24 and 13. There is said to be a heavy coating of drift on the north slope of the range from the Norwich Mine.

October 2, 1909 - Norwich Mine north of Matchwood

I went up on the hill south of the mine where an old road ascends and found it 250' above the mouth of the mine. I went south on same road I came north on last night to middle of line Sec. 35 and 36 and take readings as follows: At Norwich Mine - 1100'; At W. Branch Ontonagon River - 1025'. About a mile south of mine and a little more

than $\frac{1}{2}$ mile from the river, I reach 1100' at edge of a flat south of which is a gradual rise. The reading at corner Secs. 13, 14, 23, and 24 is 1135'.

Trip from Norwich Mine to Ewen

I read 1145' at base of the most south bank and 1160' at top. It is about $\frac{1}{2}$ mile north of corner Secs. 23, 24, 25, and 26, Upper Duluth beach. The reading is 1200' at end of road at middle of line Secs. 35 and 36. I go east a mile to range here and read 1230'. At Mr. Virants $\frac{1}{2}$ mile east - 1260'. The highest points NE from here to Mr. Sandin's in SE part Sec. 29 are 1275'. These ridges above 1250-60' are sandy loam soil while below there is generally a stiff clay. The aneroid reads 1210 at Mr. Sandin's. From here I look across the Ontonagon valley to upland east that has hardwood timber perhaps 40'. The surface is said by Mr. Sandin to be level back from the brow of the bluff a short distance and to have red clay at a few miles depth. In places there is a thin sandy coating. Mr. Sandin has a well 65' deep which has 15' of sand at bottom. Above this is a deposit called hardpan apparently hard till which is capped by a few feet of red clay. From SE part of Sec. 29, I go south through hardwood forest across Secs. 32 and 5 and along line of Secs. 8 and 9 to edge of Secs. 16 and 17. The altitude is 1250-75' on highest points but I see scarcely any sandy loam soil. It is a clay loam and in places a stiff clay of red color, much like that in the pine tract to the south. Boulders are not numerous and there is not a hummocky topography. Instead there are broad shallow draws $\frac{1}{2}$ mile \pm across that are below the upland level. It is not decidedly morainic. The surrounding pine tracts are about 1220' on swells and 1200' or less in sags and basins. The valley of Ontonagon River is 1130'35' at Ewen, and the river about 1115-20' at bridge east of the village.

There is only a narrow strip $1\frac{1}{2}$ miles wide along the valley from Ewen northward several miles low marsh to have been carried by Lake Duluth waters. From the view I had at Sandin's clearing in Sec. 29, T49N, R40W, I judge that this land east of the mine stood above Lake Duluth about as far north as on the west side or down to within a mile or so of the junction of the West branch and main branch of the Ontonagon. The bog that extended up to Bruce Crossing and north of Paynesville seems to have been only 3-4 miles wide in the township in which Bruce Crossing is located T48N, R39W and it was two miles or less wide in the low strip that runs east from Bruce Crossing on north side of DSS & A RR.

Flowing well at Ewen

At Ewen the flowing wells are 180 & 280 \pm and are through soft clay nearly the whole depth and get water in sand at bottom. The deeper ones go through some gravel and bouldery material near bottom.

I took train from Ewen to Kenton at 3 P.M. See notes on former trip with Mr. Wood late in August. From Kenton I go south $2\frac{1}{2}$ miles to Mr. Spar, a farmer in SW $\frac{1}{4}$ Sec. 23, T47N, R37W. There is a gradual increase in the amount of undulation and a gradual change from a stiff red clay to a red silt or loam and then to sandy and gravelly drift with numerous boulders. The topography is very sharply morainic above 1350' and more sandy and bouldery than below. The altitude was reached in north part of line of Secs. 23 and 24. At the corner of Secs. 23, 24, 25, and 26, the altitude is 1400' and a hill on Mr. Spargo's clearing near center of SE $\frac{1}{4}$ of SE $\frac{1}{4}$ Sec. 23 is 1415'. From this rock land hill and the church on it can be seen distinctly as well as hills further east. I presume Lake Ontonagon extended up to where the sandy bouldering till sets in but there was no definite shore where this road runs. At 1395'.

Information from Mr. Kroll - Wells at Kenton

A well at Mill in Kenton is 175' and gets water from gravel. Head - 40'. Altitude about 10' below railway. Well at Jork Hotel is also 175' with head - 40'. It is 10' above depot. There were alternations of clay, gravel, hardpan, etc. Water veins at higher levels have not much head. Two other wells, however, in vicinity of Kenton got a supply at about 100'.

Mr. Kroll of the Sparrow-Kroll Lumber Company in Kenton is very familiar with the surrounding country and gave me much information on extent of morainic tracts and sand plains to the south of the ISS & A RR east from Kenton and of the island-like highlands west and north. He says the morainic tract Mr. Wood and I crossed on the CM & Stp RR in Secs. 16, 15 & 22, T48N, R36W on road from first junction to Lidnaw only extends west a short distance into Sec. 21. From there west across Secs. 20 and 19 there is a sandy tract timbered with pine. There is loamy land south of it in Secs. 30 and 31 and west part of Secs. 29 and 32 which extends south across the railway between Kitchi and Kenton which had mixed timber. In Secs. 25 and 26 and northwest into Sec. 22 and 15 there is a large swamp.

West of this is another high tract of hardwood with boulders and sandy loam soil occupying Sec. 21 and parts of adjoining sections. On its east is the swamp just noted. While in the northwest and south is a low tract with pine timber and a thin coating of sand over red clay.- Such as is ensued from Kenton west to Trout Creek. Mr. Kroll says the high tract north of Agate is a small area of two square miles or so but the tract that I saw a few miles north of Trout Creek covers much of Secs. 13, 14, 15, 22, 23, 24, 25, 26, T48N, R38W. It has hardwood timber and is rather bouldery; on its north side is a pine tract. There is highland extending northwest from this elevated hardwood tract at least as far as Secs. 32 and 33, T49N, R38 W that

probably would be above this level of Lake Duluth. The high tract north of Gem siding that I saw from the railway east of Bruce Crossing he says runs north several miles or at least to Secs. 26 and 27, T49N, R39W. Lake Duluth extended back in narrow bogs southward to Ewen and Bruce Crossing and up tributaries of the Ontonagon further east. It probably came up the east Ontonagon into the NW part of T48N, R37W to Sec. 30 and possibly to Sec. 32. In the district SE of Kenton and south of Siconaw there is a great moraine with an extensive gravel plain south of it. The south edge of the moraine is in Secs. 32, 33, 28, 27, 23 and 24, T47N, R36W and Secs. 19, 18, 17, 9, 16, and 21, T47N, R35W. The pine runs up in a recess in the moraine into Sec. 9 east of this moraine runs south close to Sec. 33 as indicated on the Perch Lake Topographic Sheet.

On the outwash tract there are a few knolls but they, as well as the plain, were timbered with pine. The very prominent hills east of Kenton that is such an extensive landmark is a rock knob and is in the central part of Sec. 16, T47N, R36W. There is also very high land in central part of Sec. 21 a mile south. This is morainic. The hills are chiefly morainic knolls from the _____ of Kenton eastward to Perch River in the high range south of the DCS & A RR. A rock range sets in SW of Kenton in Sec. 20, T47N, R37W and runs west across Secs. 20, 29, and 30. I noted this range when at Trout Creek late in August. Rock is also found south of Kenton 5 miles in Sec. 2, T46N, R37W.

Trip south of Kenton with Mr. Spargo - October 3, 1909 - Kenton, Michigan - 8 A.M.

I go south to Mr. Spargo's. The land is limy clay in 13 and 14, but becomes loamy in NE part Sec. 23 and in half Sec. 24. The change to sandy land from loamy as noted last night is at about 1350'. The NW $\frac{1}{4}$ Sec. 23 is high land. In Sec. 22 there is loamy land and the south

border from there runs westward across south part of Secs. 22, 21, 20 and 19, along north side the range of rock hills. I go south with Mr. Spargo and reach 1500' at center Sec. 35. Altitude 1480' in slate bluff in Sec. 2 - Striae $s35^{\circ}E$.

At high point on line Secs. 11 and 12, altitude 1565'. At highest point on line Sec. 11 and 12, 1580'. Points on line Secs. 13 and 14 are about same height. At Jumbo River Sec. 23 altitude 1525'. 1570' at clearing S of center of Sec. 23 on a morainic tract. It is very strongly morainic all the way from near Kenton to the border of Paint Lake. 1570' at Mr. Spargos in SE part Sec. 23, 20' above Spargos Lake at 1 P.M. 1570' at 2 P.M. I go SE across Secs. 26, 25 and 36 into Sec. 1 to an old stock farm where aneroid reads 1590 (corrected) at the well. This is 65' deep but is only 30' to water.

Features along line from Kenton to Elmwood, Michigan

Strongly morainic with sharp knobs and basins oscillating 20-50' all the way to here. A dead lake NE of the stock farm in Sec. 6 leads WNW-ESE nearly a mile and is less than $\frac{1}{2}$ mile wide. In north edge Sec. 12 I come down a place bordering Paint River. Altitude 1560'. At beach of river 1545' about 15' above the stream making stream 1530'. There is a small tract of jack pine here on north side of Paint River about a mile long and $\frac{1}{2}$ mile wide. Elsewhere there was heavy growth of white pine with stumps 2-4 feet in diameter. This plain has a gravelly cobbly subsoil and red boulders. The moraine north of it has sandy loam soil, subsoil, and numerous boulders. Mr. Spargo said it extends for several miles from WSW to ENE coming in from head of SEW tributary of the Paint. I can see a belt of hardwood to the southeast in Sec. 24 of this town and Sec. 19 of the one east of here. The plain extends ENE as far as I can get a view.

On crossing the river in Sec. 13, I go SE along small side of stream for a mile or more and find the terrace above the flood plain at 15-20' above river level is cobbly and has also small boulders, the material very coarse than on the north side. (In back part of notebook is a plot of the township north of here that I came through T46N, R37W.)

I turn south probably in SW part of Sec. 14 and pass over a few low hummocks with basins among the thickly strewn with boulders chiefly slate rock. I soon come to a slate ledge on west side of road - altitude 1590'. I find no striae as its surface is weathered. This, I presume, is in center of Sec. 23, T45N, R37W. It is south of a swamp with corduroy road. In about $\frac{1}{2}$ mile in south part of Sec. 23 I come to a road coming on from NW that is better travelled - altitude 1585' at road intersection. This is in a nearby plain with high pine stumps and poplar brush. The edge of this hardwood is $\frac{1}{2}$ mile E southeast. In $\frac{1}{2}$ mile south, I pass another slate outcrop on road and west of road. Altitude 1590'. It is at level of the surrounding pine plain. This is full of small boulders and cobblestones. It is more than $\frac{1}{2}$ mile to next slate outcrop on road and each side at line of the pine plain and scarcely $\frac{1}{4}$ mile from edge of the hardwood. Altitude 1610'. Stony sandy loam soil in this vicinity.

About a mile further, the road turns SE and rises into the high hardwood tract at altitude 1620-80'. The surface is not hummocky like that north of Paint but has long gentle smooth slopes. It is very stony. The soil ranges from clay loam to sandy loam. This is $1\frac{1}{2}$ miles north of Elmwood. The very stony hardwood extends to the valley bluff north of Elmwood. There was scattered tract of pine on this upland on south bluff of valley near Elmwood. The valley is only $\frac{1}{2}$ mile wide here and has bluffs 75'±. There is an extensive

hardwood tract south of the valley. I read 1580' at Elmwood where it should be according to Gannet 1619'. I am told that there is very bouldery land all through the hardwood tract NE of Elmwood and rock ledges also occur in places. It is not of the morainic type.

October 4, 1909 - Elmwood, Michigan - Features near Watersmeet, Mich.

I take train on C & NW RR to Watersmeet and fix up monthly accounts. In afternoon I walked out SW to Sec. 8, T44N, R39W over stony moraine all the way reaching an altitude in Sec. 5 about 150' above Watersmeet or 1730' A.T. Deep basins enclose lake and swamps, bogs. In some cases 75' deep and often 30 or 40 feet. The moraine is of sandy loam with very little clayey till. Near Watersmeet is very sandy. Boulders abound, yet are not so troublesome for roads as in the tract north of Elmwood where nearly every square foot of surface has one. The boulders are more numerous on the low sandy knolls just south of Watersmeet than on the high ridges and knolls further out. I am told at Watersmeet that a very hummocky morainic tract runs west from here into the edge of Wisconsin across T44N, Rs. 39, 40 & 41W and eastward in T45N, R38W and north part of T44N, R38W. About 5 miles south of Watersmeet a pine tract is entered but is not flat country. The region around Lac Vieux Desert is a hardwood district not a pine plain as one might infer from the word "desert".

October 5, 1909 - 7 A.M. - Watersmeet, Mich. - Trip north from Watersmeet past Paulding and Robbins

I follow the military road northward through a gently undulating sandy tract with a liberal supply of boulders to Bass Lake. It looks to be a sort of ground moraine rather than an outwash apron. Just south of Bass Lake is a narrow strip of sandy plain with no boulders and with shallow basins with bogs in them that have been ponds. The region from Watersmeet to the north side of Bass Lake was timbered with

pine, hemlock, etc. with little or no hardwood. It is now growing up to poplar. There is no place between Watersmeet and Bass Lake where I reached an altitude of 1600'. The general level is about 1580'. Bass Lake is about 1550' being in a basin 20-30' deep.

North of Bass Lake I rise to a stony moraine with sharp hummocks that reach altitude 70-75' above lake or about 1625 A.T. The front of the moraine heads E-W and I could see its course when south of Bass Lake for 2 or 3 miles. In this moraine is some red till of heavy clayey constitution. Boulders are not very abundant - not more than on the sandy gravelly tract just north of Watersmeet.

There soon begins a northward descent from the moraine so that near line of T45N and 46N, R39W the altitude is about 1550'. A little north of here a small outcrop of slate rock occurs in the road at altitude 1540'. It is northward so I find no striae. I was told at Watersmeet of two outcrops NE of there, one near corner of Secs. 34, 9 and 10, T45N, R38W near a dam on Tamarack Creek. Another where the north line of C & NW RR comes close to the creek in Sec. 19, T46N, R38W. Outcrops seem to be rare in this region.

Striae 10-12 E

I descent to a marshy creek valey 1510' A.T. in middle part of line of Secs. 33 and 34 with grass and alder bushes and some spruce. On its north is a slight rise to pine stump land in a narrow strip, there being hardwood 1/8 mile north near Corner 27, 28, 33 and 34. In west part Sec. 27, I descend to a deep river with a spring brook in it - altitude 1450'. It has bluffs of red loamy sand and beds of clayey loam also. There is sand in NE bluff. Less than 1/2 mile from the brook NNW, the road descends to a swampy tract and the ditch on east side exposes a slate rock striated S10°-12°E. The exposure is too slight to show whether it is a boulder or an outcrop of ledge.

The striae are fine lines. Altitude 1480'.

Striae 22-32° E

On crossing this swamp and rising over a low rock point, I find striae on its north slope in ditch on west side of road that trend the same as on first exposure S10°-12°E. This is a schistose rock of greenish color with quartz? veins of light color on part of the outcrop but not where these striae occur. There is a firm schist (altitude 1490'.) Less than $\frac{1}{2}$ mile north on a northward descent, the road passes striated outcrops of several square rods with a slope to the NW and the striae rise over this slope in slightly divergent courses from S22°-32°E. The most easterly ones are a little to the east of, toward the SW, at 10:20 A.M. and then westerly ones a little to the west. Altitude is from 1430-50' on this sloping outcrop. Altitude 1400' at a spring brook 40 rods north of this outcrop.

Trip past Robbins to Bruce Crossing

I here leave the maple and birch forest and come into a tract from which pine and hemlock have been removed and the birch and scrubby timbers left. It is desolate waste camp once with the fine forest. I have been traversing from Bass Lake to here. The soil here is a sandy loam with some silty material. Boulders are not so numerous as in the maple forest and the surface is not so undulating though not plain. It is probably to be classed as ground moraine.

I read 1370' at a small brook in NW part Sec. 15. Much of this ground moraine is about 1400' with points nearly 1450' in Secs. 15, 16, 21 and 22. It rises eastward. Between here and Paulding there is very sandy land with few boulders. Paulding is in a swamp 20'± below the sandy tract and reads 1300' (corrected) at 11:30 A.M. There is an elevated tract of hardwood west of here called the Robbins

ridge that runs from Sec. 6, SE to the NW corner of Sec. 17 a distance of $1\frac{1}{2}$ miles. It is less than $\frac{1}{2}$ mile wide and lies east of the railway spur that runs from Craigsmere to Robbins. There is a tract of fine hardwood NE of Paulding in east half of Sec. 3 and in Sec. 2. A boring was made in Sec. 27, T47N, R39W, 480' that is said not to reach rock - near Mr. Leonard Nelson - At a schoolhouse a bill of \$500 was charged the school board. At another schoolhouse and town hall, Sec. 15, a well is said to be about 180'. It yielded water for a time but is now filled with quicksand.

There is red clay northwest of the Robbins ridge in the district west of Craigsmere. From Craigsmere its border runs NE toward Sec. 17, T47N, R39W. This is the SE part of the great tract that I have seen from Bruce Crossing west to Topaz past Ewen and Matchwood. There is a rise of 45' to top of mill north of Paulding. There is a strong morainic form here north with basins among its knolls. An altitude 80' above Paulding about one mile north or 1380'. The next mile is a little below this 1415-35' (1325-45'). At 2 miles 1425' at foot of a hill. At $2\frac{1}{3}$ miles on summit 1490' = 1400± (corrected). At schoolhouse $2\frac{1}{2}$ miles out 1480' = 1390± (corrected). This is where a boring over 400' deep was made at corner Secs. 21, 22, 27 and 28, 1480' = 1390 (corrected) At schoolhouse $2\frac{1}{2}$ miles out 1480 = 1390 corrected. There is a red loamy soil here and good farm land.

Features near Bruce Crossing

At town hall SW corner Sec. 15 = 1400' = 1300 corrected. It is 60-75' higher than is on side hill $\frac{1}{2}$ mile east or about 1375'. Altitude 1315' at head waters of Baltimore Creek on line Secs. 15 and 16 or 1210' corrected. A strip of red clay comes on here from

the west. It extends $\frac{1}{2}$ mile \pm into Sec. 15. There is some sandy and gravelly outwash on south slope of the ridge north of Baltimore Creek near Nuliby (?) road up to 100' above the creek or 1415' - 1310' corrected. Only the east side of forties on Sec. 9 are over elevated ground. The west half is down on the red clay and pine slashing 1420' at summit in line Secs. 9 and 18 $\frac{1}{4}$ mile from south land = 1310' corrected. At town lines, the reading is 1200. There is high rolling land in south part of Sec. 33 and 34 and on east side Sec. 34 but north and west is the red clay plain. The aneroid reads 1240' on south edge on Nuliby (?) road.

Bruce Crossing to Rockland

I read 1245' at Bruce Crossing where altitude is 1126'. I presume there has been a steady change all day to a lower barometer or there is a south wind. I adjust aneroid to correct reading at Bruce Crossing and continue north leaving there at 2:50 P.M.

At creek on line of Secs. 15, and 16 altitude 1060' at 3:15 P.M. The bluff is 1110' each side. About $\frac{1}{2}$ mile north near corner Secs. 9, 10, 15 and 16 undulating land with shallow basins and land swells sets in and extends west from this elevated hardwood tract down the slope to the Baltimore Creek. It seems to run across to the hardwood tract north of Baltimore Station in NE part of T48N, R40W. North of this undulating belt which is nearly a mile across, there are sandy spots usually on north side of shallow rivers or draws. There are a few pebbles in the sand. I get no higher than at Bruce Crossing anywhere in T48N, R39W north of the village but in places the aneroid reads 1120'. It drops to 1100' in the north part of the township. There is considerable birch and hemlock in Secs. 9, 10, 15 and 16 and part of 3 and 4. In the northpart pine is present.

In Secs. 33, 149, R39W, there is a lot of uncut pine. I read 1050' at north edge of this pine probably near corner 27, 28, 33 and 34 at 4:30 P.M.

I am told by a man from a camp east of here that high valley land across the east part of Sec. 35 and Sec. 36 and west side of Ontonagon river and there is very broken land east of the river in Secs. 31 and 32 and sections to the north. The timber there is highly pine and it is now being lumbered. At 5:15 P.M. I reach Baltimore Creek and read 1010' on bluff and 960' at stream. This is in Sec. 15, T49N, R39W. The bluffs are a stiff red clay with only a few pebbles and an occasional small boulder. I have seen very few boulders from Bruce Crossing to here.

The surface is flat with a gradual northward slope from north part of T48N, R39W northward to the Ontonagon valley in Sec. 34, T50N, R39W. It is only 930' at bluffs of the river. On descending to this valley, I pass a terrace at 750' and one at 700'. The river flat is 675-685' while the stream is about 660' by my aneroid. The north bluff rises abruptly to 930'. There is a gradual ascent to about 1050' at base of the rock range on south part of Sec. 15, T50N, R39W. There is no exposure of rock in the Ontonagon bluffs where I crossed. A gummy red clay with few pebbles forms the bluff 270' high.

The aneroid reads 1160' at brick hotel in Rockland which is within a few feet of correct, possibly 10' too low - so the readings from Bruce Crossing to Rockland may be reliable. I allow 15' an hour correction on readings Watersmeet to Bruce Crossing.

October 6, 1909 - Rockland, Mich. - Lake Duluth 1180' at Rockland

I set aneroid at 1180' on highest shore of Lake Duluth in Rockland and then go up the hill east to the church and make it 1370'.

Points near the shaft $\frac{1}{2}$ mile ESE are above 1400'. There are faint or obscured grooves on the rock ledges east of this church being S15°E that may be striae. I look SE up the middle branch of Ontonagon River and see a plain bordering it for several miles or to about opposite the elevated hardwood west of the river in Secs. 35 and 36, T49N, R39W. Probably the first hills on east side are what Mr. Kroll of Kenton mentioned October 2 in Secs. 32 and 33, T49N, R38W.

Where the road descends into Rockland from the SE, there are on the side of the bluff heavy scorings bearing S12°E-15°E. It is near where the road turns north. I find striae here, similar bearing, near an old shaft directly south of Rockland, an outcrop in a col just west of the road to the Victoria mine. I go out on this road and read altitude of tracks between this old shaft and this crossway of the C NW STP RR as follows: 1180, 1145, 1125-30, 1095, 1075-80. Reading at railroad 1060'. At sandbar 30 rods west 1030-35. At brow of bluff where road begins steep descent 1005. I read 695 at Ontonagon River where it read about 660 in August. There is a terrace 50-55' above this river.

Hills near Victoria Mine 1400'

At base of bluff in west side of Ontonagon River 755' at BM 70 NGS, I read 950' and on brow of clay bluff a few rods further 985'. Base of a low bluff of clayey till $\frac{1}{2}$ mile SEW 1005' - Top of bluff 1025'. About $\frac{1}{3}$ miles west road turns SDW and crosses at base of a till bluff at 1035'. Top about 1055. Gradual rise up to forks of road at a bank 1105' (cut brush 8-10') I take left hand road leading south and come to base of another bank at 1140' and come to highest than at 1175'. There is a rock outcrop just east on north side of a road running west at 1185'. Southeast of here less than $\frac{1}{2}$ mile is a

small rock island rising to about 1200'. There is high land across this river from the Victoria mine within a mile from the river that rises to about the height of the highest shore of Lake Duluth. The trend of the highest part is SW from there for 2 or 3 miles and then south to Baltimore. I can see the high hardwood tract that I passed through NW of Ewon on October 2 very clearly. Some knobs SW of the Victoria Mine reach about 1400'.

Gaps in Range

I take road SW toward Norwich Mine and after crossing rock hill 1325' at crest of road and 1375' just north of road, I descend to a tract of red clay gently undulating 1350-75'. Then rise to 1325' with strongly morainic topography. From this about two miles from the Victoria Mine, I descend rapidly to a flat clay plain draining north passing from morainic to flat land at altitude 1170' and crossing a gravelly sandy bar at 1160'.

Hills about 1500' in copper range

The plain is about 1120' with ravines cut down to 1100'. It is a stiff red clay and road is wet and muddy in it but there is a heavy maple hemlock and birch forest and it would not be wet if cleared and ditched. I am fully 1½ miles in this lake bed. I come to its bluff where I turn southward in Sec. 34. Only the SW part of Sec. 34 stood above it and only the east part of Sec. 35 (See sketch of knobs in Secs. 13, 24, 25 and 36 on the blueprint map that I took from plots at Ontonagon in August) These show the ones that stood above Lake Duluth. A large part of T50N, R40W was below the lake.

I followed the shore line SSE in SW part of Sec. 34 past old explorations on a rock ledge to south side of the ledge probably in NW part of Sec. 3, T49N, R40W. A bar there runs out SW from this

point of the ledge showing that lake currents swept past it. The ledge is bare at its east end but where the road rises to it, there is some drift on it. At the base of the cliff is a bouldery strip made by shore action. The aneroid reads 1180-85 here now at 12:20 and read the same at 11:40 when I left the road to follow the shore line out to the Ontonagon valley.

I rise nearly continuously from SW part of Sec. 34 up to Sec. 5 and there reach about 1500-20. The rock is within 20' of top of highest hills, but is generally concealed. I passed two slight outcrops that have been heavily glaciated but the striae on them are weathered off. They are both in the road. The drift is a sandy loamy till above about 1300' but below that is largely a red clayey till.

I stop for lunch by a brook flowing south probably not far from line of Secs. 5 and 6 aneroid here reads 1385' at 1 P.M. and same at 1:30 P.M. I am wondering if this gap in this range that I crossed in Secs. 34 and 35 may not have been the proglacial course of the main Ontonagon. It now circuits around the hills by the Victoria Mine instead of taking this more direct course. An examination of the bluffs of this stream below this gap and in it ought to settle this question (Suggest getting Mr. Hopkins, Jr. to do it).

I now enter the rock ledges in south slope of the range. I find one plain with grooves in road that may be striae bearing S12°E. The road runs the same course, however, so there is a possibility of wagon scoring. There is a break in the range near the line of Secs. 1 and 6 running NW back of the range on which the Norwich and Hamilton Mines are opened. I come down to the river in this gap and the low bottom 15' above stream reads 1095. The altitude reads 1200-10' at top of the clay filling south of the range. I read 1200 at mouth of Norwich Mine at 2:30 P.M. where I read 1100-1105 October 1. I presume

the altitude is really about half way between or 1150' if this is the height of the highest shore (See notes October 1 on a shore line north of the range at same altitude at the mouth of the Norwich Mine.)

Shifting of Ontonagon River

I am told by Neil T. Ferguson at Norwich Mine that the river south of where the gap on the range occurs, 2-3 miles SW of Victoria Mine, has no rock ledges. There are rock dells SE of the Victoria Mine along the river so it seems there to be a post-glacial head course. The preglacial course may be through the gap in the range west of the Victoria Mine. The reading is 1205 at mouth of Norwich Mine at 4 P.M. (probably about 1150')

Norwich Mine to Ontonagon, Michigan

I go with team through to Ontonagon. The summit on the gap reads 1230'. The first beach 1205 (probably 1150') There is a series of sandy bars with interval of only 5-10' in height between adjoining ones down to 45' below the uppermost beach. There a flat clay plain extends to the rock knob in Sec. 24 called Agate Bluff. These sandy bars are on north part of Sec. 2, T49N, R41W and south-east of Sec. 35, T50N, R41W. There is black heavy soil in the sags between the sandbars. As I approach Agate Bluff in Sec. 25 and 24, T50N, R41W a rise is made to a reading 1200' (probably not over 1150') The bluff is rocky and rises 25-30' above the plain and the west side. There is a well defined cutbank on its north side that runs eastward. I presume it follows cut bluff or cliff shown on land office charts eastward across Secs. 19 and 20, T50N, R40W. From Sec. 24 a rapid descent of about 150' is made in perhaps a mile or two about the line of Secs. 24 and 13.

This brings down to about 1000' A.T. by corrected reading (calling the highest shore 1150-60' A.T.) The descent is then more gradual to 700-25' probably 675' about 5 miles from shore of Lake Superior.

Features of Ontonagon River

The plain is red clay and it has little or no undulating surface. It is trenched by small rivers cut 20'+ into the red clay. Agate Bluff in Sec. 24, T50N, R41W rises only about 30' near the road and is base rock on top but much weathered so I find no striae.

October 7, 1909 - Ontonagon, Michigan

The clay flat back of this sand ridge on Ontonagon is not over 10' above lake level and there is no distinct notching on the slope above it so it is doubtful if Lake Nipissing was more than 10' here above Lake Superior level. (See notes below to show it was 15' a short distance west).

I take road leading west not far from the shore and am on a sandy ridge that is 15-20' above the lake level. The belt of sand is scarcely $\frac{1}{2}$ mile coverage wide. There are no pebbles in the ridge along the road but some on the present shore - sloughs between the ridges are 5-10' lower and less than 10' above the lake.

Potato River is first large stream cutting in Sec. 4. Hardwood enters in Sec. 5 on east side of this stream just south of the road is a cut bank in till that I presume is the Nipissing beach. Its base is 15' above lake level as determined by hand level and a sandy bar in front of it is 17'. The ordinary lake level seems to have been 15' above Lake Superior at present stage or about 616' A.T.

At Iron River Nipissing beach 614' A.T.

At Iron River the Nipissing beach is only 12' above Lake Superior level. There is a sandy gravel bar in front of the cut bluff - at same

altitude. Rock underlies this at 4' depth. The rock rises southward and has a decided northward dip.

Nipissing 618-19 at Union Bay

Three miles east of Iron River it is up to 30'± than lake level. At Union Bay the Nipissing bar built across head of bay is 17' by hand level above the lake and is a pebbly sand clear to top. Probably it was heaped up 4-5' above ordinary lake level.

Beach at 730'

I continue up road west and rise to a terrace by BM of MGS at 76 6/10'. The back of terrace is about 80' above lake. It is a weak shore line at best. I am on another border terrace at MGS BM for 129'. The lake level for this runs probably 130-32'. This is nearly level for about 20 rods width. There is then a rapid ascent to where my aneroid reads 880' A.T. (should be 915') I read only 900' at MGS BM 332'. This is on a side hill slope. There is a slight bench or terrace 925' at back side below here to the north. Beach 925'±.

Another bench mark nearly $\frac{1}{2}$ mile farther on 322' is just below the back edge of terrace so it is 325' or 925' A.T. Go west as far as west edge of Sec. 13, T51N, R43W and are there on a terrace of narrow shelf 10-12 rods or less wide, apparently formed by lake rivers that is close to the 1000' contour or 400' above the lake.

Beaches up to 1140'

I here ascended southward and pass three higher shore lines which by aneroid read 1040' (good shore), 1060 (weak cut), 1100' (good shore), 1140' (good shore). This has a cliff back of it 20-25' high and above this is steep slope rising according to the contour map to 1500'. The highest shore is said to be at the road intersection a short distance north of the center of Sec. 14. It is described to be

a back cliff there also. I have not time tonight to go up there but I see by the map it is close to the 1550' contour.

The pass over the range south of this road intersection is below 1400'. This pass has had some mining exploration. There is said to be very little drift on the range on this pass or the knobs each side. On the south there is a sheer precipice down to Carp River nearly perpendicular in places 250'. Lake Duluth came around the Porcupines in this depression on which Carp River and Carp Lake lie. This is below 1100'. The base of the steep bluff on the south in Sec. 13 is just below 1150' as shown by the contour map.

I passed a striated ledge south of the stream in Sec. 22 at altitude 790' with bearing S20°E Beach 928' Beaches 670 and 618

I returned from Sec. 13 to Union Bay and took the road south to the Nonesuch Mine in Sec. 1, T50N, R43W.

The Mississippian beach at Union Bay is 618'. The next beach about $\frac{1}{2}$ mile south is 670'. It has a gravel pit on it and is a ridge 5-6' high and several rods wide. A cut bank south of it about 50-60 rods reads 675-80 at base. This corresponds with one of the terraces on the slope of the Porcupines. There is another ridge at about 700'.

I come to a good beach at south edge of Sec. 22 into a clearing that is said by Joseph Bigge of the Nonesuch Mine and a slight down grade. I read 300 at the Nonesuch. Probably it is 930' here. There is a prominent hill west of here on west part of Sec. 2 and east part of Sec. 3 that rises to a level higher than Lake Duluth, but there would be only a few acres above 1150' A.T. Mr. Bigge says there is a low tract west of it separating it from the main range of hills south of Carp River and Lake.

There is a bench mark of MGS near the correction line $\frac{1}{2}$ mile north of the Nonesuch location 340.9 feet A.L.S. Setting my aneroid there

and come to Mr. Bigge's house I read 928' above Lake Superior or about 930' A.F. This is on a plain of stiff red clay and suffers from frost where there is no frost on slope north of Hallowell Mine.

From Nonesuch Mine to Lake Gogebic

October 8, 1909 - 7:30 A.M. Altitude 930' at Nonesuch Mine, Sec. 1, T50N, R43W. The prominent hill west of here in Secs. 2 and 3 has a heavy drift cover so Mr. Bigge says and outcrops are few. But the range further west has large exposures of rock ledge. Mr. Bigge's son goes with me SW from the mine along the old Bessemer road which is now abandoned for travel. We rise in about two miles to 1000' on the plain between Little Iron and Big Iron river. The reading is 995 at Witness Tree near corner 10, 11, 14 and 15. 1070' on north bluff by Iron River near a MGS Sta, I read 1010 at river at road crossing south of here by a homestead. Valley is narrow and cut in clay plain 1060-80 across Sec. 20, 29, and 33, T50N, R43W to stream in Sec. 3, T49N, R43W. Bluff north of stream 1065' - stream 1015'. At narrow valley cut in red clay. Time 11:20 A.M. In Sec. 10 I come to a rock bluff and the highest beach of Lake Duluth at reading 1120' A.F. There are two shore lines along the face of the bluff 20'± different in altitude. The road from north part of Sec. 10 across Sec. 15 is along the shore with a steep bluff on the west and a gradual slope to Iron River (east fork) on the east. There is a very stony strip at crest of highest shore part of the way.

I am above this shore for a short distance in north part of Sec. 22 but come down to it at a creek with wide ledges in its bed in east part of Sec. 22 and read 1120' on a plain that opens out along this creek just below the road crossing. It is higher to the south. The shore seems to run east to the east branch of Iron River in Sec. 23,

T49N, R43W - only 4-4½ miles north of Lake Gogebic. I am in a very gently undulating tract in SE part of Sec. 22 and in Secs. 26 and 27. It gradually becomes morainic toward the line of 26 and 35 with swells 15-20' high. This belt is 2-2½ miles wide and has its border at Lake Gogebic. There is no rock in the vicinity of this road at north end of the lake. The highest altitude reached is only about 1320' at 1½ miles northwest of Lake Gogebic station. When I come down to this station my aneroid read only 7' higher than the correct altitude, so no change seems necessary in readings taken today.

The moraine north of Lake Gogebic has a loose textured loamy clay soil of red color and in places sand or sandy loam. Boulders are not conspicuous feature, though not rare. The rock ledges that I come to in Sec. 10, T49N, R43W extend across Sec. 11 or nearly so and rise to 1150-75' more or less. I presume the shore of Lake Duluth runs westward from Sec. 10 to the west branch of Iron River before turning northward striking it about Sec. 1, T49N, R44W or possibly a little farther south. It is likely then to follow the east edge of the high country on west side of Iron River across SE part of T50N, R44W and NW part of T50N, R43W about to Sec. 4. Then there is the high tract in Secs. 2 and 3 that probably stood as a small island in the lake.

From where I left the shore in Sec. 22 it seems likely to cross east branch of Iron River then turn NE keeping north of the Trop Range into T50N, R41W.

Ewen to Choste

Take train to Ewen from Lake Gogebic at 2:25 P.M. having walked 10 miles today over rough road. From Ewen I take a horse and buggy and go across to Choste (let driver return with horse). The road



leads SE to corner of Sec. 25, 26, 35 and 36, T43N, R40W rise about 1170-80' on the gently undulating tract of red clay at the section corners. I then go south through this red clay about to middle of line of Secs. 13 and 14, T47N, R40W reading an altitude of 1230' on north part of here of these sections. I then go into very bouldery hummocky land, strongly morainic and rise in one place near south end of line of Secs. 25 and 26 to 1290'. This moraine crosses the east half of Sec. 26 and all of Sec. 25 nearly all of Sec. 36 and the NE part of Sec. 35 but extends north only into the SW_{1/4} of Sec. 13 and SW_{1/4} of Sec. 14. There is a great tract of red clay to the NE of it in Secs. 17 and 18, T47N, R39W and sections north of there. There is also an extension of till clay from Choate SE towards Robbins with a range of high hardwood hills circling around it on the east and south. The Robbins hills noted October 5 from Faulding lie on its east border, and are in plain view from Choate.

I stop at Choate overnight with Mr. Hanson, experienced in lumbering around here. The aneroid reads 1170' at Choate at 5:40 P.M. The Sucker Creek valley east is 40' lower. Mr. Hanson says the clay land and level ground runs SE from Choate to Craigsmere crossing all of Sec. 35 all of 36 except NE_{1/4} of NE_{1/4} and all of 26 except NW_{1/4}.

There is sandy ground along the same valley from Craigsmere up to Faulding and up another fork from a mile south of Craigsmere up to Robbins. Each side of this valley are prominent morainic ridges timbered with maple that in the east bring the Robbins ridge already noted.

The north edge of the strong moraine to the west from Robbins runs through Sec. 12 and near line of 2 and 11, 3 and 10, 4 and 9, T46N, R40W in a nearly westward course. There it trends north and west

across Secs. 5 and 6 but scarcely touches Sec. 31. In T47N, R41W it runs north to edge of Secs. 25 and 36 and then trends WNW to Lake Gogebic coming to the lake about 5 miles from its south end or near line of Secs. 11 and 14, T47N, R42W. This is a moraine several miles in width. The tract north of it was timbered with pine clear to its edge as far west as Sec. 22, T47N, R41W and the pine comes nearly to it clear across that town. But in T47N, R42W and T48N, R42W, there is hardwood on the nearly plane ground morainic tract to the north of this strong moraine. The part timbered with pine is a stiff red clay, but the strip timbered with hardwood that lies east of the north part of Lake Gogebic has a looser textured red clay with some loam and sand.

There is a small tract of hardwood in Sec. 29, T47N, R40W about 2 miles west of Choate that had rolling surface and a bouldery sandy drift.

Choate to Watersmeet, Michigan

October 9, 1909 - Choate, Michigan (6 miles S of Ewen)

I follow the railway track to Robbins. The cuts show red clay as a rule but in some cases there is sand on west slopes. The low land along Sucker Creek is swampy but the lands are generally sandy. Red clay is present for $1\frac{1}{2}$ miles south of Craigsmere but has sand on slopes of knolls. Farther south there is nothing but sand. A few boulders occur in it. The aneroid read 1160 at Sandhurst 1170' at Craigsmere and 1270 at Robbins. I am told that no ledges outcrop in the morainic tract SW of Robbins but there are many boulders, some of them very large.

I take road leading SE from Robbins and rise through a bouldery sandy moraine for $2\frac{1}{2}$ miles to an altitude 1470'. I then enter a plain that extends to the military road $1\frac{1}{2}$ miles farther. It has maple and hemlock timber but the soil is a sandy gravel with very few boulders.

It seems to be an outwash plain from the moraine west of it. It is in Sec. 28 and north part of Sec. 33, T46N, R39W. The aneroid reads 1465 today at this marshy plain near middle of line of Secs. 33 and 34 where I come to the military road. It read 1510 there October 5 but on that day, the readings of elevations were too high.

I read 1610 on summit north of Bass Lake today where I read 1625 October 5. At Watersmeet the aneroid reads correct altitude - so today's readings are probably reliable. I am told that a great pine plain lies south of here a few square miles being in Michigan NW of Lac Vieux Desert (see map) but it is chiefly in Wisconsin. Hardwood country with strong moraine probably extends south beyond the state line from Lac Vieux Desert eastward. There seems to be reentrant in the ice border where the pine plain extends up into Michigan, from there moraines run WSW on west side and ESE on east side. The Wisconsin River has its heads in Lac Vieux Desert to there was an escape southward for glacial waters. The only part of the pine plain that is drained northward is near Duck Lake outlet.

October 10, 1909 - Watersmeet, Michigan - 8 A.M. - Trip west from Watersmeet

I start west on the C & NW RR track to map the features near the railway. A morainic topography borders the railway closely on the south in Secs. 28, 29 and 30, T45N, R39W but on the north there is a low nearly plain tract out to the NW part of Sec. 20. A morainic strip runs from there NW to Sucker Lake in Sec. 12, T45N, R40W. There is a lower tract back east and west of it. Another ridged belt runs NW from west part of Sec. 19 into Sec. 14. It is strongly morainic around a lake in Sec. 15, T45N, R40W, and southward from it past the railway in Sec. 22. There are camps here on a small creek and bouldery knolls occur on both sides of the stream.

On going west into Sec. 21 and 16 near Blumers. I leave this strongly morainic tract and enter a swampy region with only occasional low knolls 10-20' high. It is not an outwash but more like ground moraine. The moraine continues westward through the south part of T45N, R40W, in Secs. 28, 25, 30, 31, 32 and 33. There are not many boulders on the knolls in this swampy country. The swamps are timbered with spruce and tamarack and in places are open marshes with huckleberry bushes. The knolls have loose textured drift with but little clayey till. Turtle Station there is a ridge 20-25' high, the highest passed in four miles. It contains reddish loamy till. It looks like red clay when seen from a few feet away but contains a fine sand. There are lakes and marshes from here north to Beacon Lake in Secs. 12 and 1, T45N, R41W.

Watersmeet to Gogebic - South of Lake Gogebic

It is also marshy south from Turtle on the shore that runs to the chain of lakes near the state line. Around the lakes there is strongly morainic topography. The marshy land extends 3-4 miles south from Turtle Station. It also extends south past Beacon Lake to borders of T46N, R40W.

I enter a flat tract west of a branch of Ontonagon River $1\frac{1}{4}$ miles NW of Turtle in Sec. 3, T45N, R41W. That extends north to the west flowing part of the river in Secs. 32, 33, 34 and 35, T46N, R41W and south $1\frac{1}{2}$ - $3\frac{1}{4}$ miles from the railroad. It was covered with pine which has been lumbered off. North and south of it are hardwood belts. That on the north is rolling but on the south it is nearly plain at north edge. It is said to become strongly morainic a few miles south. About $3\frac{1}{4}$ miles east of Thayer, I pass a small rock bass on north side of railway. It was plained off by the ice but the surface is now too weathered

to show striae. About $\frac{1}{4}$ mile NW of Thayer on east bank of a small stream is a prominent glaciated rock bass 40'± above the stream. The one east of here is only 8-10' above surrounding plain. I did not go out to this larger one. About $1\frac{1}{4}$ miles NW off Thayer at west side of RR track on the ditch is an exposure of a striated ledge with striae somewhat divergent and ranging from N-S to S10°W. It is near center Sec. 31, T46N, R41W. A few rods west of the railway here there is a low rock bass 10-15' above this track. It has been plained off by ice but the surface is now too weathered to show striae.

The railway cuts into rock $\frac{5}{8}$ mile east of Gogebic Station and exposes striae bearing nearly due N-S with divergence of 2-3° each side. Rock basses occur each side the railway rising 10-20'± above track. At Gogebic the rock rises 25' above station.

October 11, 1909 - Gogebic, Michigan - Features between Gogebic and the lake

I go north on road to Lake Gogebic and enter a moraine no less than $\frac{1}{2}$ mile where crest is 30-40 feet above the level of the station. It is sandy and gravelly with but few boulders. About $1\frac{1}{4}$ miles from Gogebic, I pass an outcrop of granite that is striated S10°W altitude 10' below Gogebic. There is morainic topography out to NW part of Sec. 14. I there enter a flat tract 100' below Gogebic Station. On turning north, I descend over terraces to Lake Gogebic - one road 140', another 165' below Gogebic Station.

There are prominent rock hills on west side of Lake Gogebic from its head northward past Alligator Point. The point itself is low for about $\frac{1}{4}$ mile back from shore. On the east side there is high land north past the mouth of Trout Brook. There is also a low ridge just north of Big Bay in Secs. 10 and 3, T47N, R42W, perhaps 50' above lake. Trout Brook is said to be among hills all its length.

Depth of wells is 20'

South of the rock range at head of Gogebic Lake, the land rises 100-150' above the lake but the rock range rises probably 250'. There are two flowing wells at the resort by head of Lake Gogebic 5-6' above level of lake with a fair quality of water and a strong flow. I am not able to get data concerning them. Temperature of water 41.5°F. Air temperature 38°F at 9:45 A.M. - altitude of Lake Gogebic 1278'.

Features near Gogebic

1318 terrace by water bank at Lake Gogebic resort. 1360 at south side of next higher terrace 5/8 mile. 1405 at south side of third terrace about 7/8 mile. 1428-30 at top of steep rise back of terrace and about 20 rods north of a large boulder around which the road curves a reddish rock 12' x 12' x 3'. 1450-55 on plain south from here to turn of road. 1465 at MP from Lake Gogebic on moraine. 1550 at a summit near line Secs. 14 and 23 on the moraine. There is a reddish loamy sand here but in much of Sec. 14 is a loamy clay of reddish color and this is present all the way down to Lake Gogebic at the resort. The drift is very sandy from where I turn SE in Sec. 23 to border of moraine in north part of Sec. 25. I read 1530' at Gogebic on return. I am told there is a rock canyon on Nelson's Creek, a branch of Slate River about 3 miles from Lake Gogebic that rises to nearly 200' above the lake. There are cascades in the stream there. There are also falls on Slate River about a mile by stream above this junction with Nelson Creek called Judson Falls. There is a swampy land up to the junction of Slate and Nelson's Creek.

Features near Marenisco

I take train at 1 P.M. - Gogebic to Marenisco. There is a swampy tract 15-20' near the Gogebic Station for two miles \pm . Then a morainic tract with points 30-40' above Gogebic Station. There is moraine from

here clear into Marenisco. The swamp west of Gogebic seems to cut a gap in the moraine which has a westward coarse past south end of Lake Gogebic.

I am told there is a deep artesian well in Sec. 21, T47N, R43W, at edge of Presque Isle River drilled for mining exploration. It is said to spout up with great force to considerable height. There is a lot of rocky ledges from Marenisco north. Granite sets in first and then iron a little further north. L. P. Bourquin of Marenisco gave me a good outline of the distribution of morainic belts from meridian of Lake Gogebic westward past Dunham. The southern belt is near the state line extending 1-3 miles into Michigan but chiefly in Wisconsin west of the Lake Gogebic meridian. North of this is a strip of very gently undulating land with clay loam soil extending nearly to the railway from Presque Isle River eastward to Gogebic Station. Some of its ridges trend NE-SW. There is a narrow strip of swamp land near the railroad as far west as Presque Isle River. West of Presque Isle River this north moraine is north of the west fork of the river. The gently undulating hardwood land lies south of the river. In his opinion this gently undulating land will be excellent for farming. It runs westward past No Mans Lake into Wisconsin through T45N, R45W. The north belt may pass through south part of T46N, R45W, but he thinks there is wet land north of No Mans Lake.

I saw nothing morainic from Wakefield to Dunham in trip made in September - so the moraine is likely to be farther south than the C & NW RR. Mr. Bourquin has put through logging roads and knows the region very intimately and is a good man to describe features. He gave estimates of amount of undulation. In the part he calls gently undulating, there is scarcely more than 30'. In the strongly morainic tract near the state line it reaches in places 80' or more. He mentioned ridges 80' high in Secs. 22 and 23, T45N, R44W, that trend NE-SW and

are very sharp esker-like. I took train back to Watersmeet.

TRIP SOUTH FROM WATERSMEET INTO WISCONSIN

October 12, 1909 - Watersmeet 7:30 A.M.

I take train south and rise from 1580 to 1700' in going to the summit. This is not a flat plain but on west side of the track there are hardwood tracts and knolls to within a mile of State line. Starting at State line the reading is 1675' but there is a flat plain here descending to south sandy gravel soil.

Reading at Rummells 1625'. An occasional low knoll here 10-15' high in the Jack Pine plain.

At Conover is marshy land 1605 ft. barometric. On line east toward Hackly the Jack Pine extends only 2-3 miles. Larger pine than occurs in dry land. It then covers a bluff 30 ft. high on north side of track where aneroid on train is 1640'. This continues less than a mile. Mud and train is then in a Spruce Swamp at 1055', for a mile. Then a rise into morainic country that borders north Twin Lake - 1675-1700' or more. Hills north of track a short distance rise to 1725_±. Then aneroid reads 1675' at Hackley 12-15' above the north Twin Lake. The morainic land I am told completely surrounds North Twin and South Twin Lake and Lac Vieux Desert. There is a recess in the moraine between Lac Vieux Desert and the Twin Lakes where flat pine land runs east about to the Military Road at Lindy Haymeadow Creek in Sec. 20 or 21.

On return to Conover aneroid shows change to 1575 ft. or 30 ft. in an hour. South from Conover the pine plain stands about 20' above lakes and streams in it.

I pass some knolls north of Sucker Lake that I am told by A. A. Denton of Eagle River run through to Pioneer Lake. They are only 15-20 ft. high but are bouldery. Mr. Denton says a range of knolls runs westward from Rummells north of junction of Tamarac Creek and

Wisconsin River.

Rock is struck at only 18 ft. on his farm east of Rummells in Sec. 34. The drift is very bouldery along this rock. East of there in Sec. 25 & 36 are knolls of considerable size that run east on south side of Haymeadow Creek. The range that runs west from Rummells is interrupted by a plain 2 miles wide at Tamarac Creek but sets in on north side of Stormy Lake and runs toward Lake Laura. South of it near Buckatabon Lake is a pine plain. There is a ledge of rock south of Sucker Lake running east past Deerskin Lake. The pine plain extends about to Deerskin, Carpenter and Bass Lakes. I read 1585' at Eagle River.

There is continuous pine plain Eagle River to Three Lakes aside from Marshy basins and lakes. The aneroid reads 1570' at Three Lakes. South of Three Lakes is a gently undulating land (?) with large swamps for two miles. Then morainic features of pronounced type. Sharp knolls 10-25 feet or more in height - for a mile. Then swamp to Stella Junction.

Aneroid 1560' at Gagen

Aneroid 1500' at Monico Junction

There is a tract of swamps and scattered knolls all the way from Three Lakes to Monico Junction and I am told it continues south past Summit Lake. There is less swampy hardwood land south from there.

Features Near Monico Junction

I go west along the track toward Rhinelander to an outcrop $1\frac{1}{4}$ miles from Monico Junction. It is glaciated with striae about S50°W. It is a small exposure in the railway cut rising 4-5 above the track.

Northwest from Monico there is considerable pine and a very gently undulating surface. Southwest as far as I can get a view there is morainic topography with knolls 15-30 ft. high and hardwood timber.

Small lakes around here. I was told by a resident of Monico that I interviewed on the train that a belt of hardwood timber on rolling bouldery land runs west from Three Lakes past Thunder Lake to Sugar Camp Lake a distance of seven miles. North of it between a line from Thunder to Sugar Camp Lake and lines from these lakes to Columbus Lake there is swampy land. Spruce and tamarack with but few knolls. To the NE and NW of this swamp there is pine plain. There is a pine plain from near Sugar Camp Lake southwest to Rhinelander. It's eastern edge is at Lake Creek the outlet of Stella Lake. There is a swamp between Stella Lake and the moraine around Thunder Lake that turns some distance down Lake Creek toward Roosevelt. There is a belt of rolling hardwood land around Stella Lake and southward from there to North Pelican Lake. This extends in rather weak form about to Roosevelt with scattered knolls in swampy tracts. I take train Monico to Rhinelander at 3 PM and make descent of 60 feet.

Features Near Rhinelander, Wis.

The land is rather hummocky most of the way with little gravelly knolls and ridges sharp as eskers but not forming a live.

These are especially conspicuous for 56 miles east of Rhinelander. They seldom exceed 20 ft. in height and some of them cover only an acre or so. This hummocky land I am told by Mr. Vaughan, the county surveyor, fills much of the interval between the Soo Line and C & NW R.R. as far out as Roosevelt Station. More level land then sets in along the Soo Line and runs to within 2-3 miles of Gagen. It was timbered with pine and so was much of the hummocky land. From there eastward for many miles the hardwood predominates over the pine, and there is a great rolling tract running north from the Soo Line R.R. to State Line in eastern Oneida and Eastern Vilas counties and west part of Forest county.

The knolls near Rhinelander are very bouldery but the boulders are not conspicuous for more than 2 miles east.

East of Rhinelander I note only a few knolls fully 90 percent being plane as far as Roosevelt. East of Roosevelt is considerable swampy land about 20-25' lower than the pine plain. There on only occasional knolls for several miles east of Gagen and as far east as I have a view before dark.

The altitude continues high as far as Goodman. The reading there being only 90' less than Rhinelander. The aneroid indicates 220' descent from Goodman to Dunbar. The aneroid indicates 225' descent from Dunbar to Pembine. The reading at Pembine at 7:30 PM is 900'.

I am told that the morainic at Goodman is so bouldery that is difficult to drill wells there.

October 13, 1909 - Features in Marinette Co., Wis.

I joined Dr. Weidman at Ellis Junction last night - We take morning train to Pembine. Are on pine plain for a few miles. Then for a few miles south of Wausaukee, we are on moraine. Rock knobs set in north of Wausaukee. Dr. Weidman says this moraine crosses into Michigan NE of Pembine a few miles.

There is a sand plain with rock knobs from Pike River Amberg Station to Pembine. I set aneroid at 900' at Pembine. A short distance west from Pembine a moraine with till and hardwood is crossed (?) mile or so wide. Then rock knobs for 2-3 miles.

Around Dunbar are scattered knolls but not a strongly defined moraine. There is a rock knob 30-40 feet high a short distance west of Dunbar and others SW within a mile. The aneroid shows a rise of 200' from Pembine up to Dunbar. Rock is conspicuous for about 3 miles. Then a strong moraine of sandy constitution and yet very bouldery is crossed. It has knobs 50 ft. +- high and (?) basins. Just west of a (?) station Sidney we enter an outwash plain at 110 ft. above Dunbar. There is pine on it. The width is about two miles.

Features on Forest Co., Wis.

At Goodman the surface is nearly plain but west from there it is hummocky. The aneroid shows 1370' at Goodman and 1400 ft. on summit on top of steep grade 2 miles west.

Armstrong Creek is on a hummocky moraine with little knolls 10 ft. or less and occasional large ones. There is a rise to 1490 ft. to a large swamp. It is fully two miles across. There are very few boulders on it. We then pass through a tract with knolls 10-20 ft. high and numerous boulders, which continues for about 3 miles to Conover where reading is 1440'. Some esker like ridges of gravelly sand for a mile east of Conover. There is a small stream here. West of Conover, a pine plain is entered that gives places to mixed fir, birch, spruce, etc.

Features in Florence Co., Wis.

At Laona Junction, the reading is 1500'. There are boulders here and gentle swells.

We go north to Newald - Sec. 26 T28 R14 - and hold a pretty uniform elevation between 1450 and 1500 ft. There are a few knolls and low ridges. The ridges trend E-W or NE-SW. The highest are 25-30 feet but most of them are 10 feet or less. Boulders are not very numerous. Except in limited localities. We are told at Newald that for 10 miles west from here there is no strongly morainic land. But east of here on edge of Florence county, there is a very stoney moraine with bouldery knolls 50' high. This keeps on the west edge of Florence county north from here nearly to Brule River and there swing west into T41 R14W.

The pine plain near Conover is not extensive probably only 1-2 sq. miles.

We come into morainic topography about midway between Newald and Long Lake on crossing Popple River. It surrounds Long Lake and has knolls and ridges 20-40 feet high, very steep sided like eskers and

usually very gravelly. Some have no boulders and are full of well-rounded pebbles. They inclose swampy land. The belt runs north along west side of Florence County to Pine River and there runs into the edge of Forest County. There is a rather smooth tract northwest of Pine River in north-western Florence County. There is some hilly land up the Popple River above where the railroad crosses. There is also hilly land up Pine River west from here. But the interstream areas are rather level. There is not much sharply morainic land in the eastern half of Forest County. Mr. C. R. Brooks of Long Lake, Wis., an experienced timber surveyor, gave us much valuable information on distribution of the rolling and the nearly plain tracts. There are extrusive nearly plain tracts in western Florence County east of this rolling belt that have a sandy loam to clay loam soil and heavy hardwood timber.

There was but one exposure of rock ledge between Laona Junction and Long Lake a short distance from Newald. It had faint lines on surface with bearing S 70°W that may be striae but they are hardly clear enough to be decisive.

We took the freight train to Saunders from Long Lake. The moraine topography continues 7-8 miles beyond Long Lake. There is then more swampy land. In the moraine the railway is in cuts $1/3 - 1/2$ the distance. The knolls rise 30-40± above the track.

October 14, 1909 - Features in Iron Co., Michigan

We stay at Saunders, P.O. over night and Weidman returned in morning to Ellis Junction, while I walked up to Iron River. The railway follows up the valley. It is in a low bottom land from Saunders to Palatka. North of Palatka it crosses to west side of river and rises onto a terrace 40± above the stream. There is a (?) terrace in Iron River Village. It is under lain with gravel. The valley is very irregular and has prominent hills separated by low swampy tracts on each

side that widen the valley out to a mile at these swamps and narrow it to $\frac{1}{4}$ mile \pm at hills. - See topographic sheet.

The iron formations near Stambough are in part overlain by gravel and sand and in part by an oxidized till. The till also caps the gravel and sand. I take train Iron River to Watersmeet and note rock outcrops near Beechwood and west of Elmwood. Also near Tamarack. There is moraine topography in the divide between Paint River drainage and Tamarack Creek. The belt seems to run N-S past the (?) of Paint Creek. I continue west and note morainic knolls as far as Dunham. Rock knolls occur with them in vicinity of Marenisco and Dunham. From about Sec. 16 T46 R44W - westward there are few drift knolls - but rock knobs are conspicuous. All the way to the iron range near Wakefield.

Features in Ashland and Bayfield Cos., Wisc.

Near Sedgwick on DSS & A a Norway Pine forest is entered. The high land is 3-4 miles south from here. Much laminated clay and fine reddish sand on the highest part of ridge between Sanborn and Bibon - but occurs at top. The bluff of Pike River at Bibon has a red clay with few pebbles.

Duluth Beach 1080-1090 Near Grandview, Wis.

From Grandview Station, I rise (by aneroid) 50 feet to the beach $1 \frac{1}{3}$ miles west and the storm beach is 10' higher. Grandview is 1019 ft. So this makes beach about 1070' and storm beach 1080'. My determination walking out to it from Grandview September 11 made the beaches 1075' and 1085' (R.R. Profile makes them 1080' and 1090' feet.) There is strongly morainic topography from here to Cable aside from small pine plains shut in to some extent among the morainic knolls. The east side of Long Lake has some (?) 50 \pm ' above the lake timbered with pine. Along the railway on west side of lake there are knolls with many boulders.

Features near Cable, Wis.

There is but little flat plain along the railway north of Cable. In places there is a gravelly tract nearly (?) plain aside from basins. Cable Village stands on a gravel plain and is 1370'. Just west of this village $\frac{1}{4}$ - $\frac{1}{2}$ mile are knolls 60' above level of the station.

About two miles south of Cable are high knobs east of the railway. Within $\frac{1}{2}$ mile they extend back some distance east. West from the railway opposite these knobs and distant 1-1 $\frac{1}{2}$ miles is a morainic tract with some maple. The plain along the railway seems to be a line of glacial drainage across a moraine. I took full notes on this line south from Ashland to Spooner in August and September trips.

Add 601.78 for altitude above sea level. I consult profile of Great Northern R.R. Foxboro to Nickerson

		Gannett	G N Folder
Foxboro	322.4	956	950
M P 25	331		
Road Crossing	340		
M P 26	352		
RR cut at 30-40	388		
chains w. top			
M P 27	374		
M P 28	394		
E. Bank Net R	409		
River Bed	323		
Fl Plain	332		
West Bank	416		
Top of cut 9 ch W.	421		
M P 29 (track)	416		
Natural	420		
Surface			
Holyoke	433	1141	
M P 30	436		
Net River (Bridge)	438-441		
(River)	365		
(Plain)	371		
Base of cut Bank	449	Beach	1050'
Top of Ridge	465	Higbost Beach	1066'
M P 31	457		
Top of first ridge			
west	468	Close to higbost beach	
M P 32	478		
M P 33	503		
M P 34	521		

Gannett

G N Folder

Natural Surface	543	
M P 35	540	
M P 36	553	
Nickerson	552	1157

Notes taken Sept. 6 from Foxboro west (?) beaches.

Near M P 25 at	932 feet
About 3000' west at	970 feet
M P 28	995 feet
West of E. Net R	1021-5 feet
Birch West of	
Holyoke	1050 feet
Top of bank there	1066'