Notebook No. 178 - Leverett

COUNTY

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NOTEBOOK NO. 178

September 15 - September 23, 1902

September 15. Honor to Empire, Michigan

September 16. Empire, Sleeping Bear Point, Glen Arbor, Bass Lake, Burdickville, Honor, Beulah or Crystal Lake, Copemish.

September 17. Copemish, Pomona, Marilla and back

September 18. Copemish to Harlan, Wexford, and Sherman

September 19. Sherman, Summit City, Manton

September 20. Manton to Fife Lake by rail. Drive east past Sharon to southeast part of Kalkaska County and back.

September 21. Features around Fife Lake

September 22. Rail, Fife Lake to Boyne Falls. Drive to Boyne City, East Jordan and back to Boyne Falls.

September 23. Drive northeast from Boyne Falls to Springvale, Thumb Lake and back.

September 24. Rail, Boyne Falls to Petoskey

September 15, 1902. 12:30 noon

Aneroid 29.370 at Honor, Michigan. I drive west along north bluff of Platte River for 1-1/4 miles, then cross river at a mill and go west on south side of Platte Lake. There are very strong beaches from the east end westward in Sections 12 and 11; usually two ridges. They seem to be of the same altitude and are each 15 - 20 rods wide. There is a swamp south of south one in Section 12 and also farther east in west part of Section 7. In Section 3, a bar runs out to Platte Lake from the crest that stands 11-1/2 feet above the lake. I should think the beaches in Sections 11 and 12 are at least 15 feet above Platte Lake. These beaches have well rounded cobble, but are usually quite sandy. They seem to have been formed by Lake Algonquin. At the west end of Platte Lake there are low sandy ridges covering nearly all the area from Lake Michigan to the base of the moraine. At outlet of Platte Lake I find the gravel on east side stands 13 feet above the stream. The sand ridges reach 10 feet or more higher.

Aneroid 29.355 at outlet at 2:15 p.m. This is probably 10 or 12 feet above Lake Michigan. Going east from the outlet I soon come to large dunes 30 - 50 feet or more, that rise to the cluster of morainic knolls noted last July on north side of Platte Lake in southwest part of Section 26 and southeast of Section 7. The dunes from there east lie north of the state road. In Sections 26, 25, and 24, a sand ridge 30 - 50 feet high is nearly continuous along that north side of the road. The cluster of morainic knolls contains some reddish till interbedded with gravel and sand. A pit is opened near the east end of the hills that shows gravel in arching and dipping beds interbedded with this reddish till. This cluster of hills is 1/2 miles or more east-west and less than 1/2 mile north-south. Its highest points are perhaps 75 feet above the lake. In Section 24 there is a strip of damp land

timbered with poplar between the dunes and a morainic tract that lies east of there. The timber on the side to the west from here has been largely pine -- some white and some Norway pine. Aneroid 29.330 at base of moraine on west side of Section 19, T.27N., R.14W.

Aneroid 29.230 - 29.240 on the first place where general level is reached in north part of Section 19. There is a sandy gravelly drift here and only low swells, 10 feet, more or less high. The west border of this upland plain runs north through west part of Section 18 and turns northwest in Section 7 and comes to the shore of Lake Michigan in southwest part of Section 1, T.27N., R.15W. A moraine sets in in the northwest part of Section 7 and covers much of Section 1 and northeast part of Section 12. It is about 200 feet above the lake. It carries numerous boulders. The drift is gravelly with only a small amount of till at surface. The plain which covers much of Sections 7, 8, 17 and 18 runs a narrow strip north into Section 6. There are boulders on this narrow strip but I saw none on the main part of the plain. Aneroid 29.170 at store on plain at center of Section 6.

Aneroid 29.125 on tableland south part of Section 31, 100 rods, more or less, from south line. High hills, $1\frac{1}{2}$ - 2 miles east of here, are flat-topped. This tableland is nearly plane. Aneroid 29.180 in basin that covers much of north half of Section 31. It is dry and sandy. It opens west-southwest toward Lake Michigan and has high morainic hills both north and south of it.

Aneroid 29.050 at summit on angline road in east part of Section 25. There are morainic knobs 50 - 75 feet higher on each side of the road, or about 900 feet A.T. Aneroid 29.300 at Empire in swamp back of Algonquin sand ridge.

I go east up the ravine that the railroad follows and find its slopes sandy but thickly set with boulders. North of this is a high plain on which the aneroid reads 29.070. There are scarcely any boulders within 30 - 40

feet of the surface of this plain. From this high plain I command a view of a much higher tract to the east in Sections 21 and 28 that probably reaches 900 feet A.T. The high tract south of Empire is about as high. Between this high land south of Empire and the high tract in Sections 21, 28 and 33, there is a tableland about as high as the level I reached in Section 31 and on this tableland are large depressions or valleys, one of which is utilized by the railroad that comes to Empire. I am unable to see from here whether it runs southeast of the road I came north on.

Aneroid 29.330 at Empire at 6:20 p.m. There is a line of dunes of modern development standing between this village and Lake Michigan that are 40 - 50 feet high here. The sand is drifted south of here up to the top of the high tract south of Empire. That tract seems to have a level top like a small tableland. This is a remarkable region for tablelands at various levels -- I am not able tonight to interpret them.

There is a sandy ridge running through the south and east parts of Empire in a southwest-northeast course that seems likely to be the Algonquin beach. Gravel appears near its base. The ridge is 15 - 30 feet high and 10 - 12 rods wide.

There is a flowing well at the Empire Lumber Company's mill, 54 feet, that rises 4 feet. It is a 6-inch well and supplies the village with water. There was some sand at top, 40 feet, more or less, then a thin bed of reddish clay, under which the flow from gravel is obtained.

September 16, 1902, Empire, Michigan

Base of first cut bank 12 feet, more or less, above Lake Michigan. Level of stores and post office, 23 feet. Base of Algonquin beach, 28 feet. Top of gravelly part of beach, 1 block south and 1 east, 35 feet. The sand reaches 40 - 45 feet. Aneroid 29.440 at level of Lake Michigan at 6:30 a.m.

My levelling was from the mill pond, which is now 16 inches above Lake Michigan.

I cross a gravelly beach about 35 feet above Lake Michigan. Aneroid 29.400 on street running east from Hotel Weston, and, upon turning north, come to it at point where telephone road turns northeast. Its trend here is north-northeast. With hand level, I sight east about 40 rods to the sandy outer beach and find that its base is about level with top of this gravel ridge, or possibly 2 feet higher than the ridge. There is a sandy ridge inside of this gravel one, standing 20 - 25 feet ±. There is also a beach at about 12 feet. The lake extended into Sections 7, 18 and 19 at Algonquin stage, the shore being about 3/4 mile in places, from present shore. East of it is a prominent range of hills that covers Sections 7, 8, 9, 10, 4, 5, and 6 in T.28N., R.14W., and comes out to the Lake Michigan shore in Sections 36 and 25, T.29N., R.15W. It is known as the Sleeping Bear Range and is a very prominent one, standing in places nearly 400 feet above Lake Michigan. Its south border trends northwest-southeast as far as Section 16, T.28N., R.14W., and there turns southward.

Aneroid 29.050 = 930 feet at summit on road on Sleeping Bear ridge. At the lake front, 1/2 - 3/4 mile west from here, the altitude is at least 980 feet, or 400 feet above Lake Michigan. The drift is very sandy in Sections 7 and 6 where this road ascends, but on the crest there are small boulders. I go west from west end of Glen Lake onto Sleeping Bear Point and find the bare part has boulders and pebbles at surface. Aneroid 29.050 - 29.110 on glacial surface of north end of Sleeping Bear Point = 870-930 feet A.T. This is in Section 25. On slope of a basin -- peaty material with shells. Aneroid 29.160 = 825. There is also some peaty material in bottom, 25 feet lower. Peaty strip is only 2-4 inches thick and is exposed for 30-40 rods on east side of the basin -- and the basin is just east of

the eastern range of dunes a mile east of Lake Michigan.

Aneroid 29.435 at Glen Lake. The dunes are about 1/4 - 1/2 mile from the end of the lake and run north past the end out to the extreme Point. The gravelly moraine extends as far north as opposite the extreme north end of Glen Lake in Section 25. Aneroid 29.300 at summit in road south of Glen Haven. Aneroid 29.410 at Algonquin beach south of Glen Haven.

Aneroid 29.460 at shore of Lake Michigan at Glen Arbor at 10:00 a.m. The gravelly low beach on which Glen Arbor is built is 6 - 10 feet above Lake Michigan. Aneroid 29.400 on flat terrace at west base of hills in Section 24 -- probably level of Lake Algonquin. Aneroid 29.400 on Algonquin beach at north end of School Section Lake in Section 16. Aneroid 29.415 at Mr. Sheldon's at 11:50 a.m.

There is a very high range of hills west of Port Oneida in Sections 31 and 32, T.30N., R.13W., and part of Sections 5 and 6, T.29N., R.13W. It probably reaches 350 feet and possibly 400 above Lake Michigan. South of it is a valley fully 1/2 mile wide, occupying parts of Sections 6, 7, 5 and 8, T.29N., R.13W. It is near the Lake Algonquin level. There is an open valley out to Lake Michigan from Section 6 to Port Oneida at Lake Algonquin level.

A range of hills on the border of Lake Michigan south of Port Oneida covers much of Sections 1, 12, 11 and 14, and the northwest corner of Section 13, T.29N., R.14W., and stands 200 feet or more above Lake Michigan. It is separated by a narrow valley, in places less than 1/4 mile wide, from the high morainic tract to the east. The road in Sections 12 and 13 is in this valley. The valley is near the level of Lake Algonquin. The aneroid reading on it being 29.400 - 29.410. There is a barrier beach at north end of School Section Lake in Section 16 (Bass Lake on County Map) and the lake

has no surface drainage but seeps through this beach into the outlet of Lime and Traverse Lakes which passes within 1/4 mile north of north end of Bass or School Section Lake. This outlet is on a low tract north of the Algonquin Beach that is timbered with poplar.

Aneroid 29.385 at Tony Sheldon's at 1:00 p.m., where it read 29.415 at 11:50 a.m. Aneroid 29.370 on Lake Algonquin shore at North Unity Post Office at corner Sections 9, 10, 15 and 16. The range of hills between Bass and Lime Lakes is about 800 feet A.T. on highest points. The range west of Bass Lake is higher, some points northeast of Glen Lake being fully 900 feet.

I take road south on east side of Bass Lake and make a gradual ascent to Section 33 where I am about 725 feet A.T. There is strongly morainic topography on each side, but a strip 1/2 - 1 mile wide south of Bass Lake has only gentle swells. It was probably occupied by a tongue of ice and so probably was the Lime Lake valley east of here, each tongue running north to south. This would be after the ice had shrunk from the high moraine south of the Maple City - Burdickville wagon road. Aneroid 28.280 = 700 feet ± where road turns south from the Maple City and Burdickville road to go up to Judge Williams (see notes in July). I turn west on the Burdickville road in Section 4, Kasson Township, and go over to Burdickville. There is a shore line here 17 feet above Glen Lake and this is said by the postmaster to be 18 feet above Lake Michigan. It is about 20 feet above Glen Lake to base of this higher beach back of line which is a cut bank. A little farther south is a beach at 23 feet. Aneroid 29.390 at Glen Lake at Burdickville at 2:30 p.m. = 598 feet ± . I level a mile west of Burdickville and find one beach 17 and another 23 feet above Glen Lake. The upper one is sandy and has points about 30 feet above Glen Lake. The lower one is much more regular in height. I take a road south, keeping in a ravine for 1-1/2

miles and reaching an ascent of about 100 feet in it. The road then runs a steeper grade along side of east bluff. Aneroid 29.030 = 930 feet at top of bluff near middle of line of Sections 23 and 24, T.28N., R.14W. There is a tableland here but there is a still higher one east in Section 24, about 970 feet. In the southeast part of Section 24 are knolls 75 - 100 feet higher, or 1050 - 1075 feet. There are also knolls in the south part of Section 23 that reach 1050 feet.

Mr. Will Pageant, in southeast of Section 23, has a well 240 feet deep. There was about 100 feet of gravel; then a reddish clay, about 20 feet; then dry sand and gravel to water. Water does not rise any. Mike Kern's, in south part of Section 24, is of similar depth. William Torrant, in northeast of Section 26, has one 240 feet. One at school house in east part of Section 26, is of similar depth.

Aneroid 29.630 at corner Sections 25, 26, 35 and 36 on plain. The northwest part of Section 26 is strongly morainic, but south from there is a tableland 930 feet, ±. Section 25 is also of similar height and is plane. The north part of Sections 36 and 35 is on the same tableland but the south part has a higher tableland. Aneroid 29.000 on this higher one near middle of line of Sections 35 and 36 = 955 - 960 feet. A well here is 180 feet at Mr. Dorr's. It rises about 17 feet. This is in Section 35. Joseph Pageant has one in Section 36 that is fully 200 feet. Mr. James Osborn's well, in northeast part of Section 2, is 172 feet. It has 10 feet of water in bottom. Aneroid 29.000 at well.

Boulders and low swells set in near middle of line of Sections 2 and 35 on county line, at the altitude of this high plain. There is soon a descent so that the aneroid reads 29.080 at Empire Railroad. Isaac Huff's well at Osborn Post Office, in northeast of Section 2, is 136 feet. Aneroid 29.070 at well. Aneroid 29.040 at corner of Sections 3, 4, 33 and 34 on county line on a plain.

I take road south. This crosses ravines that make it an uneven road but the plain is maintained between ravines and as a sandy drift for 1¼ miles. I then come to the border of a lower country and the stripe from this plain down to it is knolly and bouldery. Aneroid 29.170 at corner Sections 9, 10, 15 and 16. The hills east of here are 75 - 100 feet higher. To the west is a gently undulating tract with a sandy loam soil and a few boulders.

About the corner of Sections 15, 16, 21 and 22, I rise to a high tract. Aneroid 29.110. I then descend to a ravine at a swamp near middle of line of Sections 21 and 22. Aneroid 29.250. The drift is sandy on the slopes of this ravine and not bouldery, but a mile north there are boulders and a loamy soil. I am told that there is a very broken country from here west to Almira Township where a plain sets in, as noted in July. Aneroid 29.100 on hill near corner Sections 21, 22, 27 and 28. There is an undulating tract here with boulders. Aneroid 29.090 on highest points.

I cross a ravine at line of Sections 28 and 33 and south of this rise to where aneroid reads 29.080. The surface here, as north of the ravine, is gently undulating and has a few boulders. The soil is loamy in much of Sections 28 and 33. Aneroid 29.070 at south side Section 33. There are knolls west of road in north part of Section 4, Homestead Township, 20 - 25 feet higher. There is no higher land in view to the east.

H. G. Ryan in center of Section 4, has a well 240 feet. It was in sand nearly all the way. There is 20 feet of water in bottom. Aneroid 29.070 at well = 850 feet ±. Aneroid 29.365 at Honor at 6:15; 29.380 at Honor at 7:15. Aneroid 29.100 at highest point on road in Section 19, Homestead Township; 29.390 at east edge of swamp at head of Crystal Lake, 3/4 mile east of railroad station; 29.400 at Beulah Station at 8:15. This is 606 feet A.T. Aneroid 29.390 at 9:30 p.m. I take train from Beulah to Copemish.

September 17, 1902, 7:30 a.m.

Aneroid 29.140 at Copemish, 807 feet. I go south a mile along brow of a low bluff, 25 feet ± high. Turning east on line of Sections 17 and 20, I rise to a low tableland, 830 feet ± A.T., which extends only 20-40 rods south of this road, there being low knolls farther south, 15-20 feet high. Near the east end of the section line I drop 10-15 feet to a swampy tract which the Ann Arbor Railroad follows up nearly to Pomona (see map). I turn south on line of Sections 20 and 21 and after going 80 rods on this swamp, I rise to a tableland that stands about 870 feet. It has a sandy gravel and few, if any, surface boulders. There are sags forming a network in places 15-25 feet below the level of the tableland. Aneroid 29.050 = 870 feet at corner of Sections 20, 21, 28 and 29 on tableland. There are several deep basins with steep rims near the section corner, and, as noted in July, basins are conspicuous from here west to the edge of the tableland. Aneroid 29.135 = 810 feet at a swampy valley on line of Sections 28 and 29 near middle. The swamp is only 20-30 rods wide. There is a very broken tract from this swamp south past the section corners that has few points that rise to the level of the tableland.

Aneroid 29.070 on sandy tableland. A few boulders appear near middle of line of Sections 32 and 33, just north of a low morainic ridge. This ridge is the northwest edge of a strong moraine. It rises like a bluff about 40 feet above the tableland north. Its surface is nearly as plane as the tableland. Aneroid 29.025 on bluff-like rise near south end of line of Sections 32 and 33. The southeast half of Section 33 is on this higher tract but only the southeast corner of Section 32 is on it. There are boulders and cobbly material on this higher tract as well as the gently undulating topography to distinguish it from much of the tableland to the north. Mr. William Ward,

south side Section 33, says boulders abound in the south half of Section 33 and northwest part of Section 34 and east part of Section 5 -- on this higher tract.

Wells in this vicinity are about 70 feet. It is nearly all gravel and sand. Aneroid 29.015 at Mr. Woods = 905 feet. Aneroid 28.950 on sharp ridge at corner of Sections 33, 34, 3 and 4. This is only 1/8 mile wide and has a sag or ravine back of it. 60-75 feet lower. Aneroid 29.030 at sag 30 rods east and south of Section corner of 33 and 34, 3 and 4. There is a rolling morainic country east from here. I go south near line of Sections 3 and 4, winding around among knolls and coming up at corner of Sections 3, 4, 9 and 10 to gently undulating elevated tract. Aneroid 28.850 = 1040 feet ±. There are low swells 10 feet high. The soil is a sandy loam. There are only a few boulders -- rather small. Those on the tableland in Section 33 and northwest part of Section 4 are large. I go west on line of Sections 4 and 9, reaching the 1000 foot contour near middle of line. From there it bears south-southeast. I descend to the sag that runs diagonally southwest across Section 4 and find its altitude at line of Sections 4 and 5, 40 rods from south end, is only 860 feet. The sag bears north of west from there through south part of Section 5.

I go south on line of Sections 8 and 9, reaching a tableland at corner of Sections 8, 9, 16 and 17 that stands about 940 feet. It is rather broken both north and south from here but looking southwest, I can see the general level maintained. I continue south across some steep ravines, the lowest of which, near south end of line of Sections 16 and 17, stands only 870 feet. At corner of Sections 16, 17, 20 and 21, I am up on the general level. Aneroid 29.000 = 915 feet ±. South from here 1/2 mile, I enter a low plain. Aneroid 29.085 = 840 feet ±.

Aneroid 29.050 = 870 feet at Charles Bakers' in north part of Section 28 in the sag or valley. His well is 50 feet deep, and has 20 feet of water. It was nearly all clay. Aneroid 29.000 = 910 feet at middle of line of Sections 21 and 28 on about general level of the upland. It is sandy and gravelly with but few boulders. Aneroid 29.000 at corner Sections 21, 22, 27 and 28 on plain. The south half of Section 22 is plane and Section 27 is all plane and so is the east half of Section 28. Orren Switzer, in southwest part of Section 27, has well 120 feet. Aneroid 28.975 at well. The plain rises nearly 40 feet from north to south on line of Sections 27 and 28. Hills then set in that soon rise above 1000 feet. There is a general level at about 1050 feet with swells 10-25 feet high and basins 10-25 feet deep.

A well was made in Reitz Camp near south end of line of Sections 3 and 4, 240 feet deep that was sand and gravel the whole depth and water did not rise in the well. Aneroid 28.860 = 1035 feet at well. The well was dug and cribbed. The well is in a shallow basin. The drift on this high upland is a loose-textured sandy gravel with only occasional boulders except in ravines where they are concentrated. Aneroid 28.985 at place where ravine is springy, probably in Section 10, south part. It is where Mr. Ed King had a camp. He made a well here at time he was levelling that was 51-60 feet deep. We continue down the ravine about a mile farther, probably to Section 15, and stop at a spring for dinner at 1:00 p.m. Aneroid 29.030 at place where we stop for dinner at a spring = 890 feet ± A.T. Aneroid 29.030 1/2 hour later; 28.885 on extreme point of land east of the ravine in which this spring occurs. There is only a tableland west from here at about this altitude 1000 - 1015 feet A.T. But north there is a range of hills along the west bluff of Manistee River that is 1050-1100 feet A.T. The west bluff runs southwest only 1½ miles beyond where I am. It there turns west along north side of the river. Aneroid 29.080 at top of clay in bluff of Manistee River = 850 feet±.

The river is 50-60 feet lower. This is in heavy timber so I cannot see any distance into Sections 14 and 15 or south part of Sections 10 and 11. Aneroid 28.750 on summit where I enter a clearing near middle of line of Sections 10 and 11. This is fully 1050 and perhaps 1070 feet. The cleared parts of Sections 10 and 11 are knolly, the highest being 40 feet ±. Aneroid 28.800 at corner Sections 2, 3, 10 and 11, 100 feet ±. The south half of Section 2 and southeast part of Section 3 have few knolls but the surface is slightly wavy. I am told that Sections 13 and 14 have very little plain but no undulations, and 13 is cut by ravines that lead into Manistee River.

I reach a high summit 80 rods north of town line at corner of Sections 34 and 35, 2 and 3. Aneroid 28.750 = 1050 feet ±. A range of hills runs east-northeast from here. Aneroid 28.860 at middle of line of Sections 34 and 32. Aneroid 28.890 in ravine 20 rods north. There are remarkably few boulders along this road thus far. The drift is sandy with a few pebbles. Although a hardwood tract, it has very little clayey till. Aneroid 28.920 at corner of Sections 26, 27, 34 and 35 on a low tract. There is a hill 60 feet high within 40 rods east. There is also a sharp range of hills nearly 1/2 mile west that runs north across the east half of Sections 27 and 22. I go north to corner of Sections 22, 23, 26 and 27 and there turn west into this range of sharp hills. The highest points are nearly up to the 1000 foot contour here and reach it in Section 22. This is a combination, in Sections 27 and 22, of the sharp ridge of Section 34 and the bluff and bouldery terrace west of it, but here there is not a terrace but, instead, a tract of low sandy knolls west of the sharp ridge. The northwest part of Section 27, west half of Section 22, and much of Sections 21 and 28 are on a tableland standing 875 feet ± A.T.

Aneroid 28.980 at Pomona, 6:00 p.m., 867 feet A.T. This is in a swampy valley but there is a rapid westward descent. Aneroid 29.030 1 mile west at corner of Sections 16, 17, 20 and 21. The sandy plain or tableland 1/4 mile south of Pomona is about 20 feet higher than the Station. Aneroid 29.020 on tableland near west end of line of Sections 17 and 20. Aneroid 29.070 at Copemish, 807 feet.

September 18, 1902. 7:30 a.m.

Aneroid 29.215, 807 feet, at Copemish. Aneroid 29.170 = 850 feet ± on tableland east of valley. There is a moraine north of this overlooking the lowland to the north on which the aneroid reads 29.130. It carries a few boulders. There are basins among the knolls and, as I go east, it becomes a nearly plane surface that stands about 900 feet A.T. 80 rods west of corner of Sections 8, 9, 16 and 17. Aneroid 29.110 . I go north between Sections 8 and 9, 1/2 mile, and find the same altitude. North from here it is lower but is undulating and bouldery. There is a lower plain east of here, 875 feet ±, that heads at the brow of a bluff overlooking the plain on the M. & N.E. railroad and runs south past Pomona. There are basins at its east edge near line of Sections 9 and 10, and altitude is 900 feet.

Aneroid 29.140 = 867 feet at Pomona, 8:20 a.m. Aneroid 29.140 at corners 1/4 mile south. The Ann Arbor Railroad enters the moraine and makes cuts just east of Pomona. The creek shown on the map does not follow the railroad into Pomona, but runs southwest to line of Sections 15 and 22. This height is maintained for 1/2 mile. There is then a gradual descent eastward to the Ann Arbor railroad 80 rods from east end of line of Sections 14 and 23. Aneroid 29.035. There seems to be a separation of moraines here that are blended to the north. The western one leads southward through east part of Sections 22 and 27 and then swings southwest as a sharp ridge as

noted yesterday with a bouldery tableland west of it. Nearly all of Section 23 is on the plain that lies between the moraines, the southeast part only being morainic and a narrow strip on west side.

Aneroid 28.990 = 1000 feet ± at corner of Sections 23, 24, 25 and 26 on a nearly plane tract west of a sharp morainic ridge. This is the prominent moraine that runs south through Sections 3, 10 and 15 and east through Section 14 into 13 and then south through Sections 24 and 25. It is 1050 - 1080 feet or more. Aneroid 28.900 at corner of Sections 25, 26, 35 and 36, Cleon Township. There is much of the surface nearly plane at about this altitude in the vicinity of these corners. In the south part of line of Sections 35 and 36, the surface is more broken.

Aneroid 28.960 at corner of Sections 35, 36, 1 and 2, town line of Cleon and Marilla townships = 1030 feet ±. There are knolls in Sections 1 and 2, 20-30 feet high. I have seen very few boulders on this high moraine. The drift is all rather sandy. The road that angles southeast across southwest part of Section 1 is on a plain between morainic ridges. Aneroid 29.020 = 960 feet in ravine or low tract at place where road comes to line of Sections 1 and 12. There are very sandy hills, or rather slopes, to ravines from here east a mile.

Aneroid 28.990 = 1000 feet ± on hill on line of Sections 6 and 7, 40 rods east of middle. This overlooks a plain that borders the Manistee and stands 40-50 feet lower than this hill. There is a bluff-like rise from the plain up to this higher tract so the plain may be valley bottom rather than a morainic outwash. The southeast corner of Section 6 and east half of Section 7 and much of Section 5 are on this plain. The higher tract is very sandy drift with but few swells though it is broken by numerous sags and ravines. I see scarcely any boulders and there are few stones that exceed 6 inches in diameter. The aneroid reads 28.960-29.000 on this higher tract,

aside from ravines in Sections 5 and 6, 31 and 32.

I go north between Sections 5 and 6 and then west on line of Sections 6 and 31 to county line. Aneroid 28.960 1/2 mile east of county line. Aneroid 28.980 at county line and township corners 3 miles south of Harlan. I go north on the county line. Aneroid 29.030 in ravine just south of corner Sections 25 and 36, Cleon, and Sections 30 and 31, Wexford Township. Aneroid 28.950 on upland north of ravine near south end of line of Sections 25 and 30 = 1040 feet ±. There are a few small boulders here. S. C. Miller's well here, in southeast of Section 25, is 95 feet. It has about 4 feet of clay - 40-44 feet. There is 5-7 feet of water. J. H. Hotchkiss, 1/4 mile north, across road in Section 30, is 65 feet. Aneroid 28.950 at corner Sections 24, 25, 19 and 30.

Aneroid 28.985 at Harlan at 11:00 a.m. There are several wells here at 25-30 feet. William Myers, 1/2 mile south of Harlan, in northeast part of Section 25, has a well 70 feet. It was in loose gravelly sandy material 12-15 feet and below this was in a reddish clay nearly to bottom. It has only 6 feet of water, but is strong. Alex Pratt, in southeast of Section 24, has a well of similar depth. They are both on ground 30-35 feet higher than Harlan Station. Wells near Bognall are, in some cases, over 100 feet, though on lower ground than near Harlan.

Aneroid 28.995 at Harlan at 12:30 p.m. Aneroid 29.000 at 12:50 = 1010 feet ±. Aneroid 28.950 at corner Sections 13, 24, 19 and 18 on general level of upland. There are swells northwest of here in Section 13 that reach 1060 feet or more. Section 18 and much of Section 19 have nearly plane surface with sandy loam soil. Aneroid 29.000 at corner Sections 12, 13, 7 and 18 in a swamp that drains east. A large part of Section 7 is in this swamp and I am told that Sections 8 and 9 also are largely covered by the same swamp. It

is drained southward from its east end by Fletcher Creek into the Manistee River. There is a morainic tract west and north of it that rises 75-90 feet above the swamp on the highest points.

Aneroid 28.910 about 80 rods east from west end of line of Sections 12 and 13, 1090 feet. This altitude is maintained for about 1/2 mile west. Wells in this vicinity are about 100 feet on highest land, but on lower ground in Sections 11 and 12, wells are obtained at 40-50 feet. Aneroid 28.940 at corner Sections 1, 2, 11 and 12. There is a level surface 1/2 mile west but beyond there it is broken to where I crossed south of Nessen City in July. There is a gently undulating surface in Sections 1 and 2 with swells 20-30 feet high. There are a few small boulders in these sections, usually a foot or less in diameter. Boulders are remarkably scarce over nearly all this high morainic belt. Aneroid 28.900 = 1100 feet ± about 60 rods south of county line on line of Sections 1 and 2. This is about as high as any point in this vicinity. There are two points east from here on county line on line of Sections 1 and 36 that are 1100 feet.

Aneroid 28.930 = 1075 feet ± at county corners (Benzie, Grand Traverse, Wexford and Manistee). Aneroid 28.980 in swampy cat hole about a mile east. This is 20-50 feet below surrounding country. Aneroid 28.930 at corner Sections 4, 5, 32 and 33 at general level of the country. Aneroid 28.988 at Fletcher Creek 40 rods east of section corner. Shallow basins appear east of this creek giving the appearance of a pitted plain. The surface is slightly wavy. Aneroid 28.925 at corner of Sections 3, 4, 33 and 34. Aneroid 28.920 at corner Sections 27, 28, 33 and 34. There are a few boulders in the vicinity of this corner. The surface is very gently undulating here and for 2 or 3 miles north. There are saucer-like depressions 5-6 feet deep and swells 3-4 feet high. There is a rich loamy soil, better than the sandy soil to the south on west side of Fletcher Creek.

There is a marsh at corners of Sections 22, 23, 26 and 27 that covers about 300 acres and is 40 feet ± below border country. It has no outlet. South and east of this large basin are a lot of small ones 15-25 feet deep, that have very steep rims. Some of them have only 5-10 square rods area.

There are several square miles in the southeast part of Grant Township and southwest of Mayfield Township on which the surface is deeply indented by the basins and there is seldom a 40 acre lot free from them. They extend north to the morainic tract noted September 14th on trip west from Kingsley.

Aneroid 29.000 at swamp in Section 29, Mayfield Township, southwest corner, that covers much of Section 29. Aneroid 28.940 = 950 on border of upland plain that carries basins south of this swamp.

Aneroid 28.950 at Wexford Village. Wells near here are about 50-60 feet, largely through sand and gravel. Some go through clay near bottom. They have very little head, water being only 305 feet in bottom. In 1/2 mile south from Wexford, there is a descent of 40-50 feet to a lower plain. Aneroid 29.000 at middle of line of Sections 6 and 1; also at corner of Sections 1, 12, 6 and 7. Aneroid 28.970 at corner of Sections 1, 2, 11 and 12, Wexford Township. The rise of 25 feet is very gradual and not bluff-like. There is a more loamy soil here than a mile east, that being sandy.

I go south through a plain between Sections 11 and 12, descending about 20 feet. Aneroid 28.995 at corner of Sections 11, 12, 13 and 14. There are saucer-like basins here. In Sections 13 and 14 there is an undulating tract with swells 20 feet ± in height. There are sags and basins that are more conspicuous than the swells, so but little level land occurs in these sections. Aneroid 28.970 at corner of Sections 13, 14, 23 and 24. The highest points near here are perhaps 10 feet higher. This tract has a loamy soil and an occasional small boulder. I descend to a plain south of this

undulating or morainic strip just south of corner of Sections 23, 24, 25 and 26. The moraine covers the north edge of Section 25.

Aneroid 29.070 in a valley near west end of line of Sections 23 and 26. This is apparently a line of glacial drainage through the outer moraine. It is 35-40 feet deep and 20-30 rods wide on this plain. Aneroid 29.020 on plain west of it at corner of Sections 22, 23, 26 and 27. The moraine border passes 80 rods north of here and has a relief of 30 feet ±. The sharp narrow valley runs southward across the west part of Section 26, then west-southwest across north part of Section 34 to Fletcher Creek. Aneroid 29.140 where it joins the creek.

Aneroid 29.105 at Bognall = 915 feet. This is about 40 feet lower than the plain. Aneroid 29.050 on plain west of Fletcher Creek. Aneroid 29.090 on Manistee River bluff 1-1/2 miles west of Sherman. Aneroid 29.210 on Manistee bottom at base of west bluff where a road leads south. Aneroid 29.230 on lowest bottom land 1/4 mile farther east at a lumber mill. Aneroid 29.240 = 810 feet at Manistee River west of Sherman 1/2 mile. There is a terrace on east side at about 870 feet. Aneroid 29.160. This is cut into by the river and a fine sandy gravel is exposed from top to bottom.

Aneroid 29.135 on plain at Sherman in business part of village = 910' ±. This is at the general level of a broad sandy plain that lies south of the river. It is lower than the one outside the moraine on north side of the river. Wells in Sherman vary greatly in depth, some being but 15-20 feet while others are over 100 feet. One of the deep wells is at the schoolhouse. Clay outcrops in a ravine on north edge of Sherman at 20-25 feet below level of village. There is also clay exposed on north bank of river north of Sherman.

September 19, 1902. 6:00 a.m.

Aneroid 29.240 at Sherman = 910 feet ±. Aneroid 29.260 at 6:40 a.m.; 29.290 at brow of bluff north of Sherman; 29.350 at river; 29.100, 1040 feet, on north bluff of Manistee River near middle of line of Sections 25 and 30. The brow of bluff is 1/4 mile south. There is a narrow plain here south of the moraine less than 3/4 mile wide that has shallow basins. Aneroid 29.050 = 1100 feet on moraine at corner of Sections 19 and 30, Hanover Township, and Sections 24 and 25, Wexford Township.

I go east 3/4 mile to a deep ravine. It has a terrace at 975 feet, aneroid 29.180. There is a narrow gorge in this about 40 feet deep. East of this, the road reaches the 1040 foot plain but the moraine lies farther north. The 1040 foot terrace crosses to north of road near corner of Sections 20, 21, 28 and 29 and the 980 foot terrace appears here along brow of bluff. The 1040 runs near south side of Section 21. It is cut up badly by sags that lead out to the 980 foot terrace.

I take a logging road north in Sections 21 and 16, then west to corner of Sections 8, 9, 16 and 17. Aneroid 29.080 = 1065 feet ±. The surface is undulating in north part of Sections 16 and 17 and has hardwood timber. Aneroid 29.060 on highest points on line of Sections 8 and 9. They are near middle of section line. Aneroid 29.080 at corner of Sections 4, 5, 8 and 9; 29.120 a mile east on a plain.

Aneroid 29.170 in swamp near the middle of line of Sections 3 and 16, Hanover Township. The swamp is nearly 1/2 mile wide. There are a few boulders on it and in places, clay is exposed. Much of it is a sandy gravel. The high plain that borders it is a sandy loam. The undulating tract to the southwest from here has few, if any, boulders, and is a sandy loam. It is more productive than the pine plain south, yet it looks about as sandy. Aneroid 29.120 on plain near corner of Sections 2, 3, 10 and 11.

Andrew Marlett, in Section 11, has a well 102 feet deep. It has very little head. There is some hardpan. Aneroid 29.140 at well at 8:45 a.m. There is a clay at surface for 1/2 mile east and land is swampy. Aneroid 29.130 at corner of Sections 1, 21 and 12. Ira McRill, on north side of Section 12, has a well 120 feet. It has about 15 feet of water. There is some clay subsoil in this section, but the soil is sandy as a rule. There is a strip of pine near corner of Sections 1, 2, 11 and 12 that runs northeast across Section 1 and along border of Sections 6 and 31.

There is a morainic tract in northwest and north part of Section 1 and northwest part of Section 6 and north from these sections. Its highest points are more than 100 feet above the plain south of it. Aneroid 29.000-29.010 on high points on line of Sections 29 and 30, Paradise Township, 1120-1130 feet ±. These sections, as well as Sections 31 and 32, are morainic and the moraine extends north and west several miles.

Aneroid 29.050 at school house at corner Sections 19, 20, 29 and 30, Paradise Township in a sag 25 feet ± below bordering knolls. I go east through a strong moraine with variations of 50 feet or more in every section. One high point is just east of corner of Sections 20, 21, 28 and 29. Aneroid 29.030 on road. It is 15-20 feet higher 30-40 rods south.

Aneroid 29.070 at Summit City, 1068 feet, A.T. at 10:15 a.m. There is a hill 3/4 mile northeast that is 75 feet ± above Summit City. There are a few boulders on the moraine in southwestern Paradise Township -- some large ones. I go south and rise to a high point near middle of line of Sections 27 and 28. Aneroid 29.010 = 1125 feet ±. Aneroid 29.030 at corner Sections 27, 28, 33 and 34.

Aneroid 29.100 at county line at corner Sections 3, 4, 33 and 34. William Day's well, in northeast corner of Section 4, is 60 feet. It has 18 feet of water. Aneroid 29.140 on plain outside of the moraine in north part of line

of Sections 3 and 4. Aneroid 29.180 on narrow plain at brow of Manistee bluff = 960 feet ±. The moraine covers most of Section 4 except east side. It has points 1050 feet ±. There is a very prominent point in northeast part of Section 8. Aneroid 29.250 at Manistee River in Section 9, Greenwood Township = 890. The moraine comes nearly to the north bluff of the river west from here in Sections 7 and 8. Sections 12 and 3, Greenwood Township, north of Manistee River, are largely lowland. There is a cluster of hills in the Westbrook settlement in Sections 11 and 12, Greenwood, on south side of the river between the river and Buttermilk Creek. It has a strong clayey soil. There is a blue clay in the north bank of Manistee River in Section 9 west of the bridge which, as exposed, slopes to the east and is covered with the sandy gravel of the high terrace.

Aneroid 29.250 at Manistee River at 12:15 p.m. = 890 feet ±. Mr. Carl Robinson has well here 19 feet. There is a broad plain south of the river which is generally coated with sand but there are spots where till and boulders appear at the surface. Its north edge is about 90 feet higher than the river, or 980 feet, and is about a mile south of the river. There are 2 or 3 terraces between it and the river. Aneroid 29.150 at north edge of plain. Aneroid 29.171 at line of Sections 16 and 21 where road turns west across a swamp. The road rises a few feet from the swamp to the sand plain, northwest corner of Sections 15, 16, 21 and 22.

Upon going south between Sections 21 and 22, a gradual ascent of about 20-25 feet is made. Aneroid 29.120 at corner of Sections 21, 22, 27 and 28. This is on a pine stump plain. Aneroid 29.070 = 1070 feet at school house at corner Sections 27, 28, 33 and 34, on northwest slope of a morainic tract. This morainic tract covers the south edge of Section 27 and nearly all of Section 34. It has a very high altitude near center of Section 34 -- 1250 feet ±. Aneroid 28.980 at summit on line of Sections 27 and 34, west of

middle = 1150 feet. This is about 100 feet lower than hill in center of Section. Aneroid 29.035 at township line at corner Sections 33, 34, 3 and 4. Aneroid 28.980 at corner Sections 3, 4, 9 and 10 on a gently undulating tract that extends west two miles and south about a mile. There is considerable till here and the driver states that it covers Sections 4, 5 and 6 and part of Sections 31, 32 and 33 of the township north.

Aneroid 28.900 on range of hills near middle of line of Sections 3 and 10 = 1225. There is a point 20-25 feet higher 40 rods south. This high tract covers all but the west side of Section 3 and the west part of Section 2 and continues across Section 34 into Section 27, as above noted.

Aneroid 28.970 at creek on line of Sections 2 and 11 east of middle. There is much nearly plane or but gently undulating land in Sections 1, 2, 11 and 12, but Sections 13 and 14 are high and rolling. The drift on this gently undulating tract has a clay loam soil, changing in places to sandy loam. The sharpest knolls on the ridge west of line contain some gravel.

Aneroid 28.930 at township line at corner of Sections 1 and 12, 6 and 7. Sections 6 and 7 are nearly all elevated moraine, 1250 feet ± on highest points, and the southeast part of Section 12 is also sharply morainic. This range extends north across the east part of Section 31, Liberty Township, into Sections 29 and 30, and covers part of Section 32. I am told by a farmer that the land is rather heavy clay north and west of this range of hills nearly all the way to the hills at the Westbrook Settlement in Sections 11 and 12, Greenwood Township.

Aneroid 28.900 in sag at corner of Sections 5, 6, 7 and 8, Cedar Creek Township. Points 1/2 mile north-northeast are 75-100 feet higher, and points 3/4 mile southeast are fully that high. There is also higher land at a church 1/2 mile south, 30 feet ±. East of line of Sections 5 and 8, I rise

to where aneroid reads 28.830 near middle of section line. The high land extends from here east about to the east side of Sections 5 and 8. Mr. P. H. Collins, in northeast of Section 8 has a well over 100 feet deep. Aneroid 28.830 at well.

Aneroid 28.940 at Manton, 1132 feet, at 4:00 p.m. Mr. Baxter, a former Supervisor of Liberty Township, outlined for me the extent of the hills in that township (see county map). He says a hill north of the Manistee River, in Section 11, has clay land back of it and belongs in a moraine that leads northeast from there. Aside from this tract in Sections 1, 2, 11 and 12, the northeast fourth of this township is a sandy plain. The sandy land extends south to the base of the prominent hills in the south part of this township in Sections 27, 28, 35 and 36. There is a strip of good land with more or less clay along the west edge of the township that extends into the east part of Greenwood and runs from the Westbrook hills in Sections 12 and 13 to the hills in Sections 27 and 34, Greenwood Township, and to those in Sections 31 and 30, Liberty Township. This clay strip is nearly plane.

September 20, 1902. 6:20 a.m.

Aneroid 28.920 = 1132 feet at Manton. I take train to Fife Lake. Aneroid 29.090 at Haire Siding. Aneroid 29.110 = 950 feet at Manistee River bridge, 30 feet ± above stream. There are knolls west of the railroad much of the way to the river, but they are low, 20-30 feet ± high. Till is exposed in ravines nearly to the top. On north bluff of Manistee River, till rises to the level of the railroad bridge.

Aneroid 29.050 at Walton Junction = 1011 feet. This is on a sand plain with jack pine forest. The altitude reaches 1050 feet within a mile north but the surface is plane and the jack pine still prevails.

Within the next mile, basins set in and the altitude is 1075 feet or more. Aneroid 28.970 at a lumber yard still on the plain and in a jack pine forest.

Aneroid 29.030 at Fife Lake in a basin 40 feet ± below upland. Aneroid 29.000 in the west part of village. There is a morainic tract in view from here about a mile northwest. I go southeast to line of Sections 7 and 18, Springfield Township, and take road east between those sections. It leads through a gently undulating tract with clay spots in knolls and wider swamps but it stands little if any, higher than the sand plain west of Fife Lake. That lake seems to be about at the level of the well-defined gravel plain. There is an undulating tract from Fuller's Lake, in Section 8, north into Bordman Township that stands 1050-1075 feet ±. Southeast of the lake is a strong moraine rising to 1125-1150 feet A.T. The aneroid reads 28.885 at corner of Sections 9, 10, 15 and 16. In 1/4 mile east, there is a descent of 85 feet to a swamp that is said to drain into a kettle hole in Section 9. Mr. Alex Harper, in Section 10, says that the natural course of drainage from there would be north to Boardman Creek. Section 10 has only low swells in the east half, and stands 1050-1075 feet. Section 11 also has low swells in south part, and there are small knolls.

Aneroid 28.980 at Ingersoll Lakes near corner of Sections 11, 12, 13 and 14. There is an undulating till tract all around these lakes, standing 10-40 feet above them. Aneroid 28.880 on hill near corner of Sections 7, 8, 17 and 18 = 1140 feet. Aneroid 28.950 at creek on line of Sections 9 and 16 near west end of line. The driver states that there are pine plains 1/2 mile south from here and they extend south to Manistee River.

Aneroid 28.830 on hill near east end of Section line of 9 and 16, Garfield Township = 1190 feet. This seems to be the highest point in this vicinity. The driver says this extends south to the river. Aneroid 28.840 at corner Sections 2, 3, 10 and 11, Garfield Township = 1170 feet ±. Aneroid

28.850 on hill 1/2 mile east. Aneroid 28.935 on Manistee bottom, in east part of Sections 2 and 11. Clay comes nearly to the surface in this bottom. Aneroid 28.980 at bank of Manistee; 29.015 at river level 1/2 mile west of Sharon = 1020 feet; 28.970 at Sharon. Cannon Creek enters from south just east of this Station and has clay banks. The clay is a stiff blue with few pebbles.

I go through a sand plain on road east from Sharon for 5 miles. It is through heavy pine (stump) land for 3½ miles. Then jack pine sets in. This is at an altitude of 1100 feet or more, and runs along the northwest edge of a range of hills that lies south of the Manistee River. It runs across the southeast part of T.26N., R.5W., in Sections 25, 26, 36, 35, 34, 33 and 32. Aneroid 28.900 at line of Townships 5W., and 6W., on plain.

Aneroid 28.860 at Dunpreys old headquarters in Section 8, T.25N., R.5W. This is among the morainic hills in a dry valley that opens northwest. The hills had a light growth of mixed Norway and white pine. There is jack pine in this valley. The drift is sandy gravel, much lighter soil than on the moraine north of Manistee River below Sharon. There are a few boulders in this small valley. Aneroid 28.835 at Dunprey's camp at 1:30 where it read 28.860 an hour ago. Aneroid 28.730 at east-west road on edge of hardwood forest.

Thomas Anthony outlined for me the extent of hardwood timber in T.25N., R.5W. It lies in Sections 17, 18, 19, 20, 29, 30 and 31 and stands about 1200-25 feet. It seems but little higher than the jack pine plain east of it. Wells on this tract are about 60 feet deep but on the jack pine tract in Sections 21 and 28, they are obtained at less depth, 35 feet ±.

I go west between Sections 20 and 29, 19 and 30, keeping a general level through the hardwoods. There is then a descent for 1/2 mile or more

through Norway pine forest to a jack pine plain. Aneroid 28.780. The plain is only a mile or less in width and there is a morainic tract on its south and west sides. There is a sandy gravel here with a moderate number of boulders. The timber was largely pine, both white and Norway.

Aneroid 28.700 on a summit near corner Sections 22, 23, 26 and 27; 28.920 at Cannon Creek on line of Sections 21 and 28, T.25N., R.6W.; 28.900 at Pere Marquette Railroad on general level of a sand plain. This level is maintained for about 3 miles west. I then descent to a swampy plain bordering the Manistee River on which the aneroid reads 28.980. Aneroid 29.000 at Manistee River in Section 27, T.25N., R.7W.

The moraine projects south into Section 28 nearly to the center in a narrow spar with a sand plain back of it that runs north in Sections 28 and 29, 20 and 21 into Section 16. There is a moraine south of the river only 1½ miles away in Sections 34 and 35. Aneroid 28.910 at east edge of pine plain east of township line 1 mile; 28.920 at line of Garfield and Springfield townships. Gently undulating till in Section 19 and north half of Section 30, Garfield Township (T.25N., R.7W.) There is some pine on a morainic tract in Sections 24 and 25. The knolls here are sharp and 20-40 feet high. Aneroid 28.800 on hill near west end of line Sections 24 and 25. The west half of these sections is generally high. Aneroid 28.940 at corner of Sections 22, 23, 26 and 27 at east edge of pine plain; 28.960 at swamp on line of Sections 22 and 27. There is a sandy tract with spots of clay west from here. Aneroid 28.920 = 1060 feet at corner Sections 20, 21, 28 and 29, on general level of gently undulating sandy till tract. There is pine here, but hardwood sets in a short distance southwest.

I turn northwest and reach the crest of the moraine near corners of Sections 17, 18, 19 and 20 at 1100 feet. Aneroid 28.870 at crest a few rods

southeast of cross roads. The moraine extends to within 1/2 mile of the lake in Section 18 and its west border lies within 1/2 mile or so east of the outlet from Fife Lake to the Manistee River. Aneroid 28.960 at Fife Lake Station = 1020 feet A.T. at 7:30 p.m. The lake is 17 feet lower, or 1003 feet A.T.

September 21, 1902. 8:20 a.m.

Aneroid 28.925 at Fife Lake Station= 1020 feet; 28.905 on sand plain in northeast part of village = 1038 feet A.T. This extends northeast into the southwest part of Section 6, Springfield Township, and southeast corner of Section 1, Fife Lake Township. The moraines meet in Section 6, Springfield Township, the earlier one having its inner border in Sections 6, 7 and 18, and the later one its outer border in Sections 6, 1 and northwest part of Section 12.

Aneroid 28.905 at head of sand plain in southwest part of Section 6. There are swampy tracts between here and the moraine in Section 7 that are lower, but, as noted yesterday, there are clay spots there. The sand plain has a sand with only a few pebbles. It is timbered with jack pine and scrub oak. It is deeply indented with basins near its head that have no outlet. Some of them contain ponds.

I go west between Sections 1 and 12, past several basins and ponds, coming to the edge of this moraine at the railroad. There are boulders and low swells in this northwest part of Section 12, Fife Lake Township. Hardwood timber covers the northwest corner of Section 12 and the part of Section 1 west of the railroad and a little in north part east of the railroad. It covers the north part of Section 6, Springfield Township. Aneroid 28.890 = 1050 feet at corner of Sections 1, 2, 11 and 12 on edge of moraine. Boulders are numerous along this outer part of the moraine. The drift is a

loose textured till. The topography is of the swell and sag type in these four sections and northeast from here to South Boardman and the highest points scarcely rise above 1100 feet and the lowest are 1000-1025 feet. In Sections 3 and 10 are sharp knolls that were timbered in past with pine. One, south of center of Section 3 60 rods, still has pine on it. Aneroid 28.860 = 1075 feet at corner of Sections 2, 3, 10 and 11; 28.750 = 1170 feet on hill south of center of Section 3. This commands an extensive view over the sand plain north of here in Union Township and beyond to Williamsburg moraine. The edge is only $1\frac{1}{2}$-2 miles away. It also commands a view of the moraine southeast of Fife Lake to its terminus at Manistee River in Section 11, Liberty Township, Wexford County. There is a knoll near center of $NE\frac{1}{4}$ of Section 10 that reaches 1150 feet. That knoll and this one are the only ones in this vicinity that reach such an altitude. These knolls seem to be largely a sandy gravel but near the base of the one in Section 3, springs issue and boulders set in at 1085 feet ±.

I go south past a lake at corner of Sections 9, 10, 15 and 16 through a tract with deep basins but with only a few swells or knolls. There is a nearly plane surface among the basins at about 1090 feet. There are boulders in north half of Section 10 and sharp knolls in the northeast part, but the south half has the basin topography. I go southeast across Section 15 to the G.R. and I. railroad at a lumber yard and find the plain shows a descent of 20 feet or more, the aneroid reading being 28.865 at lumber pile, 1070 feet, while it was 28.840, 1090 feet in northwest part of section. There are basins throughout Section 15. Aneroid 28.890 on plain in south Fife Lake Township = 1047 feet ±.

Aneroid 28.920 at Fife Lake Station= 1020 feet at noon. There are deep basins southwest of Fife Lake to the lumber yard, some with an area of

several acres. Fife Lake and a lake south of it are in basins.

George Davis, in east part of Section 9, Fife Lake Township, has well 194 feet that has 100 feet of water:

(1)	Sand	60 feet
(2)	Quicksand	60 feet
(3)	Red Clay	70 feet
(4)	Gravel	4 feet
		194 feet

At Brower's Quarry -- Fife Lake -- the well is 64 feet. Doctor Blue, in northeast corner Section 11, has one 78 feet. It has 33 feet of water. It has sand and gravel, except 6 feet of blue clay at bottom. One at lumber yard, 2 miles southwest of Fife Lake, is 77 feet -- all sand. Wallace Blue, at center of Section 7, Springfield Township, has a flowing well 22 feet deep. It is in a sag. There is another, 63 feet deep, at an old sawmill in west part of Section 17. It flows in a wide stream. The land there is not very low. At Walton, wells are only 30 - 35 feet deep. In Fife Lake village, in the high part of town, clay is struck (blue) under sand at about 30 feet. Some wells get their supply above the clay but the best wells go through the clay 15 - 18 feet to gravel.

September 22, 1902. 6:30 a.m.

Aneroid 28.870 at Fife Lake, 1020 feet. I take train to Boyne Falls. Aneroid 28.780 at summit in Section 31, Boardman Township, just south of a switch and lumber yard = 1100 feet; 28.900 = 1002 feet at South Boardman. The moraine directly west 1/2-1/4 mile is 50-60 feet higher.

There is a gently undulating tract with swells 10-20 feet high, mainly sandy, along the railroad to within 2 miles of Kalkaska. There is then a flat swampy tract to Kalkaska. North of Kalkaska is a sand plain timbered with jack pine. It has dry channels running east-northeast - west-southwest south of Leetsville, also basins, and this altitude is 20

feet higher 1-2 miles south of Leetsville than at that station. Aneroid 28.840 on pitted plain. Aneroid 28.860 at Leetsville. There is a steep bank or bluff where the drop is made 1/2 mile south of Leetsville, and this bank runs northward parallel with the railroad and scarcely 1/2 mile distant to Rapid River. North of the river, outside the river valley which is quite deep and narrow, there is a bluff to the west as well as east. It runs northeast across the northwest part of Section 15. I can see it but little farther north. The pine gives way to hardwood north of Rapid River, both on the plain and moraine.

Aneroid 28.830 at Westwood = 1088 feet. From here north to Alba, I have made notes on earlier trips. The railroad is near edge of moraine for two miles north-northeast of Alba, but at Clyners, the plain extends at least 1/2 mile west, and possibly a mile. The moraine east of this plain is 1½ miles ± distant at Clyners. Aneroid 28.730 = 1197 feet at Clyners. There is so much forest that I can get but little insight into the country bordering the railroad from here to Elmira. There are a few low swells 10 feet ± high along the railroad, 2-3 miles southwest of Elmira. From there to Elmira there is a cleared tract, and I can see the west border of this plain about a mile west of the railroad. The plain covers much of Sections 23, 24, 25 and 26, 35 and 34, Warner Township (T.31N., R.5W.)

Aneroid 28.690 at Elmira = 1233 feet. There are deep basins both south and north of Elmira at the head of the gravel plain. The plain only extends about a mile northeast of Elmira, as noted August 4. The valley down which the road runs widens out in Section 2, T.31N., R.5W., and the railroad skirts along its east edge from there north to Boyne Falls. The width of the valley is a mile or more, and it is largely a cedar swamp. It stands 1,000 feet ± A.T. at southeast part of Section 2, Warner Township (T.31N., R.45W.). Hills set in near west side of track, ½ mile distant a mile or so south of Boyne Falls.

Aneroid 29.270 at Boyne Falls at 8:45 a.m. = 711 feet A.T.; 29.250 at 9:15 a.m. I drive west from north part of town through a plain that seems to descent 20 feet, or about to Lake Algonquin level, in a mile. Aneroid 29.270 at a railroad crossing on line of Sections 8 and 17 = 695 feet ±. There is a flat tract of sand here, bully a mile wide, leading west to Pine Lake. Southwest of this is a range of high hills with some points fully 950 feet A.T., that lies between this valley and Deer Lake. It trends northwest-southeast.

I ascend a hill in southeast part of Section 7 that stands 940 feet. Aneroid 28.990. It commands a view south into the edge of Antrim County to the high hills of Warner Township, T.31N., R.5W.). There is a range of hills, fully as high as this, north of Boyne Creek. The altitude of 950 feet is found as far southeast as Section 32, T.33N., R.5W., and seems to be maintained on the knobs for several miles northwest, or to the north edge of T.33N., R.6W., in Sections 4 and 5. There are sags that fall below 900 feet along the crest and so there are on this range that I am on, the summit on the road at corner of Sections 7, 8, 17 and 18 being only 860 feet. This ridge is bouldery and has sharp knobs on its slopes as well as crest.

There is a high hill west of Deer Lake but it extends no farther south than the lake, there being an extensive cedar swamp south and southeast from there. Aneroid 29.250 at Deer Lake = 720 feet. A swamp 1/4-1/2 mile or more in width, runs west from the north end of Deer Lake into connection with the swamp that I crossed south of Advance. Aneroid 29.220 at the swamp. There is a range of hills south of it, as well as north. I can see this range running west to where I come into it south of Advance.

I go north in Section 11, Wilson Township, and reach the summit in road

in a low gap near the north side of the Section. Aneroid 29.130. A high range lies northeast of here, 100-125 feet above this level. Aneroid 29.270 at the Algonquin shore, 80 rods from north end of line of Sections 2 and 3 at base of a cut bank = 680. Algonquin shore 680 feet ± near Boyne Falls. Aneroid 29.300 at a sandy ridge at township line, corner Sections 2, 3, 34 and 35 = 655 feet ±. It is fully a mile west to where the Algonquin shore, as a cut bank, crosses the township line and it runs across Section 2 about 80 rods south of the north line. Aneroid 29.070 at base of the cut bank south of business part of Boyne City, probably the Nipissing beach.

Aneroid 29.385 at Pine Lake = 580 feet. Aneroid 29.360 at Pine Lake at 12:45 p.m. I go southeast in Section 35, rising from 595 feet up to 635 or 640 feet on a steep bank that probably marks an old level of Pine Lake at its base. Aneroid 29.260 at level of Lake Algonquin at base of moraine. I go along town line west to where I came in between Sections 2 and 3, and return south on same road. Aneroid 29.100 at summit in north part of Section 11 = 800 feet; 29.195 at swamp in southwest part of Section 11 = 720 feet A.T. I continue south into the range of hills south of this swamp, and reach an altitude of 980 feet. Aneroid 28.900 at top of hill in southwest part of Section 14. This range runs southeast and points in it may reach 1,000 feet. I turn west through center of Section 22 through a strongly morainic tract. Aneroid 28.940 at summit, 40 rods east of center, = 951 feet. This moraine has knolls 10-50 feet or more high. It carries a moderate number of boulders, many of them small. The drift is loose-textured but is good farming land, where cleared. Section 23 belongs to White, the lumber man of Boyne City, and is not cleared. This has a high ridge running northwest-southeast into, if not through it, the west end of which I crossed in southwest part of Section 14.

I turn south at line of Sections 21 and 22, and come to Deer Creek

valley at the east-west road by the town hall. Aneroid 29.210 at town hall. The road from here to Deer Lake keeps on the border of the valley at base of morainic hills. I go south across Deer Creek swamp between Sections 27 and 28. Aneroid 29.240 at the swamp = 675 feet ±. The swamp is less than 1/2 mile wide here, but there is a narrow slope with smooth surface on each side of the swamp, giving the valley a width of over a mile east from here, but west from here, it is a narrow valley, 1/4-1/2 mile (see map).

I go east to the township line between Sections 27 and 34, 26 and 35, 25 and 36. The north half of Section 34 is nearly all in the valley and the NW¼ of Section 35 is also. The moraine swings north and crosses the southeast corner of Section 26 and covers fully half of Section 36. It covers the southwest half of Section 30 and west half of Section 31 as far as Warner Creek, but east of the creek is a swamp that covers parts of Sections 30 and 31 and much of Sections 29 and 32 and runs farther east and south to the G. R. & I. railroad, as noted this morning.

Aneroid 29.210 at Deer Creek, in Section 25, Wilson Township, in a cedar swamp. Aneroid 29.180 at state road in Section 24, at base of moraine. Aneroid 29.200 at Deer Lake. There are very prominent hills west of Deer Lake, near the southeast end of the range that I crossed, south of Boyne City in Section 14, Wilson Township, and some points reach about 1,000 feet A.T. Aneroid 28.830 = 1,040 feet on hill west of Boyne Falls, where road turns northwest. Aneroid 29.195 at Boyne Falls = 711 feet. The hill runs south about to the south side of Sections 20 and 21, T.32N., R.5W., and is prominent to within 1/2 mile of its south end. The west slope has some low knolls and is more gradual than the east, so it is cultivated in Sections 19 and west part of Section 22. The swamp or valley in which Boyne Falls stands is only 3/4 mile wide at the village, but widens out both north and south.

September 23, 1902. 7:00 a.m.

Aneroid 29.200 at Boyne Falls, 711 feet; 29.225 at roundhouse of railroad, 1/2 mile north. It is probable that Lake Algonquin reached to here and covered a swamp that sets in here. There is a bank east of the roundhouse 20 feet ± high, that may mark the edge of Lake Algonquin. Another drop of 10 feet is made to the swamp just west of the roundhouse. The swamp extends north along the railroad and it seems quite probable that Lake Algonquin surrounded the hills north of Boyne Creek.

I go east two miles on a lowland tract bordered by hills in the south, about 2/3 of Sections 14 and 15 being on the hills, and the north 1/3 on two plains. Aneroid 29.185 at corner of Sections 11, 12, 13 and 14, on the plains. Section 12 is nearly all morainic, with hills 100-200 feet or more above the lowland west of them. The lowland extends east up a creek through north part of Section 13 and southeast of Section 12, south part of Section 7 and north part of Sections 18 and 17, being 1/2-3/4 mile wide and rising to the east quite rapidly. It is bordered by high hills both on the north and south. I go north between Sections 11 and 12 along west edge of the hills. Sections 2, 3, 10 and 11 are on the lowland tract, except a few projecting points of high land on east edge of Sections 2 and 11, and about 40 acres in northwest corner of Section 2 that is at south end of a ridge that runs north into Sections 14 and 15, T.33N., R.6W., covering a considerable part of Sections 22, 23, 26, 27, 34 and 35.

Aneroid 29.230 at swamp in Section 26. The drainage is north from here, but the swamp is continuous south to where drainage is southward to Boyne Creek. The hills west of this swamp in Sections 23 and 26 reach fully 900 feet A.T. I go east through center of Sections 25 and 30, rising to a point about 900 feet A.T. Aneroid 29.000. The ridge is much higher farther south.

This is probably in east part of Section 25. The ridges and knolls do not extend quite to the north side of these sections. I turn north at middle of line of Sections 29 and 30, Chandler Township, and soon descent to a swamp. Aneroid 29.200.

Aneroid 28.955 at Cobb and Mitchell's Station, south side of Section 2 = 940 feet ± A.T., Springvale Post Office, at 11:00 a.m.; 28.970 at Springvale at 12:20 p.m.; 28.930 on knolls north, near center of Section 2; 28.970 in basin at north side of Section 2, by school house. There are sharp hummocks in Section 2, with cobbles and small boulders on them. Aneroid 28.900 on hill in northeast corner of Section 2 = 1,000 feet.

The southeast corner of Section 36, and parts of adjoining sections, are on a lower plain than that at Springvale. Aneroid 28.910 = 890 feet ±. This valley runs north several miles up the Cobb and Mitchell railroad and is said to rise northward. It is a dry valley, no stream showing where I cross it near the county corners. It is 1/3 of a mile ± in width. I continue east, rising to upland near east end of line of Sections 6 and 31. Aneroid 28.865. I cross a small basin and then rise to a high ridge. Aneroid 28.770 = 1,100 feet ± A.T. It is an elevated upland for 2 miles or more east from here, or about to the Michigan Central railroad.

Aneroid 28.825 at cross roads, corner Sections 5, 6, 31 and 32. I here turn south and swing southeast to corner of Sections 5, 6, 7 and 8 at a school house on edge of a valley. Aneroid 28.985; 29.005 at a swamp at intersection with east-west road on line of Sections 7 and 8. There is a ridge between this valley and the swampy one in which the railroad runs west of here. Aneroid 28.910 on crest on wagon road in northeast part of Section 7; 29.000 at railroad by a camp in southwest part of Section 6, in the swamp. I go west, rising to a summit at a clearing and house in Section

12. Aneroid 28.810 = 1,070 feet ±. There are hills nearby 30-40 feet higher, or fully 1,100 feet. Aneroid 28.960 at Springvale at 2:15 p.m. = 940 feet ±.

Aneroid 28.910 at south edge of plain south of Springvale 1/2 mile, where morainic hills set in. Is it not likely that this slope was washed to a plain by border drainage that kept working to lower levels as the ice shrunk to the north? The absence of definite terraces may oppose this view. The angle between the Huron and Michigan lobes seems likely to have been at the curving part of this channel in Section 1, Chandler Township.

Near the south line of Section 11, Chandler, I reach the top of a high hill. Aneroid 28.710 = 1,170 feet ±. Parts east of the road are 20-25 feet higher. Aneroid 28.650 = 1,220 feet at a school house in south part of Section 14. This high upland is thickly strewn with boulders, has considerable till at surface, and has slopes gentle enough to be cultivated easily. Aneroid 28.730 = 1,150 feet at east line of Section 14 - 1/4 mile from south end; 28.685 = 1,190 feet at corner Sections 13, 14, 23 and 24. A knoll 30 rods southwest is 40 feet higher, and 80 rods south from it, the altitude is fully 1,250 feet. Aneroid 28.670 = 1,200 feet at corner Sections 23, 24, 25 and 26; 28.680 = 1,190 feet ± where a descent begins, 80 rods north of corner of Sections 25, 26, 35 and 36. The surface is hummocky in much of Sections 23, 24, 25, 26, 35 and 36, with little knolls of 1-2 acres among larger knolls, and on the slopes of larger knolls boulders are numerous. Aneroid 28.700 at corner Sections 25, 26, 35 and 36. It is 20-25 feet higher 20-30 rods west. Aneroid 28.780 = 1,100 feet at a basin near middle of line of Sections 35 and 36.

Aneroid 28.680 = 1,190 feet on hill north of east end of Thumb Lake at 3:50 p.m. There is a lower tract southeast from this lake than in any other direction, but there are knolls bordering the lake on that side. It is said

to be more level southeast from here, in Section 7, Corwith Township, and rather sandy. Aneroid 28.800 at cross roads at southeast end of Thumb Lake. There is a basin tract east and southeast from here, with little lakes in it. Aneroid 28.815 at west end of Thumb Lake at 4:30 p.m. There is a hill south of Thumb Lake near line of Sections 11 and 12 that reaches 1250 feet, and perhaps 1300 feet. Aneroid 28.720 at railway summit about $1\frac{1}{2}$ miles west of west end of Thumb Lake in a sag between hills that rise in the north fully 75 feet higher, and in the south, 100 feet or more.

Aneroid 28.950 at place where wagon road crosses railroad at a switch, probably in Section 8. There is a confluence of several ravines about 1/2 mile east from here, and there is a lowland tract from there west 1/2 mile or more wide, between the high hills. Aneroid 29.000 at school house about 1 mile farther west, at line of Sections 7 and 8. Boulders are very numerous in parts of this low tract. Aneroid 29.170 at corner Sections 11, 12, 13 and 14, where it read 29.185 this morning; 29.210 at crossing of creek in a swamp on line of Sections 10 and 15, near east end. The swamp is 50-60 rods wide, and has banks 15 feet ± high. Aneroid 29.200 on upper bank at cemetery 1/2 mile north of Boyne Falls. This is 15 feet above the railway and Cobb and Mitchell's roundhouse. Aneroid 29.215 at swamp at roundhouse. This is 4-5 feet lower than the roundhouse. Aneroid 29.190 at Boyne Falls, 711 feet, at 6:00 p.m.

There are no flowing wells here, but in some cases, wells 30 or 40 feet deep have flowed. Charles Crates, in south part of village, has one 27 feet that nearly flows.

September 24, 1902. 5:00 a.m.

Aneroid 29.360 at Boyne Falls, 711 feet. I take train north on G. R. and I. railroad. Aneroid 29.390 at roundhouse = 685 feet ±. North from here for 1-1½ miles, there is a sandy plain separating the Boyne Creek drainage from the Bear Dreek, and on this, the aneroid reads 375-380 feet. A swamp is then entered that drains to Bear Creek, and the aneroid reads 29.400-29.410 from there to Clarion.

Aneroid 29.430 in Bear Creek valley, south of the barrier beach in south part of Petoskey. Aneroid 29.410 where the railroad passes the beach 6-8 feet below the crest. Aneroid 29.445 at Petoskey Station.

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