Field notes of Frank Leverett; Notebook no. 283 (1924, 1932,

Notebook No. 283 - Leverett

COUNTY

OTHER STATES

ODDMENTS

DR. LEVERETT'S NOTEBOOK NO. 283

Read in June 1932 and marginal notes made.
Michigan data on pp 32-91

Kentucky, July 15-31 and Sept. 11 & 12.
Michigan, August 15 to Sept. 2; Alpena and Roscommon counties.

Worthville, Kentucky, July 15, 1924. An. 29.835 - 478' A.T. at level of the Wisconsin stage filling on Kentucky River. Backwater fill with clay. About 1/2 mile N. of the L&N RR bridge across Kentucky River I ascend to a remnant of a rock shelf at 620' which is also present at similar altitude between ravines to the N. and which may represent an old fluvial plane. On its slope I found limestone rounded pieces 6" or less in longest diameter and 1 - 2" thick.

There is an extensive recess E. of here in which the rock surface is not much, if any, above 700'. Much of it is about 650'. Around this is an amphitheatre of higher upland with bluff-like rise. This high upland is probably about 850'. There is a ridge W. of the river opposite mouth of Eagle Creek that has a rather even crest and is fully 850'. It runs N. to English.

The clay of Wisconsin age has pebbles of all sorts in it on an exposure opposite the rock terraces just noted. Some white quartz pebbles, a few quartzites 2" or less and rounded limestones up to several inches in diameter. It is highly calcerous with lime crusts and balls in its exposed slopes. I left the Kentucky valley at mouth of White's River and went a mile up the creek, then N. on a poor road up to the uplands, at about 680'.

Drift East of Kentucky River

I find a coating of till or clay with small pebbles of granite, quartzite and quartz. The deposit is only 2-5' thick, but a farmer living here on E. side of the road says he has seen a lot of them on his farm for 1/4 mile farther S. than the exposures by the road. He does not recall seeing

any boulders or any stones much larger than his fist. His house is 40-50 rods S. of a Pike that comes in from Easterday in a SW course. I followed this pike westward into Kentucky valley about a mile from the place where I noted the drift pebbles. This road comes into Kentucky valley just S. of the morainic ridge that bridges the gap in the S. bluff of Ohio River. It rises onto the moraine about 1/2 mile W. and follows the S. slope W. to the rock hills that lie S. of Carrollton.

Moraine East of Carrollton, Kentucky

This moraine is scarcely 1/4 mile wide, is hummocky and has a relief of 30-50'. Its slopes are rather steep. I saw no boulders on it - the coarsest pebbles being 4-5" in diameter. It runs into the isolated rock hill E. of Carrollton and till is plastered on the NE & SE slopes of the projecting rock spur over which the highway passes. The rock spur does not extend more than 60 rods NE of this highway. The railroad runs around it.

Drift Near Winona

I went W. from Carrollton in the afternoon to the highway that runs up Locust Creek and then up this creek valley past Locust P.O. taking the west fork of Locust Creek from there to within a few rods of the Trimble County line. I then go E. 1/2 mile and turn S. on the road to Winona. Just before I come to the Trimble Co. line I passed a nest of boulders in a gully on SW side of the road which has had its alluvium recently washed away so as to expose them. There is a jasper conglomerate fully 2' in diameter and 2 small quartzite boulders a foot or less. The aneroid makes the altitude 750' here. I see several exposures of pebbly clay between here and Winona with small quartzite pebbles and possibly other erratics, also white quartz pebbles. These are present clear to Winona.

Driftless Divide 850 - 920'A.T.

I went E. past Monitor but saw no drift after I left Winona. I turned N. at a church and took a ridge road that runs on the divide between

Notch Lick and Locust Creek drainage but do not see any signs of drift along this divide. The divide is 850' by aneroid where the road turns from it to descend to Notch Lick Creek about 2 miles from the Ohio River. The aneroid read 920' at Monitor and also at a summit N. of Winona. These are exceptionally high points but few others being over 900'. I am told by a man who lives on the highway that runs N. from Bedford to the Ohio that the surveyors made his place 947' when running a survey along the highway. It is about 4 miles N. of Bedford. They told him there was a slightly higher point between there and Bedford.

Limits of Drift

It now seems probable that the glacial drift does not extend quite to the N. side of the Locust Creek drainage but may cover the creek itself clear down to the river. The creek has a broad alluvial flat clear up to Locust and the valley of the W. Fork is surprisingly high clear up to the Trimble Co. line with cultivated fields in its bottoms. The other branches are narrower.

Bluffs below Carrollton

There are very prominent bluffs about 400' high on the Indiana side opposite the mouth of Kentucky River and for 2 or 3 miles below. There a wide open creek valley makes a break 1/4 mile or more in width. The wide bottoms are on the Indiana side from mouth of Little Kentucky River to mouth of Locust Creek but are on the Kentucky for the next 10 miles below. There is a bluff between Kentucky and little Kentucky which rises promptly 250-300' but has a sort of terrace there with rise back 1/4 mile or so to the upland level, about 800' A.T.

Discharge down Ohio River from the fluvial plain below 700'.

July 16, 1924, Carrollton, Kentucky. Aneroid 29310 - 470'+_ at P.O. 7:30 A.M. There is a terrace 20' lower on which much of the business part of Carrollton stands. I ascend the bluff at SE edge of Carrollton and

find it 800' by aneroid 28.915 inches???. From here I can see a well defined terrace along west side of Kentucky valley from a point a mile S. of Carrollton NW to the Little Kentucky which seems likely to be an old fluvial plane of the river. It is between 650 and 700' A.T. E. of this gap in which the moraine stands the bluffs are about 800' and very precipitous on the Kentucky side.

On bhe Indiana side there is a narrow terrace about opposite this gap that is 650-700' but for 2½ miles from a point opposite Carrollton both upstream and down the Indiana bluffs are generally up to 800' or more. On the Kentucky side the bluff is high between Little Kentucky and Notch Lick Creek. But there is a terrace at 650-700' on W. side of mouth of Notch Lick Creek.

The southern part of this isolated tract of hills SE of Carrollton on which I am standing embracing more than half its area is only 675' and seems to have been formed by the Kentucky River in a loop that doubled around its S. end from the NE and then run NW along the present stream course. This feature favors the view that the river discharged down the present Ohio and not to the NE. The enlarged Ohio has cut away most of the terraces on its borders but the Kentucky has not done so. I saw no drift on the high part nor on the 675' shelf. The ice sheet seems to have touched only the NE par point of this group of hills.

The Carroll County map seems to be in error as to position of dam and lock No. 1. They are only 1/2 mile W. of the Carrollton - Northville pike, instead of 1½ miles. On the flat plain E. of the river above Dam No. 1 wells in some places strike a vein of water at moderate depth 20'+ but usually the clay is compact and water tight. So most of the people use cisterns. The clay contains small, angular limestone blocks as well as rounded pebbles of various kinds of rock.

Ohio River Gravel

The Ohio River gravel has a large percentage of blue limestone pebbles probably 75%. The rest are a variety of rocks, quartzite, granite greenstones, white quartz, etc. I went up to Worthville along the highway making notes as to pebble contents in the clay, etc.

Glacial Boundary East from Carrollton

This clay is evidently a slack water deposit. It seems to fit the Wisconsin level and to show a similar degree of erosion to the Wisconsin. I am wondering if the "moraine" is merely a remnant of Illinoian filling and an erosion ridge instead of constructional form. The absence of boulders favors a water deposition but the ice appears to have reached about to this line or it would not have extended as far south on the uplands SW of Easterday as I found drift pebbles yesterday.

I went by auto to trace drift border eastward from where I found it yesterday. The drift west of White's River is in a lowland about 680' A.T. The higher land opposite there on E. side does not seem to have any drift. I come into drift on E. side a short distance No. of mouth of Wolf River. There is a gravelly soil here up to 50-60' above the creek level. This kind of drift runs for a mile No. I am told by the owner of the land but it extends only a short distance E. of White's River up to the forks E. of Easterday. It does not extend up the E. fork more than a mile from Easterday. It then runs NW.

Drift near Shoofly

I come into it about a mile S. of Shoofly just No. of the divide between Eagle Creek and the Ohio Valley. Drift pebbles are numerous in the creek bed at Shoofly and I find drift for 2 miles E. from there to forks of road at head of Stevens Creek. There are a few small pebbles in gullies in

a field S. of this road intersection.

Backwater to Sanders

I do not see any drift along the highway E. from here on road to Bramlette on a small tributary of Eagle Creek. I came to Eagle Creek valley at Sanders and went down it to Worthville. The valley is remarkably large for so small a stream the bottoms being 1/2 - 3/4 mile wide. The bluffs are prominent and rise abruptly to about 800'. Sanders is on a filling of clay similar to that at Worthville and only 10' higher, the station being 488' while Worthville is 478' A.T.

Features near Glencoe, Ky.

July 17, 1924. Worthville to Glencoe, Ky. on L&N RR. Eagle Creek valley maintains exceptional width clear up to Glencoe being usually over 1/2 mile and in places 3/4 mile between bluffs. At Glencoe it makes an oxbow bend and the village is on a terrace in the inner curve of the bend about 20' above the broad low bottoms. There is rock under this terrace at 10 to 15' in several wells and cisterns and I find it outcropping at the S. end of the terrace. The depot at Glencoe is 541 and at general level of the terrace. The stream is fully 40' lower than the depot or about 500'. There is a recess in the No. bluff No. of Glencoe with remnants of old islands in it about 600' A.T. both to the NE and the NW of the village. The present creek has muddy bed and banks here and a stage of water high enough to cover any rubble in its bed. In the old channels back of the islands just noted there is deep alluvial filling "made land" as the residents call it. These channels No. of Glencoe have beds about as high as Glencoe station, I should judge, without having run levels to them.

Drift North of Glencoe

There is a low gap at road intersections a mile No. of Glencoe which Dr. Jellson found to be about 700' A.T. It is a narrow notch and there

is a rise of fully 100' both E. and W. from it to 800' along the divide between the Ohio and Eagle Creek. There seems to be an amphitheatre of hills passing across the present northward drainage 1/2 - 3/4 mile No. of this divide which is likely to have once been the divide but which has been trenched by No. flowing streams that captured the small stream that drained S. from it to Eagle Creek. I took the road leading No. from this gap and within about 1/3 mile I came to drift pebbles and boulders, quartzite boulders and granite and greenstone pebbles. A boulder about 20" in diameter is in the bed of the little stream just below where the stream curves to W. side of road. One 10" across and 3-4" thick was found about 60 rods up the creek in the bed near a gate at E. side of road and there I saw granite and greenstones 3-4 inches in diameter. There are a few small quartz pebbles in a clay wash still nearer the divide.

Old Fluvial Plain (pre-glacial) 700'+ -.

I went up a SW tributary of this creek that comes in about a mile from the present divide and found many quartzite stones up to 6 or 8" in diameter and also much bronzed chert well rounded that probably has been let down from a late Tertiary stream bed which I find runs past here. The old valley comes in from the NE and curves around to the W. to follow the Warsaw pike from the head of Dry Creek. I have it in view for a space of 4 or 5 miles. It is 1/3 mile or more wide and has steep bluffs on outer curves and gentle slopes on inner curves. It is 75-100' lower than the high divide S. of head of Dry Creek and not far from 700' above sea level. There are white quartz pebbles and bronzed cherts as well as small rocks of glacial derivation on it from the head of Dry Creek northeastward. I saw no boulders close to the head of this creek but quartzites are present 1/4 - 1/3 mile down the NE flowing drainage line that I came up and are 6-8" in diameter. I was unable

to find any drift on the No. slope of the divide near head of Dry Creek above the level of this old valley, nor did I find any along the divide between there and the gap No. of Glencoe.

Limits of Glacial Deposits

July 18, 1924. Glencoe, Ky. I go NW on the road that follows a ridge on SW side of Dry Creek valley. It seems to be driftless for 2 miles. I then pass a few pebbles on slope of rock hills that may have been brought in with road material. Where the road turns W. for 1/4 mile toward a tributary of Craig's Creek it descends to a valley that covers drift pebbles in abundance. It is about 1/3 mile wide and crosses from Dry Creek to Craig's Creek.

Old Fluvial Plain

It seems to be a continuation of the one I noted yesterday as running down Dry Creek. There is some question of its continuing down that Creek to the Ohio. Although no prominent land cuts it off, below where this valley runs W. from Dry Creek to Craig's Creek, it may have had a barrier there high enough to cause the course of drainage to be westward. Or perhaps the drainage went both ways, i.e., to Craig's Creek and also down Dry Creek to Ohio bottoms. The drift pebbles include granite and grunstone?? greenstone?? but are chiefly quartzite and quartz. The matrix is a loose textured material more porous than the residiary clay soils.

Till and Pebbles

I see only a few pebbles on upland No. of the valley that runs from Dry Creek to Craig's Creek. I passed one small grunstane?? 8-9" in diameter and at side of road.

On brow of bluff overlooking the Ohio S. from where Dry Creek runs in the valley there is some till with loess 6-7' thick over it.

Scanty Drift near Napoleon

There is not more than 5' thickness of till anywhere that I noted. The bluff here is high probably 800' A.T.

The Ohio is in a valley 2 miles wide in vicinity of Warsaw. The bottoms on the Ky. side are a mile or more and there is some on the Indiana side which together with the stream occupy a mile's width. Below here near Etheridge the river runs close to the bluff on the Ky. side.

I take the road toward Napoleon. This goes up in the bluff near place where the Glencoe road branches off and gets to an alt. of fully 800' A.T. There is very little drift on this upland, probably little besides scattered erratics. I passed a place that looks gravelly with a pit in it about 4 miles out from Warsaw on S. side of road.

In the creek bed above 3/4 mile W. of Napoleon I find erratics and bronzed gravel. This is where the old valley that I noted yesterday comes in. I could see it to about this place from the high ridge 2 miles W. of Glencoe. I am told by a farmer that the pebbles are very numerous on the bluff W. of this creek (Sugar Creek) N. of the road. I came down at an alt. about 150' above the creek. There seems to be very little drift E. from Sugar Creek on road to Napoleon and I find none on the ridge road leading S. from Napoleon nor around Napoleon. I came into Eagle Creek valley 1½ miles above Glencoe. It is only 1/3 mile wide here, while at Glencoe it expands to over a mile wide, but is 1/2 - 2/3 mile wide below Glencoe. Its flood plain is a clayey alluvium - with little or no sand or gravelly material so far as I have seen from the mouth up to here. The No. flowing part of Eagle Creek has a valley 1/3 mile or more wide where it comes to the RR 2 miles above Glencoe.

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Drainage Features

July 19, 1924. Glencoe to Zion, Ky. The RR runs up Ten Mile Creek and this has a relatively narrow winding valley in vicinity of Zion. There seems to be nothing here to suggest a former NE continuation of Eagle Creek. The points in the bends are nearly up to upland level which is over 800' A.T. But Flat Creek which comes into Ten Mile at Elliston Station 2½ miles below Zion has a broad valley much like that of Eagle Creek. I come into this broad valley about 2 miles NW of Zion near the line of Grant and Gallatin Cos. There is an alluvial clay 15-20' thick at E. side of the valley in which iron balls and crusts occur. This valley is at least 100' below bordering uplands and 1/3 - 1/2 mile wide here near the county line. This valley is interrupted by swells on the divide between Flat Creek and Walnut Lick Creek but there are passages around these swells 60 rods wide as low as the broader flats to the S. and No. The flats have some laminated clay under the white clay with iron balls.

The general width of the valley is about 1/2 mile and its borders are very definite with bluffs about 100' high. The valley is about 700' A.T. I followed Walnut Lick Creek to the junction of 2 forks 2 miles W. of Munk. There is a rather broad flat on the E. fork in harmony with the broad valley, I am tracing, but only about half as wide. This extends across the divide to Ten Mile Creek at Munk. The flat here is only 60-80 rods wide. The gullying on the Ten Mile Creek side is deeper than on the Walnut Lick side which seems to favor the idea that the head of this branch of Walnut Lick Creek has been captured by Ten Mile Creek. I came back by auto to Glencoe on a pike that intersects the one from Leon a mile No. of that station and

on which I travelled for 3 miles this morning. It then runs SW to within 1¼ miles of Elliston on a high ridge and follows that ridge NW to the pike NE of Napoleon a mile. From there I came on yesterday's course toward Glencoe. There are fine views SE of Napoleon of the valley I have been tracing today from Eagle Creek at Elliston northward to Walnut Lick drainage. It looks to be as broad as Eagle Creek and much broader than Ten Mile Creek. That Creek is said to be 10 miles long, hence the name.

July 20. Sunday. I went up on the No. bluff of Eagle Creek a mile W. of Glencoe and find it 800'. On the slope I passed a small angular piece of weathered grenite about 3" in diameter that suggests the extension of ice to here. It is in a hillside pasture. Possibly it was carried up there from the RR but it does not look like Ohio River gravel and is up 100' above the RR and 300'+ - away from it.

Eagle Creek valley is narrowed to less than 1/2 mile at this bend a mile below Glencoe but widens out below to over 1/2 mile. It is not so narrow at this bend as it is a mile above Glencoe. There it is only 1/4 - 1/3 mile between bluffs.

Abandoned Valley near Elliston

July 21, 1924. Glencoe, Ky. I went by auto up Eagle Creek valley to the bend where Ten Mile Creek comes in. I here ascend to W. bluff of Ten Mile Creek and find a wide open valley coming in from directly No. past Elliston that is about 150' above the streams at their junction or at least 650' A.T. There are remnants on E. side of mouth of Ten Mile Creek, a church being on one at place where a highway runs E. from the mouth of the Creek. This valley is at least 1/2 mile wide at this level of 650' but Eagle Creek is 3/4 - 1 mile wide at similar altitude. I am, therefore, inclined to think this is the valley of a smaller stream than Eagle Creek.

Valley near Big Bone Lick

We went to Elliston and then Northward on uplands W. of the abandoned valley to the head of Paint Lick Creek. This creek follows the course of an old high level valley from source to mouth which is 1/3 - 1/2 mile wide. This valley seems to be more wide open to the NE to Big Bone Creek than to the SE on S. Fork of Big Bone or Walnut Lick Creek. I find there is a valley around the bend of Walnut Lick past Ryle. This place Ryle is 3 miles or more SE of the place indicated on the Gallatin Co. map but its terraces are well defined only a little beyond the place where the creek turns W. at Ryle, the part on which the name "Big South Fork" appears on the county map. This may prove to be the place where a divide has been cut through. There was a shower came on as I got to the head of Paint Lick and we turned down that valley instead of working out relation to the Big Bone valley NE from here.

High-Level Gravel (pre-glacial)

I found bronzed cherts and geodes in abundance along Paint Lick Creek but did not note any glacial material in its stream rubble. In my studies years ago I carried this drift border near the mouth of Paint Lick Creek and the observations today seem to sustain the old mapping. I went up Sugar Creek valley to the Napoleon and Warsaw pike and found that remnants of the old high-level fluvial plane occur all along this lower 2 miles.

Drift near Sparta

I went W. on the pike toward Warsaw to intersection with the Warsaw-Sparta pike and followed that to Sparta. I found drift pebbles numerous all the way up the creek and also on the upland in vicinity of the divide between the Ohio and Eagle Creek. I found them in the gullied slopes W. of the road just N. from a cross road 2½ miles from Sparta. This gullied

slope is drained N. for 1/2 mile and there the drainage whichever went on N. to the Ohio has been captured and taken SE by a tributary of Eagle Creek. So the pebbles are found up about to the old divide. This is considerably higher than the present divide. The pebbles found near the divide are of several classes and some show glacial planing. The largest noted are about 6" long and 2-3" in other diameters. White quartz pebbles of all sizes from a pea up to hen egg, are abundant here. I found the geodes and chert abundant in lower course of Craig's Creek where the high-level fluvial plane comes in.

Old Fluvial Planes 675-700-?

July 22, 1924. Glencoe, Ky. I took train to Walton and set aneroid at 588' at Elliston. It read 700' at Munk and 850' at Venna??Verona?? or 12' lower than Venna alt. 862'. It read 900 at Walton instead of 912'. I infer that the old valley by Munk is about 150' lower than Venna or 912' A.T. This is considerably higher than the high level fluvial plane on Walnut Lick Creek 2 mi. W. of Munk. That may not exceed 675'. The highest land in Walton is about 925'.

Old Drainage near Big Bone Lick

I went W. to Beaver Lick on foot looking carefully for traces of glacial drift but found none. I continued toward Big Bone a mile and then examined a lot of gullies on upland N. of the road. I found a single quartz rock about 1½" in diameter and a small bronzed chert after looking at not less than 50 gullies that cut down to the rock. Possibly the quartz rock is of glacial derivation. The definite drift border probably lies a little further W. I returned to Beaver Lick and took road NE to Richwood but saw no traces of drift here. When on the upland a mile W. of Beaver Lick I could see a large valley with high level fluvial plane W. of Big Bone. The dr drainage E. of Big Bone is sharply incised with little or no terrace remnants.

High points on opposite sides of the road that descends from Beaver Lick to Big Bone are scarcely 1/4 mile apart at alt. of 800'-/. The railways are on a prominent divide from Walton N. past Richwood over 900' A.T. The fresh cuts for new highway on W. side of RR S. of Richwood show no drift pebbles.

Till near Richwood

July 23. Walton, Ky. I go by auto past Richwood to first road W. that leads to Union. Cuts where this road turns off show no drift pebbles. I come into boulders and till at the creek valley about a mile W. of the pike. There is several feet of till on the slope N. of the road, W. of the creek. I took road from Union to Beaver Lick and saw only a few pebbles in the head of a N. flowing stream 1½ miles S. of Union. There seems to be no drift farther S.

Old Drainage near Big Bone Lick

I went from Beaver Lick to Big Bone. The drift pebbles are scarce in the rubble of Big Bone Creek but I found one granite 6" in diameter at the creek crossing a mile E. of Big Bone store. (The map erroneously puts Big Bone at this road crossing a mile E. of its actual position). There is a sulphur water issuing from a well made at Big Bone S. of the church. I am told the bones that made this place famous were in the valley S. of here and that an occasional bone is still found but there is considerable earthy material over the bones. From the brow of the bluff N. of Big Bone I can see an old fluvial plane coming in from Mud Lick Creek and turning W. along Big Bone Creek past Big Bone store and then W. to the Ohio. There is a low-land following the creek down to the Ohio.

The one that runs to Mud Lick Creek follows it down to Big Bone and then W. to the Ohio. There is also a swale where road crosses from Mud Lick to Big Bone Creek a mile W. of the pike.

I went down Big Bone Creek to mouth of Mud Lick Creek and then up Mud Lick to the pike that runs toward Napoleon and followed that pike toward Napoleon till I came to place marked Ryle on the map of Gallatin Co. There is no store or hamlet here but the residence of Mr. Scott with whom we got dinner. This place is in the bed of a fluvial plane that runs to Ohio River northward along Big Bone and to Ohio River southwestward along Paint Lick Creek. The valley is fully 200' above Ohio River and nearly 1/2 mile wide. It is deeply dissected away by the later drainage. I find quartz pebbles and some pebbly sand around this place. Sand shows well on a dirt road running W. from the pike, being several feet thick in the road grading. This is down 15-20' from the level of the main floor of the fluvial plane. Mr. Scott says considerable gravelly sand was taken out a few rods S. of this place. Whether this deposit should be referred to the old stream or to glacial action is somewhat uncertain. I do not find granite or other pebbles that are definitely glacial, but only quartz pebbles and chert such as the old stream may have carried. Possibly the ice never reached here.

Till near Erlanger??

We returned from here to Walton past Beaver Lick and I took afternoon train to Ludlow and electric car to Covington. Glacial deposits are visible in gullies around Erlanger - with several feet of till exposed. The drift border as placed by Fenneman is 4 miles E. of Erlanger along Bank Lick valley and he has noted pebbles near Windsor Hill School S. of Latonia. Fenneman says boulders are conspicuous SE of Erlanger along Bullock Pen Creek nearly to Bank Lick Creek.

Molding Sand in W. Covington.

July 24, 1924. Covington, Ky. I went with Dr. N. M. Fenneman to Devon Park S. of W. covington to see deposits of molding sand. The deposit

has been worked extensively in past years but now that a park has been established here it is abandoned. The deposit is on the highest part of the ridge that catches the 860' contour and with associated beds is fully 30' thick. The fine molding sand is at the base of the pit up to about 15'. Above it is a somewhat pebbly deposit, small pebbles less than an inch in diameter and of all sorts of rocks of glacial derivation. The pebbles are in a loamy sand. There are horizontal bands somewhat clayey alternating with nearly clean sand. These clay bands stand out clearly on the fact of the bank as they do not break down so quickly in the sand. The whole deposit seems to be waterlaid. To the E. from this is a ridge standing between 820 & 840'. that has rock and residuary clay nearly to surface.

With Fenneman in Study of Molding Sand.

There is an occasional drift pebble on the residuary clay. On the way from the place where molding sand has been excavated down to this 820' strip we passed exposures with a few feet of fine sand at base and above this a pale whitish clay with a few iron balls 1/2" or less in diameter. It is 4 or 5' thick. This is at 840' or more. There are small quartz pebbles in the white clay up to 1/2" or more in diameter. There is a sort of terrace at this level and we can see a similar terrace or beach to the W. at about this level, SE of Bromley. It looks like a flat formed by stones active when a broad shallow valley was present. It is the only indication of high level fluvial plain we have noted. The molding sand knoll seems to be dumped on this old fluvial plain. We wonder how extensive a deposit there was originally and whether this is a small remnant of a widespread thick deposit, or whether it was deposited only in this place by some walling in process connected with the inshut.

We next went to Newport and examined still thicker deposits of fine sand E. of the southgate carline in E. part of Newport. The sand extends up just high enough to reach 700' contour here and sets in at about 600'. It

is a very fine sand and some use has been made of it for molding sand. Fenneman says it occurs in another hill that catches the 700' contour about 1/4 mile NNE from this one. We wonder if quite an area was once built up with this deposit to a little over 700' and there are mere remnants of the deposit. The great thickness seems to favor a rather wide extent so as to take in both of the 700' knolls and some bordering lower land. These two localities are the chief ones. Fenneman has noted molding sand in this district but others may occur as he did not examine every hill and ridge in his survey for the Cincinnati Toledo.

Fenneman says the aggradation in Licking Valley near Latonia is slightly lower for Wisconsin stage than in Cincinnati but is close to 540'. The Latonia race track is on this level and is but little below 540'. The Ohio has gravel deposition where the Licking has clay.

Clay at Latonia

July 25. Covington, Ky. I take electric car to Latonia. The clay there has bluish color at a few feet depth as shown by material thrown out of sewers and is full of calcareous nodules.

Scanty Drift N. of Southgate and E. of Dayton, Ky.

I went up on the Winsome Hill ridge to see how many or few the pebbles are that Fenneman reported to occur there. In a dozen or more gullies on the ridge that reach rock I saw only 2 small pebbles that seem referrable to glacial action. They were at the first gulley examined about 1/4 mile NW of Winsome in ravines draining NW from the school toward the pike. In those directly N. and NE from the school I did not find any. There is about 6' of clay over the rock. The lower half is a deeper brown color than the upper and more waxy and barren. The upper half is pale and in places shows iron balls. It seems likely to be eolian rather than residuary or a mixture of the two classes of material.

I returned to Covington and went up to Southgate to the drift border as mapped near there by Fenneman. There seems to be very few drift pebbles in the highland ridge E. of Southgate and northward from there to the bend of the Ohio E. of Dayton. There has been considerable grading done about 1/4 mile NW of the Tower at Fort Thomas that exposes a lot of white clay with iron balls and a few cherty and quartz pebbles in it. It is 5-6' thick and below it is the dark brown waxy residuary clay. I found a few limestones that are etched and pitted by solutions that were lying on the slope. I am not sure they belong in this clay as there is considerable river gravel on the pike near here and they are rather fresh looking for Illinoian pebbles. I also found a small quartzite of pinkish color that looks old enough to be Illinoian. This pebbly material in the white clay is all the drift material I could find here or anywhere between Fort Thomas and Dayton. I found some pebbles in gullies S. of the road where it begins descent to Dayton that are over 2" in diameter. The largest is a pink or purplish quartzite.

Old Divide Cut by Ohio River

The old divide on the Ohio seems to have run N. from where this highway crosses a 820' contour about a mile SE of Dayton. It seems to cross from there into sec. 32 of Walnut Hills. There is an institution on a hill SW of center of sec. 32 and a high ridge SE from it to the brow of the bluff in S. part sec. 32 at about 800'. Only a slight detour to the N. of these points is much lower land. This suggests a col considerably below 800' where the river cut across. As the space is fully a mile between 800' alt. on opposite sides of the valley there is room for a saddle of considerable depth. A similar question comes up in the case of the col crossed below Cincinnati near Riverside. The immediate bluffs there are nearly 900' A.T. but the ridge on S. side drops to 770' at Crescent Springs less than 2 miles SE from the brow of S. bluff. The col by Riverside is thus likely to have been below 770'.

Stream Piracy

July 26, Covington, Ky. I take Fort Mitchell car out to end of line. I passed through a cut on the ridge SE of Devon Park at 820'-/ that shows sandy and pebbly material several feet thick. This ridge runs N. to intersect the one in Devon Park on which molding sand was noted July 24. There is some sandy material about 1½ miles farther on a ridge about 900' A.T. 1/2 mile NE of Fort Mitchell.

The car line ends near forks of road 1½ miles SE of Crescent Springs. I walked down to Crescent Springs and examined stream piracy at the gap there at 770'. It has no sand and gravel. There is a slight amount of pebbly clay opposite the depot but at the col 20-30 rods E. only a few feet of pale grayish brown clay with iron balls covers the rock formation.

I took the road SW on W. side of the Southern RR and found a terrace like flat on ascending S. of Dry Creek at about 770' but there is only clay over the rock here. There seems to be very little drift on the uplands in this vicinity merely scattered pebbles in clay that is of paler color than the residuary clay and has some iron balls in it.

Pre-Illinoian Drift

A cut a few rods SW of Erlanger station has limestones in highest park but about 5' of pebbly clay on the SE end - Illinoian, only small pebbles 2" or less in diameter. I take car back past Fort Mitchell and then walk the track to the place where sandy deposits occur up to the 900' contour. I find there is a heavy deposit of drift here that includes an indurated deeply weathered till cakey and seamed probably pre-Illinoian. Also reddish sandy gravel so firmly cemented I cannot shove my trowel into it. There is clear sand exposed under gravelly material just north of the Lexington pike and this is not so red and indurated as the gravelly material and includes thin beds of gray gravel but little stained by iron compared with that above.

I follow this high ridge from the Lexington Pike N. 3/4 mile to the Amsterdam Road and find it gravelly in places clear to top nearly 900'. On turning E. on Amsterdam Road I pass exposures of molding sand like that in Devon Park and in plain view about 3/4 mile from it. The sand is in inclined and somewhat disturbed position in a pit S. of this road a few rods W. of the Fort Mitchell electric line. It is 25-30' exposed. Probably this is nearly the full depth as rock outcrops along the electric line only a few feet lower level. The top of the deposit is but little more than 800' here. It is perhaps 850' at an exposure farther W. on N. side of the road. From the summit crossed by the electric line at S. end of Devon Park I find thick deposits of sand extend N. along the ridge to where Fenneman and I examined an exposure of molding sand July 24. I also found sand is thick S. from here past the Amsterdam Road and the Lexington Pike. A pit for molding sand is opened on S. side the Lexington Pike near St. Joseph Heights where a ridge above 880' contour comes to the pike from the E. The sand here is overlain by a deeply oxidized reddish brown clay 10' or more thick. The molding sand is a paler color and is exposed about 10'.

The sand and accompanying deposit on all these ridges seems to lie above 800' as if areas below that level had been swept clean. In places the rock is at surface up to 820'. I have not time today to determine the full extent of this deposit as I leave for Frankfort at 4:30 P.M. It should be completely mapped.

Backwater Clay to Falmouth

On trip to Lexington from Covington I took L & N RR up Licking Valley. There is slack?? water clay at least as far as Falmouth. That station is about the same alt. as Covington. The RR runs up the S. fork and this has a more rapid fall than the main stream. The oxbow curve in the Licking near Grant has a high ridge which the RR cuts through in a tunnel.

Across the river there is a similar ridge but not so prominent in the curve there as in the one west of river.

The train was an hour late leaving Covington so it became dark before we reached Cynthiana. I went to Frankfort on Sunday and then returned Sunday evening via Lexington & Covington, Ky.

July 28, Covington, Ky. I take Fort Mitchell car out to Amsterdam Road. About 60 rods from the car line on S. side of Amsterdam road is a sand pit. The sand arches up in middle of pit to within 4' of top. It has a dark brown clay and sand mixture over it. This thickness to 7 or 8' at S. end of the pit. The pit faces NE. There are no pebbles over an inch in diameter in the clay and they are scarce. They are chert in the main. The sand doesn't seem to be pebbly. It is rather coarser than molding sand at this pit. A few rods further W. is another pit on S. side of Amsterdam road facing NW. It is a much larger pit and sand 15' is exposed that has horizontal bedding and only a little clay cover. It varies in fineness in the upper layers, some being damp by capillary water and others dry. There are large segregations of lime in the sand making irregular concretionary masses a foot or more long and 2 or 3" thick. When broken the central part looks like limestone. They are 6-10' above base of pit in what looks to be good molding sand. A few rods W. of this on higher part of the ridge is a pit with coarser sand capped by a clay with more pebbles and back of this at highest part of the ridge is a gravelly deposit with very old looking erratics up to 5" in diameter. A granite, greenstones & micaceous schist were noted. The alt. here is above 840'. The molding sand is between 820 and 840'. The capping pebbly material may have continued down the slope eastward for I find some gravelly material directly back (west of) the deep pit in the molding sand.

I go N. on this ridge and find gravelly surface much of the way to where it drops below the 800' contour. Two points on it rise above 860' and there is quite a strip above 840'. I pass two sags on the ridge that look to be 40' lower than the high points but the map keeps them above 840' contour. In one of these are two gravestones by a locust tree that are now broken and lying flat on the ground in woods pasture. One a Mr. Wm. Riggs born 1826 died at 28 yrs. old. It might be difficult for relatives to find these graves now.

The pebbly material in this ridge is largely quartz and chert but a few granites and other pebbles were noted.

On the tract below 800' on this ridge I find a pale clay 5-6' thick containing pebbles and iron balls and this rests on a brown residuary clay of ___?___ limestone. I went down this ridge to the Southern RR track and followed it S. to the ridge that lies E. of it. From the RR I have in plain view the ridge SW of Bromley and its highest part seems to have sandy or gravelly material of an orange color. There are points near its NE end that reach 840' contour. On the ridge that I ascended E. of the Southern RR there is rock near surface up to fully 820'. There is gravelly material probably 20' thick at the W. end of the 840' ridge but a part farther E. that seems to be down to if not below 840' has rock near surface. This is 20-30 rods across. There is then a rise of about 15-20' to a narrow gravelly strip that runs along the ridge to the Amsterdam road, about 80 rods.

I went into Covington on Fort Mitchell car for dinner. I then took the Ludlow car to Bromley and ascended the bluff S. of there. I found no sand and gravel in the two points that rise to 840' contour. Mr. Biel lives on one of them and his well entered limestone at 5'. I go SW from there to where alt. is above 860' contour. This area has thick drift of which till seems to be the main deposit but at the E. there is sandy gravel of reddish

brown color extending to the brow of W. bluff of the valley that the Southern RR comes in on. At the W. it is above 860' contour but at the E. the 820' is the highest contour. There seems to be sandy gravel on this ridge alone for residents say the ridges S. as well as N. have limestone near surface and a clay soil. In this gravel I found deeply weathered granite the largest rock noted being 7 or 8" in diameter. Most of the pebbles are less than an inch in diameter.

I came to the highway a mile S. of Bromley. I passed a granite rock 8 or 9" in diameter in a pasture field in the valley where I came to the highway the largest erratic I have seen today. I took electric car from Bromley to Covington and then examined the hill on W. bluff of Licking River just N. of the Lexington Pike and found it has no sand or gravel but is residuary clay from limestone. It catches 820' contour.

July 29, Covington, Ky.

I took Fort Mitchell car up to the tract of thick drift near Fort Mitchell. It is called Barrington Hills and the road S. from it to Lexington Pike is Barrington Road. It is on this that I found the exposures of old till and cemented pebbly sand over a finer sand. July 26. I got a specimen of the old till today from S. of electric track on Barrington Road. This drift extends only a short distance W. There is rock near surface and a pale grayish brown clay over residuary clay up to 860' contour. The highest part of this old drift catches 900' contour so there may be 40' of it.

I find the sandy gravel extends but little S. of the Lexington Pike. From the molding sand pit noted July 26, it extends E. less than 1/4 mile on the ridge with 880' contour. The contouring?? seems to be inaccurate for I cross this ridge as low as 840' on a private road about 1/4 mile E. of the molding sand pit. I went S. 1/2 mile from St. Joseph's Heights to Fort Wright but saw only clay. I am told by residents that ridges W. of Latonia

that rise above 840' have clay on limestone and it is only a few feet to limestone. I appear, therefore, to have got the sand and gravel area worked out. I returned to Covington and then went to Newport and examined hills to the NE of the one visited with Fenneman that had sand up to 700'. I do not find sand on them. The limestone is within 10-15' of top and has a yellowish brown clay over it that is loess-like in character.

The high ridges directly S. of Newport like the ridge from Fort Thomas to Dayton have rock almost to the top and only scattered pebbles to represent glaciation. It seems remarkable that I have seen red boulders a foot in diameter in this district from Erlanger N. and E. to the Ohio valley. They are said by Fenneman to occur SE of Erlanger along Bullock Pen Creek. They also occur in the S^{W} part of the Cincinnati quadrangle in vicinity of Burlington as I noted when here many years ago.

With Fenneman

July 30, Covington, Ky. Prof. N. M. Fenneman joined me here and we examined together the exposures of old drift along the Fort Mitchell car line and Lexington Pike and Amsterdam Road. We found all kinds of pebbles show much weathering and alteration and there is no limestone in any of the drift except the concretions in the molding sand. Fenneman has seen concretions as large as this of sandstone but not of limestone. These masses if trimmed so as to remove crust of sand might easily pass for a paleozoic limestone. Cherts are etched and in some cases are of low specific gravity because of solution of the calcareous places in them. The drift over the molding sand was probably full of limestone at one time and the dissolved $CaCO_3$ has perhaps soaked the molding sand so as to render it more calcareous.

With Fenneman near Erlanger by and near Delhi, Ohio

We went to Erlanger for lunch and examined the railway cuts in that vicinity. The till in them is evidently Illinoian. It is full of limestone pebbles to within 6' of top. The overlying deposit is chiefly a white clay with iron balls and small quartz pebbles. When I was working in this district many years ago I noted a black soil between the till and overlying white clay in a road grading not far from Erlanger at a depth of about 3'. Fenneman next took me across the Ohio to exposures of very red gravelly material on upland NE of Delhi immediately overlooking the valley. In these there is a reddish surface loam several feet thick with some very fine reddish sand near its base. Under this is a red gravel from which the limestones have been dissolved out to a depth of about 6'. Under this is fresh looking gray limestone gravel - i.e. fresh enough to be classed as Illinoian.

This deposit of reddish gravel has been excavated at several places along the N. side of the highway clear out to the brow of the Ohio bluff and down to 800' or less. Fenneman says there is a similar red gravel 4 miles below here that extends down to 700' contour. These deposits seem, therefore, to have been laid down on an eroded district similar to the present but the deposits W. of Covington where old till and gravel overlie molding sand seem to be restricted to an alt. above 800' and may have antedated the cutting of the gorges.

Stream Capture at Crescent Springs

Fenneman called my attention to evidence that the gap at Crescent Springs is where Dry Creek has captured a stream that once ran NE from Crescent Springs and carried it NW. Dry Creek has cut a remarkably steep sided trench in its lower course because of the increased size of its drainage area.

Richardson on Molding Sand

Prof. Richardson of Syracuse University is now at work on molding sands for Kentucky Survey. He met me at Covington and we spent July 31 together. He has noted molding sand on some ridges E. of Newport and Bellevue??? as indicated on my topographic map of Cincinnati and vicinity. Two places are on ridges N. of the Fort Thomas electric line, each at about 820'; the eastern one is directly N. of Newport WW Reservoir, and the other nearly a mile W. He also found such sand at and below 800' S. of Dayton near the highway I travelled a few days ago. He thinks the sand there is different from that found under the old drift W. of Covington. He did not notice any old drift over it in the Newport district.

Pre-Illinoian Drift Visited with Richardson

We went to the exposures of old drift and molding sand on Amsterdam road and he gave the weathered pebbles of the old drift careful scrutiny with pocket lens. In all that contain feldspar the kaolinization of the feldspar is in an advanced state. Some of the cherts have been so acted upon as to have a low specific gravity. Several pebbles are an Arkosic sandstone. The largest is of the jasper conglomerate type but the jaspers are small grains 1/8 inch or less in diameter. Some sandy quartz occurs in this conglomerate. I took specimens of several classes of rock, granite, banded quartzite (or quartz schist??), Arkose rocks, jasper conglomerate and quartzite. Prof. Richardson will ship specimens of the concretions found in the molding sand to Dr. Gillson. He sends 50# samples of molding sand to H. Ries at Cornell who has a testing laboratory.

The pit in which the molding sand has beds that are dipping sharply and more or less crumpled we find has a gray sand with horizontal bedding resting in its inclined slope in unconformable attitude as if deposited subsequent to the development of the strip slope in the molding sand. In this

gray sand we find small chert and jasper pebbles up to 1/2 inch in diameter. This gray sand is overlain by beds of sand somewhat sharper sand than the molding sand and suitable for plasterer's use. This is full of large concretions of limestone like the molding sand that underlies the gray horizontally bedded sand. It seems to have crept down the slope past the gray sand. We found no pebbles in it but more careful search may reveal them. This puzzling set of beds is not clearly understood by us. The presence of the gray, pebbly sand so free from iron stain and from aged appearance at this level which is below the old glacial gravel, throws a little doubt upon the great age of the glacial gravel just as the fresh limestone gravel under the red gravel on hills back of Delhi, Ohio, does. It would seem remarkable for so fresh a looking sand to antidate the development of the present topography of the region, as Fenneman and I have been inclined to suppose. It still remains true, however, that the degree of alteration of the pebbles in this old gravel and the kaolinization of the till in the exposure in Barrington Road is much greater than is common in the Illinoian drift.

We got a sample of the old till on Barrington road to ship to the Survey officer at Frankfort. In the pit E. of St. Joseph Heights on S. side of the Lexington Pike we find that a thin capping of white clay scarcely 2' thick carries small siliceous pebbles, but the sand below seems to be pebbleless. Possibly this thin pebbly clay deposit is Illinoian. The sand below is somewhat earthy and is deeply iron stained for several feet. Below this is a molding sand that is of yellow color. It has distinct lamination showing water bedding. This point is mentioned for Prof. Richardson thinks this molding sand has been considered by Prof. Miller of the University of Kentucky to be a wind deposit.

In the afternoon we visited the exposure in Devon Park where the molding sand shows clearly a horizontal lamination. I gave some attention

to the overlying pebbly material. It is partly sandy but much of it is clayey. The clay is a reddish brown color to within 3-5' of top. It there becomes pale and ashy color - like the white clay.

Perhaps this paler clay is all there is of Illinoian age, in this exposure. The molding sand reaches nearly to top of the ridge in its highest part and shows the horizontal bedding exceptionally well in this highest part. The pebbly material simply veneers the slope to a depth of a few feet. We went from here to Ludlow and examined the fresh Wisconsin gravel in the railway pit in S. part of the village. All kinds of pebbles are firm and fresh looking. The gravel has a capping of loam 5-6' thick. Below this, gravel of medium coarseness is exposed 25-30' to base of pit. The top is about 540'.

Old Divide

We went down the Ohio valley to Anderson's Ferry and took road up Dry Creek for 1/2 mile and then E. to the upland at place where there is supposed to have been a divide crossed by the Ohio. The upland here reaches 880' and we find a few feet of yellowish brown till of Illinoian type exposed in ravines that drain to Dry Creek from near the brow of the Ohio bluff. The limestone reaches about 860' here and the drift surface catches 880'. It is doubtful if the till exceeds 20' anywhere here and it may average scarcely half that amount. We find limestone pebbles in it. The largest stones seem are about 8-10" in diameter. There is an occasional deeply weathered pebble such as dominate in the old drift W. of Covington but nearly all the pebbles are relatively fresh looking. The Illinoian glaciation evidently made the great part of this drift. It is about as good a deposit as I have seen on the Kentucky side.

We came back by Crescent Springs and noted the stream piracy there which Fenneman noted but where Dry Creek captured the headwaters of Bromley Creek and took the drainage NW. We then returned via the Lexington Pike to Covington.

Notes by Wm. Duncan. Later Study Showed no Erratics There - See notes Sept. 17, 1924.

I was told by Wm. Duncan of Covington, 519 Greinopt??, at whose home I had a room while working here, that he was born and raised near Milford, Ky. on lower course of North Fork of Licking River, and that he remembers a large rock 4' in diameter that he thinks was a boulder that was near the site of the dam at Milford and was broken up and built into the wall at end of the dam. The dam is now out and he thinks one might be able to find the pieces of this supposed boulder. He refers me to James Kennan of Milford who is likely to remember the boulder and may be able to help in identifying it.

Mr. Duncan has noted small rounded rocks a foot or less in diameter along the stream bed near Milford that may prove to be of glacial derivation. He has also noted a black sand and gravel on this stream that suggests glacial derivation. He has not found it on the main Licking above the mouth of the North Fork. There is a bank of yellow sand in the angle between the two streams standing perhaps 50' above them. Very little sand is found below their junction for slack water conditions in the Wisconsin glacial stage extended beyond Falmouth and the deposits are stiff clay up to about 540' contour. The South Fork has a rather sandy alluvium nearly down to its mouth at Falmouth.

August 1, 1924. I took B&O train from Cincinnati to Toledo and T&AA train to Ann Arbor.

Molding Sand Waterlaid

A letter from Prof. Charles H. Richardson dated August 3 from Cincinnati is as follows: "You will be pleased to know that yesterday in the molding sand bed on the right of Taylor Ave., Bellevue district, 8' below the surface and in a bed some 6-8" thick, I found several fossils varying in size from a fraction of an inch up to an inch or more with striations and plications

perfectly preserved in the original calcium carbonate. This find proves the Newport molding sands waterlaid. In another deposit on the left of Monument St. 20' below the surface I dug out a pebble 1½ x 1 x 3/4". It could not be eolian. In the mantle of till or soil that washes all the Newport molding sands, I found over 100 pebbles of quartzite jasper granites and diorites. Their surfaces were perfectly fresh as if belonging to the Illinoian ice movement. Yours very sincerely, Chas. H. Richardson"

Erratics at Beaver, O. In Pike Co.

Samples of rocks sent me by F. P. Taylor, Co. Agt., Waverly, Ohio, include a quartzite that seems to have had glacial planing and a feldspathic sandstone with the feldspar kaolinized. Both kinds of rock seem to be of glacial derivation. They are from near Beaver, Pike Co., Ohio. The largest pebble of this sort noted by Mr. Taylor is 5" in diameter but he did not send a chip from it.

Daly Estimates Effect of Ice Sheets on Sea Level

Made trip to Toronto Aug. 6, to attend meeting of British?? Ass'n for Advancement of Science. Met W. B. Wright, Sollas, Slater, Boswell, Double, Watts, Gregory and Bather from Gt. Britain, and several Canadian and many U. S. geologists. In the symposium on Monday, Aug. 11, R. A. Daly gave following data on effect of glaciation the sea level - with ice cap radius 10°.

		Center of ore cap	Edge
A.	Rise due to ice attraction	65m	30m
B.	Towering	50M	24M
C.	Net displacement	15m	6m
D.	Elastic depression of ground	130m	60m

North American ice cap probably had 15° radius. If so:

A.	At center	90m	40m
B.	" "	70m	32m
C.	" "	20m	8m
D.	" "	175m	82m

The thickness of ice may average 10,000'. Elastic adjustment at

disappearance of ice was prompt. Isostatic was slow and probably very deep seated. Daly regards /1/ Ruttske, a Russian, who published a paper in 1899 on the effect of ice attraction to have come nearer the truth than R. S. Woodward who made calculations about 1886 for T. C. Chamberlin which came out as a bulletin of U.S.G.S. Daly presented estimates by several geologists, etc., as to lowering of sea level as a result of glaciation. Several recent estimates give it around 50 and Daly is in this group.

Sollas on Correlations of Terraces with Glacial Stages

Sollas made remarks to endorse Deperet in his interpretation that the four stages of glaciation on Europe are correlatives of four sets of marine terraces. At 100 m for 1st, 65 m for 2nd, 35m for 3rd, and 15-20m for 4th glacial stage - all of which I regard as without foundation. See my statements in connection with H. F. Osborn and Chester A. Reed's paper in Bull. G.S.A. Amherst meeting which reviewed Deperet's interpretation.

Views on Ice Age Lowering of Sea Level

W. M. Doors discussed the coral reefs in relation to glaciation. (See his synopsis in the Journal issued at this meeting). Hobbs made a few remarks on the same phase of the subject. W. B. Wright discussed the basis of his own computations to which Daly had made reference. Leverett called attention to the evidence from morainic correlations that the ice sheet of the Wisconsin stage and probably that of other stages did not cover its entire field at any one time and this should be considered in computing the amount of ice in the ice sheet.

Erratics at Cape Girardeau

A letter from H. A. Buehler, State Geol. of Missouri, dated Aug. 4, reports finding small pebbles of quartzite (found by Walter F. Hunt to be more probably indurated sandstone) and a granite pebble from the quarry stripping over the Plattin limestone at the new quarry being opened by the

Portland Cement Company south of Cape Girardeau, Mo. They seem likely to be of glacial derivation - specimens sent. Letter acknowledged August 13.

Studies in Alpena County, Michigan

August 15, 1924. I went to Alpena County to join the force that are mapping that county. The camp is 8 miles WSW from Alpena on E. bank of the outlet of Hubbard Lake on an Algonquin bar in sec. 11, T 30 R 7 E.

Strine

There is a sandy district from Alpena to here with places where the rock is near surface along the M 10 Highway as far W. as a stream in secs. 19 & 30, T 31 R 8 E. (The Traverse formation). It was in this that I found strine many years ago bearing S 41° E.

Beach of Lake Algonquin

I am told by the man in charge of the forests Reserve in sec. 34, T 31 R 7 E (Mr. Morey) that very little, if any, clay land is found E. of this Algonquin bar on E. side of the outlet of Hubbard Lake (or lower S. Branch Thunder Bay River). The bar follows the E. side of this stream at distance of 1/2 mile or less from sec. 9, T 31 R 7 E S. to sec. 14, T 30 R 7 E about 7 miles. It is sandy with a few cobblestones and pockets of gravelly material. There are some stones 8 or 10" in diameter well rounded. In sec. 14 the bar bears away from the stream and runs SE through central part of sec. 24 into the NE part of sec. 25 where it connects with the upper beach of Lake Algonquin. It is about 10-15' lower than that beach where it joins it in sec. 25 and probably along its course northward. Pits for road gravel were opened in it in sec. 24 but found unsuitable there being too much sand at depth of 3-5' and too many cobblestones in the surface part. The Algonquin beach has good road material in sec. 25 and sec. 23 T 30 R 7 E. We found an interesting bar of gravel running WNW into sec. 23 which was formed partly by wave action of the lake and partly by waters coming down the outlet of Hubbard Lake.

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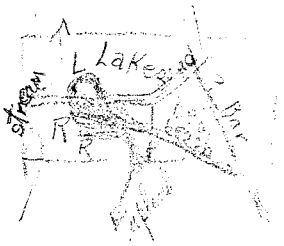
L - Lake Algonquin

R - River Bar



The river bars have beds dipping NW toward their W. ends and radiate out without forming a loop, such as the lake currents formed just N. of these bars. There may be a nucleus of till around which the lake beach wraps in central part of sec. 23.

Drumlins

The upland rises a little above the beach in S. part of SW¼ Sec.24 and in SE corner of sec. 23. There are numerous boulders on this upland. Low sandy ridges are scattered over it in secs. 25 & 26 that are evidently wind blown deposits. They rise about 10' above the bordering till. The till does not seem to have drumlins E. of the outlet of Hubbard Lake but there are several W. of this outlet.

Mr. Walter Ver Wiebe has been mapping them. I went with him through this district across secs. 22 & 21 and then N. to Paxton. Some of them arch up strongly and show the typical form with steep slopes at the stoss and then the lee slope. In all these the ice was moving E. of south so the N. or NW ends are the stoss ends. In some cases there are low swells that have the shape of drumlins but rise scarcely 10' above the border tracts. The best formed ones are 26-30' high.

In the NW part of sec. 16 is a drumlin that seems to have been cut into by wave action at N. end but it seems by the aneroid to be too high for an Algonquin level. There is another ridge in SW¼ sec. 9 that looks somewhat like a drumlin but has a large amount of gravel. The pit in the NW end shows beds dipping steeply to the SW like a delta and the land is low on that side. I do not yet understand how it was deposited. It seems to be above Algonquin level and the ridge is much larger than a lake beach. The pit in it is 15'

deep and sand extends 5-6' below its base. The owner says tests show sand under the gravel all along the pit 20-30 rods but red clay sets in it 5-6' which I presume is till. He says the gravel is found along the whole length of the ridge across a 40 acre tract.

Notes at Forest Tower

Aug. 16, 1924. At Forest Station in sec. 34, T 31 R 7 E. I leveled up to the observation tower from the low flood plain of the Hubbard Lake outlet and find it to be 19'. Mr. Morey, the forester, says a flood stage of 5 or 6' covers this bottom to where I began leveling so the tower may be 24' above low water level of the stream opposite NE¼ sec. 34, or 698' A.T.

The alt. of stream by levels run by Prof. C. D. Wisler is 674' A.T. So the forest tower is 698'-f, possibly not over 695 or 696' as the level of lowland W. of it is uncertain. Mr. Morey says there is a cedar swamp in nearly all of NW¼ sec. 19 and in much of sec. 18, T 31 R 7 W and it extends W. into sec. 13 T 31 R 6 W. N. from there in sec. 6 and N. part of sec. 7 there is bouldery land. The lake bed is boulder strewn each side M 10 Highway W. of the Hubbard Lake outlet in secs. 20 & 21, 28 & 29, showing till to be present.

There is a shale ridge in E½ sec. 30 which is above level of Lake Algonquin in highest parts but there are shale exposures below lake level along the road in line of secs. 29 & 30. The SW part of sec. 19 seems to be above Lake Algonquin level.

Wislers Levels

Bridge floor of Hubbard Lake outlet at M 10	679.6
Water surface	673.8
At bridge between secs. 22 & 23 T 30 R 7 water	677.5
Top of rail	688.5
Cor secs.22, 21, 27 & 28, T 29 R 7 E water	695.2
Top of rail on bridge	708.9

(An.29,035 at Forest Station or Algonquin bar about 695' A.T.)

Post office at Hubbard Lake NE corner Sec.33 (water)	699.4
Bridge floor	710.1
Bridge on county line water	704.0
Top of handrail on bridge	713.8
Hubbard Lake	709.2
Top of concrete wall (same)	711.1

An. 29.050 at M 10 at 1/4 SW corner secs.22 & 27.
An. 29.040 on Algonquin bar on M 10 Highway 685'
An. 29.045 on bridge of Hubbard Lake outlet 679.6
An. 29.025 at Algonquin shore 698'
This is a faint notch in the shale.
West of shale crest there is a shale spur running west across north part of 1/4 line of sec. 30 about 20-30 south of line of 19 & 30. It is as narrow as a beach but it is a shale ridge with a few pebbles that are waterworn.

An. 29.010 - 29.015 in this shale spur. The highest part of shale ridge is 4-5' higher at line of secs. 19 & 30 and about 120 rods south it is 10' higher (by hand level). So highest part of shale is 720'-/.

On the range line near N. end of line of secs. 25 & 30 is a low sandy pebbly ridge on which aneroid read 29.005. At this place shale is struck at 7 or 8'. This seems to be 705' and probably the highest Algonquin beach.

Ffom D & M Profile

D & M Profile makes Algonquin bar by Kersten	690-691' A.T.
RR bridge on Hubbard Lake Outlet (Water 674-/)	685.61'
Top of cut west of Paxton	695'
Road at crossing by "	685'
1/3 mile E. of Apple Orchard	716'
Road at Apple Orchard	711-712'
Gravel bar W. is about same Alt., looks like a lake feature	
West base of esker	720'
Summit on track at esker - Top of cut 744'	735'
Bridge on stream a mile E. of Lachine	702.57
Water below bridge	693'
Lachine	732.5
Ridge of Selina	733.5
Bed of Thunder Bay River W. of Selina	713'
Bridge " " "	726.31'
Swamp W. of Thunder Bay River	713'
Small ridge 3/4 mile	722'
West edge of swamp 1 3/4 miles E. of Hillman	740'
First ridge W. of swamp - Not??Nat.?? surface	761.5
Flat land W. of ridge	742½
Hillman station	752.5'
S. of Long Ropes (Wisler) Bridge floor 715.3	704' water
On range line of Rs 6 & 7 E	
At Orchard Hill	670.6 water
Top of abutment (No.) round steel plate	679.6

I went with Prof. Walter Ver Wiebe to the shore of Lake Algonquin on M 10 Highway. There seems to be a shore at about 705' as well as at about 690' here in S. part of sec. 19 and N. part sec. 30 T 31 R 7 E. The shale reaches 720-725' in highest points in sec. 30.

There was an Algonquin Bay in King Creek Valley covering NW part of sec. 31 and south part of sec. 30 T 31 R 7 E and much of sec. 36 & 25 and E. part of sec. 35, T 31 R 6 E. Most of it is swampy land. The lake extended nearly to the esker in T 31, R 6 E covering all the land up to about 700'. There is a gravelly bar in SE part of sec. 25, W. of Apple Orchard station that seems to be about the same Alt. as the station 711'. It looks like a lake feature but is a few feet higher than the neighboring parts of the Algonquin shore. Possibly the bar is down to 705'. It is opened for gravel about 100 rods WSW of Apple Orchard station. Test borings for gold are being made south of Apple Orchard in SW part of sec. 30 and in SE of 36. The claim is made by drillers that gold is found in the Devonian shale.

Esker

The esker is fully 750' A.T. near the crossing of the D&M RR the height at the RR is 744' and points near by are at least 10' higher. Several pits have been opened in it in the vicinity of M 10 Highway. This seems to have been a projecting strip in Lake Algonquin for a mile or two at its N. end. Lake Algonquin waters appear to have extended up Bear Creek beyond the Hillman Branch of D&M RR in a strip 7 3/4 mile wide at RR for the profile shows that much of the railway to be over ground below 705' A.T. Lake Algonquin did not extend up Thunder Bay River much above the mouth of Bear Creek for the stream at Long Rapids bridge is 704' and the valley is narrow for 1½ miles E. from there.

We drove back through the drumlin district from Apple Orchard and got barometric alt. as given on the Alpena Co. map. The highest points are

about 760 to 770' A.T. The gravel pit in W. part SW¼ sec. 9, T 30, R 7 E is 745-750' at top or nearly 50' too high to be under Lake Algonquin. A stream N. of the pit is about 710'.

Mapping Shore of Lake Algonquin

In the afternoon I map the shore features of Lake Algonquin from sec. 22, T 30 R 7 E northward to the shale ridge in sec. 30, T 31 R 7 E where a bay in King's Creek valley opened into the lake. The shore is on NE side of a drumlin ridge in sec. 22 N. of the highway and continues NW about to the line of secs. 15 & 16. There is a hummocky bouldery island S. of center of sec. 15 covering perhaps 20 acres that seems to be above Lake Algonquin - a few feet, scarcely 10'. In the NE part of sec. 15 and SE of sec. 10 there are several low parallel sandy ridges with NNE-SSW trend scarcely 5' above wet strips between them. The shore of Lake Algonquin crossing the line of secs. 10 & 15 within 80 rods of west end on east side of a drumlin ridge. The shore runs near line of secs. 9 & 10 and across west part of sec. 3, T 30 R 7 E. The shore wraps around a drumlin in S. part sec. 33, T 31 R 7 E and comes back to corner of secs. 3 & 4 at twp. line. There is a gravel pit in it here in NW corner of sec. 3.

Within 40 rods W. of this a gravel bar sets in just S. of the twp. line and runs N. 86 rods+ and then swings westward across the SW¼ sec. 33 into SE¼ sec. 32. There is a drumlin here just south of beach?? in SE of 32 and N. edge of sec. 4. There are points on line of secs. 3 & 10, T 30 R7E that rise to Lake Algonquin level and carry bars and hooks of gravelly structure.

Features Bordering Algonquin Shore

There is considerable hummocky bouldery land at and a little below the Algonquin level in N. part of sec. 10 and S. of sec. 3. There are also sandy ridges fully up to Lake Algonquin level back of a schoolhouse in NE¼ sec. 10. East part of sec. 10 is sandy. The Algonquin shore wraps around

the N. end of a drumlin in S. part of sec. 29, T 31 R 7 E which is the most northerly drumlin noted in this district. East of this drumlin in SE of sec. 29 and NE of sec. 32 is a sandy plain which has some large boulders near the contact with base of drumlin. I saw one granite 8-9' across that stands only 1' above surface of ground. There is considerable sand mixed with boulders on the slopes above the level of the Algonquin beach in secs. 29 & 32, T 31 R 7 E.

Algonquin Cut Bluff

Sunday Aug. 18, 1924 - I went to the Forest Service tower in sec. 31, T 30 R 8 E and found the alt. at its base to be 770'. The tower is 80' high and commands a very wide range. The Algonquin beach in secs. 30, 31 & 32 is a cut bluff 25 to 50' high, about 700' at base. This continues to center of sec. 5, T 29 R 8 E where a stream breaks through it. The uplands in sec. 31, T 30 and secs. 5 & 6, T 29 R 8 E are gently undulating till with some low sand dunes along and near the brow of the Algonquin bluff. The Forest Tower is on dune sand 10'+/ above the level of the till. Boulders are not so conspicuous on this till area as common in this region - yet are not rare. Where the road is being cut through on line of secs. 30 & 25 to ascend from Lake Algonquin to this upland there are exposures of sand and cobbly material under a few feet of reddish clayey till. One of the men with me took a kodak view of the cut on E. side of this new highway showing an abrupt change from cobble to sand horizontally and downward. The till is on cobble and boulderets at N. end and on sand at S. end of cut. The cobbly bed is only 4-5' thick and underlaid by sand of undetermined depth.

Mr. L. R. Schoeneman has worked farther SE on the Algonquin shore. It is a strip cut bluff in secs. 9 & 15, T 29 R 8 E and W. of a stream in sec. 22. E. of this stream is a gravelly bar in W. part of sec. 23 and this runs SE into Alcona County through NE part sec. 26, SW of sec. 25, NE of sec.36

and SW of sec. 31, T 24, Rs 8 & 9 E. There is a swamp W. of it in sec. 36 that runs NW into SE part of sec. 26. There is a strip of dune sand near the county line in sec. 31, T 29 R 9 E.

West of this swamp is the edge of Lake Algonquin as a cut bluff. A moraine lies back of this in secs. 26, 27, 35 & 36. West of this in secs. 27 & 34 is a till plain. There is swamp in N. part of sec. 27 and S. part SE¼ sec. 22 N. of which is moraine a mile or so wide along the bluff back of the Algonquin shore from sec. 23 NW to S. edge of sec. 5, T 29 R 8 E. West of this is till plain about as shown on my old map. Schoeneman has symbols on topography to show degrees of steepness of slope. The till plains thus are distinguished from moraines by the more gentle slopes.

Sink Holes near Lachine

Hill S. of Lachine is 912' at highest point. The base is 50. Base of gravel pit 770. This has crumpled beds of which Ver Wiebe took a view looking into W. end of pit. Till is involved with gravel and sand beds in disturbed condition in S. part of pit. The surface of hill has numerous boulders and is gravelly to top. There is a group of ravines here in secs. 20, 21, 28 & 29 covering about 500 acres mainly in sec. 20. (See map).

There is a sink hole at its N. edge near a schoolhouse in E. part sec. 20 S. of highway 32. It is about 770 at __?__ and is 35-40' deep and about 300' in diameter. The view is sandy gravel. No rock shows in bottom but it probably is a limestone sink.

Features near Long Rapids and Lachine

The hill has smoother slopes below about 770' then above - probably the smooth part has a larger per cent of till but at this sink the smooth slope has sandy gravel.

We went N. past Lachine a mile to corner secs. 8, 9, 16 & 17, T 31 R 6 E, Alt. 735'. There is a strip of sandy ridges wind blown running WNW-ESE from SE part of sec. 8 across S. part SW¼ sec. 9 and then along line of secs.

9 & 16 to corner secs. 9, 10, 15 & 16. The alt. here is 725'. A few rods E. and S. there is a shore line which seems to be 720'. There is a bouldery sandy ridge along it only 30' or so in width that is slightly winding and slightly uneven on crest as if it might have been shoved up by an ice jam. There is a bouldery slope below it down to 700' - is slightly less - and then a plain E. to Bear Creek. One granite boulder is 14' long and 6 or 7' wide and is buried deeply in the ground. On going N. from here we find shore features at about 720' in SW part of sec. 10 S. of a ravine which runs E. into sec. 10. There is a ridge in NW part of sec. 10 above 720' that extends through SW part of sec. 3 into SE of sec. 4. A swale runs W. from its N. end that is below 720'. The shore features of wave washed slope show on its E. side across the NE¼ sec. 4 to Thunder Bay River. There is a lower terrace at about 700' bordering the river which is only 8-10' lower at NE corner of sec.4.

We crossed the river at Long Rapids and found the aneroid needed no correction, the reading on the bridge floor being 715'. At Long Rapids cross roads the reading is 725'. We go E. and descend gradually to 705' at 2 miles E. The land here is sandy and is a little below Algonquin level. In sec. 35 we have the highest beach in view within 1/4 mile N. of the road. The reading at the bend in road is 695' and the shore is about 40 rods N. It is about the same distance N. of the cross road at Orchard Hill. The Alt. of the lower shore here is about 695' and the higher one is 710' or more.

Beaches Near Ossineke

The higher shore is near the road in sec. 31 nearly to E. side but there turns abruptly northward into SE part of sec. 30 into a low tract bordering North Brench of Thunder Bay River. We see no more of the beach along the river from there to Alpena. The aneroid reads 675' opposite a dam under construction and 660 opposite an old dam a mile farther down both readings on the highway. It reads 640 at corner secs. 7, 8, 17 & 18, and 625' at Nipissing beach 1/2 mile E. of this crossing. It reads 605' at Union Hotel at 12:45 and

the same an hour later. This seems to be about 10' too high as I read 592 at Lake Huron level in S. part of Alpena.

In afternoon we drove the shore road to Ossineke and then SW to corner secs. 14, 15, 22 & 23, T 29 R 8 E. We came to the Nipissing beach near turn in road in NW part of sec. 14. It seems to be 615' at base of bank. A bar E. of the creek near corner secs. 14, 15, 22 & 23 is 660' but it rises to 675' a short distance SE. West of the creek is a shore line at 675' and another at 690' along base of a bluff that is 730' at top; At sec. corners of 15, 16, 21 & 22 there is a kame with gravel pit in it that reaches 800'. Another of similar elt. is in NW¼ sec. 22.

Kame

A strip of knolly land runs diagonally NW-SE across sec. 22 which is scarcely 1/2 mile wide that looks to be morainic but each side the land is gently undulating and also to the N. in secs. 15 & 16 clear to the bluff of Lake Algonquin.

Near corners of secs. 21, 22, 27 & 28 is a low smooth ridge running NW-SE of drumlin type. There is a prominent elliptical hill in sec. 28 nearly a mile long from NNW-SSE and about 1/4 mile wide. It passes N. & E. of center of section.

Borders of Lake Algonquin

Aug. 19, 1924. An. 29.365 at Forest Tower sec. 34
" 29.375 - 679.6' on bridge on M 10

I read 720' on range line at corner secs 19 & 30, 24 & 25 where there is a sandy gravel bar that I have supposed to be 705'. I read 725 at quarter post where M 10 turns WNW. I read 735 on track of D&M at Summit W. of esker. I read 715 at D&M track near S.quarter post sec. 15, on a swale that opens eastward into a large cedar swamp in sec. 14, and westward to Bean or (Bear?) Creek valley. There are two islands of Lake Algonquin N. from here - a small one in S. part of sec. 15 and a larger one in central

and N. part extending a little into sec. 10. There is swamp eastward to the esker near line of secs. 13 & 14.

There is a narrow strip on Bean or Bear Creek where crossed by M 10 Highway that is below Algonquin level and an expansion into a swamp S. of the highway in SW of sec. 22, SE of sec. 21 and adjoining parts of secs. 27 & 28. This has dry strips in form of low ridges visible from M 10 highway in SW part of sec. 22. They are 10-15' high and look to be sandy. There is a red clayey till in the dry land along and north of M 10 in sec. 22. The islands in sec. 15 have a sandy bouldery surface.

Features near Long Rapids

We drove N. to Long Rapids from Lachine to see if any low passages extend W. across the highway that might have been covered by Lake Algonquin but find the land too high clear to the Thunder Bay River valley. The valley is but little more than 1/4 mile wide for a couple of miles above Long Rapids. It then expands and is fully 1½ miles wide on the range line N. of Selina. This tract has a sandy soil as far N. as the corner of secs. 6 & 7, 1 & 12, that is low enough to have been covered by Lake Algonquin, being 715 to 720' A.T.

Esker

The Algonquin waters seem to have extended about to the line of secs. 6 & 7 and covered the part of sec. 8 W. of Thunder Bay River and the SE half of sec. 5 except a narrow strip on E. side E. of the river.

There is a very winding short esker in NW¼ sec. 33, the SW end being just N. of the cross roads at Long Rapids. The cemetery is on it. It is only 5-15' high and a few rods wide. There is a gravel pit in its SW end and also near the NE end. The material is fine in the first one. There are a few boulders on it.

Drumlin

In the afternoon we went W. from where M 10 turns E. 1/2 mile S. of Lachine and crossed a strip of gravelly knolls in E. part of sec. 19 that are

too diffuse to class as an esker. They run for over 1/4 mile in NNE-SSW course in a strip about 30 rods wide. W. of Flanders is a prominent drumlin fully 800' A.T. nearly a mile long and about 1/8 mile wide. There is another in SE part of sec. 24, T 31 R 5 E, very prominent.

Kames

We went a mile S. from Flanders and then E. 4 miles. There are gravelly knolls in a strip in SE part of sec. 28 that nearly connects at the NW end with the prominent kames S. of Lachine. These extend nearly to center of sec. 28 at SE end. There is a prominent place near center of sec. 32 that may be a group of small knolls but it is brushy so the contours do not show well.

Till Plain

There are some gravelly knolls in NW of sec. 34 with NW-SE trend. Aside from the knolls, drumlins and gravelly areas mentioned there is a till plain occupying the greater part of several sections in NW part of T 30 R 6 E and SW part of T 31 R 6 E as far E. as the esker. In secs. 4 & 9, T 30 R6E there are two prominent drumlins and in central and S. part of sec. 3 and elevated dome-like area with gently undulating surface. These are the most conspicuous features aside from the esker in the N½ of T 30 R 6 E.

Esker

The esker is very complex near the line of secs. 4 & 11 with several ridges in a network. The main and central one has coarse gravel cobble and boulderets up to a foot in diameter all well rounded. There is considerable limestone among the larger stones. Some of the Antrim shale is present and some red Superior sandstone. I crossed the esker on this section line and again in S. part of sec. 10 and near corner of secs. 9, 10, 15 & 16. At the last place I overlooked a low area along Bean [Bear?] Creek over a mile wide.

Bay of Lake Algonquin

Lake Algonquin seems to have extended up King's Creek to N. part of sec. 12. There is a nearly pebbleless clay under the flat land bordering the creek at line of secs. 1 & 12. There is a tiny esker in E. part of NE¼ sec. 1 scarcely 5' high and 20-30' wide and about 40 rods long. It winds in esker fashion. It seems to be a few feet above Lake Algonquin level. A knolly strip runs N. from here into SW¼ sec. 36, T 31 R 6 E, the knolls being 15' or more high. The Algonquin shore wraps around the N. end as a wave-washed flat. This flat extends slightly into the NW part of sec. 6, T 30 R 7 E.

Esker & Drumlins

Herron Station on line of secs. 1 & 6, on BCG & AR Ry is only a few feet above the level reached by the Algonquin waters and the railway comes down to that level ½ mile W. in King Creek valley.

There are drumlinoid ridges in this region, one in NE part sec. 14, T 30 R 6 E, and one in central part Sec. 7, T 30, R 7 E, and perhaps others. The esker lies E. of a prominent till ridge not shaped into good drumlin form, however, in S. part of sec. 26 and N. part of sec. 35, T 30 R 6 E. Near the line of secs. 26 & 23 the esker makes a sharp turn to a NW course and dies out S. of M 10 Highway. There is a till ridge where D&M Rk and M 10 cross just N. from this end of the esker and undulating till runs W. along M 10 to Bean?? Bear?? Creek. The esker sets in about 80 rods E. at M 10 and runs N. through E. part NW¼ sec. 23 or possibly on edge of sec. 24. It is very prominent along or near the line of secs. 13 & 14 perhaps 40' high in highest points.

Levels in Alpena by Joe W. McNeil, City Engineer

Landing of stone steps of Federal Bldg.	590.096
Sidewalk First & River Sts.	586.777
Fixed point in Federal Bldg.	590.909

An. 29.250 " " at 9:30 A.M., Aug. 20.

Road Survey on "Ossineke Road"	Lake Huron	A.T.
Ossineke at D & M Station	25.3	606
Stream west of Ossineke	17.8	598.5
Turn in road in sec. 14 by Nipissing Shore	49.2	630
The Nipissing is E. of here and 4-10' lower or 620-/		
At line secs. 14 & 23 on Algonquin bar	82.6	663-/
S. Branch Devil River 400' W. of sec. corner	68.1	649
Gravel ridge W. of River - 2nd Algonquin	96.7	677.5
Base of bluff on line secs. 15 & 22, highest Algonquin shore	108.	689
Corner secs. 15, 16, 21 & 22	218.2	799
Summit in road a few rods east	221.4	802
West base of ridge 600' west of corner	193.6	774.5
Corner secs. 16 & 17, 20 & 21	190.8	771
Corner secs. 17, 18, 19 & 20	151.4	732
Range line secs. 18 & 19, 13 & 24	204.1	785
Crest 1000' W. of quarter post secs. 13 & 24	316.3	897
Corner secs. 13, 14, 23 & 24, T 29 R 7 E	254.2	835
Corner secs. 14, 15, 22 & 23	175.6	756.5
Water surface	694.5	
Lower S. Branch, Thunder Bay River (bridge)	119.2	700
Corner secs. 15, 16, 21 & 22 (Hubbard Lake Road)	169.4	750
Corner secs. 16, 17, 20 & 21	193.8	774.5
Corner secs. 17, 18, 19 & 20	229.8	810.5
Range line secs. 18, 19, 13 & 24	245.4	826
Corner secs. 13, 14, 23 & 24, T 29 R 6 E	314.1	895
Corner secs. 14, 15, 22 & 23	199.3	780
Corner secs. 15, 16, 21 & 22	139.2	720
Wolf Creek flats for 400' E. of stream	136.9	717.5
and 2000' west - at 2000' west	138.4	719
Wolf Creek	136.9	717.5
Bed 715'		
Corner secs. 16, 17, 20 & 21	139.9	720.5
Base of bluff W. side of swamp (1800' W. of sec.cor.)	148.4	729
Tamarac extends up to 2500' W. and up to 777'		
Corner secs. 17, 18, 19 & 20	285	866
Crest 600' E. of corner	287	868
Range line secs. 18, 19, 13 & 24	321.4	902
On range line secs. 19 & 30, 24 & 25	306.2	887
On range line secs. 30 & 31, 25 & 36	267.5	848
(Ridge on line secs. 24 & 19 (1400' from S. end)	344.7	925.5

Gravel Bars & Levels near Long Lake

Leveling from Long Lake. Steep slope to 17' in 30 rods-/. Very gentle slope for 80 rods to foot of a beach 28'4". Top of beach 40-/. This runs across NE part of sec. 16 and along line of 9 to within 60 rods of W. end, then runs N. 1680 rods as a prominent bar to base of a limestone cliff and rounds this cliff at base crossing from sec. 9 into sec. 8 near quarter post. The cliff in W. part SW¼ sec. 9 about 30 rods E. of school house is.

75' above Long Lake. The summit in road by the school house is 63' above Long Lake. This seems to be at a beach level but limestone is near surface.

About 30 rods SW of school house is a rise to a level topped area fully 80' above the lake. It seems to have been wave swept and has limestone at top. The school house is near middle of W. side SW¼ of sec. 9.

There is a flat tract S. of the high point in SE part of sec. 8 about 60-63' above the lake. A bar across it to a bluff on line of secs. 8 & 17 being 63'. There seems to be lower land to the SW draining to Thunder Bay River. This flat is 50-60 rods wide near line of secs. 8 & 9. The higher tract N. of it seems not to extend more than 1/2 mile W. and 40 rods E. of line of secs. 8 & 9.

About 1/8 mile S. of corner of secs. 8, 9, 16 & 19 I rise to a beach 90' above the lake. There is a gravel pit in it on NW part of sec. 16. It is a horse shoe shaped bar open to the NW. Another little bar is on a knoll 40 rods NW near line of 8 & 17, that is 90' above the lake. There is about 7' depth of gravel at the bar pit in sec. 16 resting in red till. From this place a strong bar runs SSE across W. part of sec. 16 for 3/4 mile and there hooks?? around to the W. for 40 rods and dies out. This stands 15 to 20' above land along and W. of the line of secs. 16 & 17 that is not much wave washed. The small drift hummocks are present and it looks like unmodified till.

Lake Algonquin Bars and Other Features

The waters from the SW were not so effective as those from the NE in forming a strong shore. There are shore lines along the base of the SW side of this shore in W. part of sec. 16 that are 5 to 10' below its crest. They seem to have been formed from the NE before the higher one was formed. They are full of large limestone masses like the higher one. Perhaps the lake level rose after they were formed as the W. one is 5' lower than the

middle one and it is 5' to 8' below the eastern and highest one. There is, however, a possibility that the highest one is a storm beach or a beach shoved by ice jams to a height that wave action did not reach. It is more even crested than I should expect it to be on this hypothesis. Along the E. side of this 90' beach is one about 75' above the Lake (Long Lake). This doubles back around the S. side of the West becoming part of the high beach. A few rods S. is the N. side of a strong beach of same alt. (75' above Long Lake) that runs NE across SE corner of sec. 17 and then swings around to an NNE course across S. part of SW¼/SW¼ sec. 16. There is a gravel pit in it here 15' deep that does not reach the base of the deposit for it is a bar fully 15' above border tracts. This shore line runs NNE for 120 rods and then turns NE and runs, (I am told by Mr. Cadarette, a farmer living on it in sec. 21) to the SE corner of sec. 21. There is an offset S. to another ridge in NE part of sec. 28 which he says runs SE across sec. 27 to where I crossed it just N. of corner of secs. 26, 27, 34 & 35 on the way N. from Alpena. My aneroid reading there was 690' and at Long Lake 630'. So it seems to be the 60 foot beach rather than 75' one. Mr. Cadarette says a 90' beach that crosses the line of secs. 20 & 21 near quarter post does not extend far into sec. 20 but runs SW about 80 rods and dies out. In sec. 21 it curves around to the S. and comes back SW to the corner of secs. 20, 21, 28 & 29 and there dies out. It seems to be present on the highest land in these sections.

Features near Long Lake

A beach about 60' above Long Lake crosses the line of secs. 16 & 21 about 30 rods E. of quarter post and runs SE into sec. 21 and slightly W. of N. into sec. 16 passing not far from the center. I came to this on the line of secs. 9 & 16 about 120 rods from W. end and it runs just S. of the line from there W. to the corner of secs. 8 & 9, 16 & 17. I came to the beach 40' above Long Lake a few rods E. of corner of secs. 15, 16, 21 & 22. It is a weaker feature here than 1/2 mile N. where I started on it. It is in drift

here but on limestone 1/2 mile N. The limestone reefs are the main relief for the gravel deposit is thin.

I noted a good many granite and greenstone boulders along the 40' shore but limestone blocks and rubble are the main deposit. The 75' and 90' shores are in drift and have large amounts of gravel. The 60' one is generally on limestone but seems to be in glacial material at line of secs. 16 & 21. On the line of secs. 26 & 27 it is in limestone and there is a cliff here 10-15' high N. of the quarter post.

The Camp of the Land Economic Survey is located at "The Narrows" of the outlet of Long Lake where the highway crosses and where an old dam site was located. The stream here cuts through about 6' of reddish till before reaching rock and has rock rapids above the highway and very narrow channel. Just below the dam 20 rods E. of highway it expands into a small lake. This is probably 8-10' lower than Long Lake.

Nipissing Beach

Aug. 21, 1924. 6:15 A.M. An. 29.425 at hotel by Long Lake about 10' above lake level - 640'-/ A.T. 29.430 at camp by outlet - 635'-/ at 6:45 A.M. 29.435 at camp at 7:05 A.M.

We drove to where Middle or Mud Lake was but it is now drained. It has rock on S. and W. and sand ridges on E. The N. end is a marsh and there is deep mud that was down into 50' without reaching rock. There is a weak rubble beach near school house in SE corner sec. 13. The barometer read 625' here and 620' about 20 minutes later. It reads 630 on ridge at SE end of Mud Lake 4/10 mile E. of corner secs. 13 & 24, 18 & 19. It read 570' at Lake Huron at 8:05 A.M. - 581' A.T. An. 29.505 at Lake Huron level in SW?? part sec. 17. I run hand levels up to the highest Nipissing beach which is near quarter post of secs. 18 & 19. Top of strip rise 20 or 600' A.T. Wide flat back of a 34' shore. Strip rise at 40-45' (shore line). Crest of highest sandy & cobbly beach 50' or 630' A.T.

The turn in road 6 or 7 rods S. is 4' lower or 626'. [illegible] corner is 638' and ridge 6-8 rods W. is 643'. Ridge 60 rods SSW is about 650' and has a notch 643' and another at about 638'.

A rocky island 40 rods SW of corner also reaching 650'. The road crosses a 650' ridge 30-40 rods W. of quarter post of secs. 18 & 19. The aneroid at 9:00 A.M. is 645 at range line corner secs. 18, 19, 13 & 24. An. 29.482. I read 655 on a gravel bar 1/4 mile W. and 10-15 rods N. of road. It comes to the road 35-40 rods W. We go back to camp and read 645. Then N. to Long Lake near center sec. 14 and find it 645. The road at turn S. of center of sec. 14 is 650'.

Algonquin Beach

There is a gravelly strip NE of camp 6' above camp level or fully 650'. There is a strong beach in E. part of sec. 11 about 40' above Long Lake or 685' A. T. It crosses the 1/4 line road in sec. 11 about 60 rods E. of the Grand Lake road and runs SE 1/4 mile or more. It runs N. for 60 rods or more. It is higher at the SE end than at the road and doubles back so as to cross this E-W road near the line of secs. 11 & 12.

Nipissing

It is composed of coarse rubble where cut by the E-W road 60 rods E. of the Grand Lake road. It is steepest on side toward Long Lake and drops off more there. There are rock reefs on high land E. of here 685'+ A.T. So there is not good material for beach building and they shut off strong wave action from the NE at the level of the gravel bar. The reefs are up to 675' about to center of sec. 12. In 4 miles E. there is a drop to 630' at what seems to be the Nipissing shore. There are some rocky reefs between here and the shore of Lake Huron. The Rockport quarry in sec. 6 is in one about 20' above the lake. This quarry has 20' or more of limestone over a dark shale, that is reached at bottom of the quarry. There are places near the

quarry where the rock comes out to the shore at 15-20' above lake level.

We went N. on Grand Lake Road to edge of Presque Isle County and find the bars of the 685' beach in SW part of sec. 35, T 33 R 8 E. There is a bar facing Lake Huron 685' A.T. and SW of it one facing Long Lake that is 675-678' or 7 to 10' lower than the one in the exposed situation fronting Lake Huron. These run a short distance into sec. 2, T 32 R 8 E but soon die out. The SW facing one runs into SE part of sec. 34 and curves around from W. to N. within 40 rods W. of the sec. line in SE¼ sec. 34. There is a much lower district to the N. & E. So Lake Nipissing shore is a mile or so inland in secs. 26 and 35, T 33 R 8 E.

We returned to camp and find barometers need no correction. The camp seems to be 640' or at about level of Long Lake. In afternoon we went S. to the summit reef near corner secs. 26, 27, 34 & 35, T 32 R 8 E and find it 690'. We went E. on line of secs. 26 & 35 and cross a shore line at 680' about 120 rods from E. end of line.

South of corner secs. 25, 26, 35 & 36 a few rods is an abrupt rise of 15' to a reef of limestone 690' to 695'. South of this at similar alt. are shore lines of cobble and gravel at about 690-695' that may form an elliptical loop in SE of NE of sec. 35 and SW of NW of sec. 36. The land is not cleared far enough to show from the road. South from here about 1/2 mile near S. end of line of secs. 35 & 36 is a gravel & cobble beach at 675'.

A mile farther S. in SE part of sec. 2 NE of sec. 11 and NW of sec. 12 is a reef of limestone 665' about 10' above the flat land NE of it at sec. corner of 1, 2, 11 & 12. South from here reefs are crossed at frequent intervals clear into Alpena. The alt. decreases so as to be 630' near S. end of line of secs. 11 & 12 and 592' at the railroad track at Second St. The aneroid reads correctly 590' on the steps of the Federal Building at about 2:00 P.M.

Bar at 716'

Dr. Ver Wiebe and I went out to the place where a drill hole for gold prospecting is being made in sec. 30, T 30 R 7 E. I there examined the ridge that crosses the D & M RR west of the center of sec. 30 and the sandy gravel bar in sec. 25, T 30 R 6 E and find that the latter is a clearly defined shore line with a bar at W. end built out into a swamp. Its highest points are about 716' or the same height as the sandy ridge cut by the RR near center of sec. 30. This sandy ridge has very few pebbles but the one on sec. 25 is a sandy gravel.

Highest Algonquin 716'

The bar of pebbly sand near N. end of the line of secs. 25 & 30 I find by hand level from the D & M north is also 716'. So that alt. seems established for the highest Algonquin at this place. This bar overlooks lower land to the north. But to the S. is a till swell fully as high and to the E. one still higher.

The D & M RR cuts into a red clayey till in E. part of sec. 25 the surface of which is about 716'. The bar in this section was built by water on the S. The one in sec. 30 cut by the RR faces lower land in the E. Part of the shale hill in sec. 30 stood above Lake Algonquin a few feet.

Extent of Shale

Dr. Ver Wiebe has found the shale near surface as far N. as central part of sec. 17 but that appears to be its N. limit for just N. of center of sec. 17 there is the Traverse formation at surface. The boulder strewn area E. from the shale hill probably has shale at slight depth (in secs. 20 & 29).

Study of Gravel Bars near Long Lake

Aug. 22, 1924. 6:15 A.M. An 29100 at Long Lake 640'
7:20 A.M. An 29065 (640)

Gravelly area in NW¼ sec. 23 has gravel pit 6' deep. Across the outlet (south) in E. part of sec. 23 is a gravel bar 660-665'. Numerous boulders in it. We turn S. on line secs. 23 & 24 and soon see a bar to the E. that is 675-680'. It is 300'-/ wide and stands 10' or more above border land. It is horseshoe shaped open to the S. The E. area is W. of center of sec. 24 and W. area ends about 60 rods far west line and 40-50 rods S. of quarter post that lies onto the higher one E. of the quarter post. It runs W. along the quarter line road to sec. 23 about 60 rods.

There is a bar 655' running NNW-SSE across SW part of sec. 24 into NW¼ sec. 25. East from this is a cedar swamp on line of secs. 24 & 25 to quarter post. Standing 645'-/. East of this are sandy ridges up to 655' in road.

To the N. about 80-100 rods is a ridge 5-10' higher that runs eastward to the line of sec. 24 & 19. This proves to be a rock reef about 660' A.T. There is rock in road for 40 rods W. of corner of secs. 24 & 25, 19 & 30. An. 29030 - 650' at range line corner secs. 24 & 25, 19 & 30 at 8:30 A.M. Near center sec. 30 are gravel beaches 675'-/ with ESE-WNW trend - two parallel ones - the N. one 5' higher than S. one and 30-/ rods apart. The Nipissing comes to N. end of quarter line road in sec. 30 and the shore turns WNW from there to W. quarter post sec. 19 to outlet of Rifle River and then runs E. on N. side of outlet across sec. 19 into NW¼ sec. 20.

We went S. crossing sec. 30 and read 635' at line of 30 & 31. About 70 rods E. we rise to a gravel and boulder bar that starts near sec. line and runs S. into sec. 31. It reads 650' near crest. There are many granites and other erratics of all sizes. Those less than a foot in diameter are well rounded. There are deposits of this sort nearly to the school house in NW corner sec. 32 where the limestone comes to surface at 655'. Boulders are numerous E. from here for 60 rods then a descent over rock reefs sets in and

boulders are not numerous. We read only 630 at quarter post secs. 29 & 32.

The reefs run to about 120 rods E. of quarter corner where sand sets in - aneroid reads 610' here. I read 595' at Grassy Lake. There is a gravel bar E. of N. end of Lake 5-6' above it. Coarse gravel & cobbles. There is a strip about 80 rods wide of this gravelly cobbly sand on E. side of Grassy Lake - its entire length. The outlet cuts it in E. part of sec.33 in a narrow channel 8-10' deep.

Nipissing Shore

29.145 at L. Huron at 10:00 A.M. at a bay in sec. 26.
29.122 at sandy ridge at forks of road 40 rods west.
29.110 at RR track by sand ridge.
29.110 on sandy cobbly bar east of Grass Lake - 612 - 615' A.T. The lake is nearly 610' - probably 608'.
The Nipissing shore is at base of a rock reef 4/10 mile W. on line secs. 29 & 32.
29.090 at shore. It runs east of south from here toward SW edge of Grass Lake.
29.075 at quarter post secs. 29 & 32 - 645'
29.050 at corner secs. 29, 30, 31 & 32 - 665' A.T.
29.065 at quarter post secs. 30 & 31 - 650'
29.065 at RR crossing on line secs. 25 & 36 - 650
29.025 at Summit on rock reef about .45 mile west of RR - 690'

A gravelly cobbly beach crosses road NSE-WNW course. An. 29.015 - 698'. This is W. of quarter post 29.020 at corner secs. 25, 20, 35 & 36 where it read 680 yesterday. Today it reads 690 but yesterday's readings seem more reliable. I adjust to this alt.

Algonquin Bar 715'

A low gravelly ridge 3/10 mile W. is 685. 29.025 at corner secs. 26, 27, 30 & 35 - 685 by earlier readings. This runs W. 1/2 mile as a reef. Then a gravel bar runs WSW into N. part of sec. 34 at 685' -

West from here are ridges running NNW-SSE the eastern one is 700' and one back of it 715'. They are closely banked together. These are ⅌ cobble & gravel. We go S. 3/10 mile on line secs. 33 & 34 to where the gravel ridges cross it. The highest is 710 - 15' and one S. of it about 700'. The

ridges run S. of W. from here across the section. I think the same ridge crosses the line of secs. 32 & 33 about 4/10 mile from N. end. The reading on it today is 407' but this may be too low. There is a rather irregular ridging of gravelly material about 1/4 mile E. of corner of secs. 28, 29, 32 & 33 with ENE-WSW trend and this runs into connection with the more prominent ridge in the NW part of sec. 33. There are also faint ridgings in NE part sec. 32 at a slightly lower level than the main shore ridge that crosses from 33 into 32 4/10 mile from corner secs. 28, 29, 32 & 33.

We noted a rather abrupt rise on line of secs. 28 & 29 about 80 rods from S. end but did not go to it. The aneroid read about 698 at corner of secs. 28, 29, 32 & 33 and this ridge is about 10' higher or similar to the one 4/10 mile S. in alt. There is no road on line of secs. 29 & 32 and the brush obscures the view into sec. 29 so we cannot see whether these ridges run together SW from here though that seems probable. We continued S. on line of secs. 32 & 33 and descended rapidly reading 670 at corner of secs. 32 & 33, 4 & 5, and 645' at D & M RR a mile farther south. We came into sandy ridges in NW part of sec. 9. There are occasional small limestone exposures in the sandy area as well as bouldery land between the sandy ridges. There is a gradual descent from here to the shore in Alpena. The aneroid read correctly at Federal Bldg. at noon but was off 20' by 1:00 P.M.

Esker

An. 29.170. We went W. to the esker on M 10 highway and traced it to the N. end in NE part of sec. 14, T 31 R 6 E.

Algonquin Beach

The highest Algonquin beach is along its E. base and continues N. into SW part of sec. 12?? fully 1/4 mile beyond the end of the esker. A sandy plain about 10' lower continues northward to Thunder Bay River. At its E. edge there is a few ft. drop to a cut tract standing about 690-695'. The plain is 700-710' and the highest tract about 720'. 29.070 at testline-724' A.T.

Ridge just W. is 728. We went to Long Rapids and then E. on N. side of Thunder Bay River to where North Branch comes in. There is a spur in SW part of sec. 34 that runs E. like an Algonquin shore feature. It is about 80 rods S. of the highway and runs 80 rods-+. N. from here is low land which was probably covered by Lake Algonquin. It seems to extend into secs. 27 & 26 as well as secs. 34 & 35. In sec. 36 higher land comes in view a short distance from the highway that is up to the full height of Lake Algonquin and this also covers the N. part of sec. 31, T 32 R 7 E. Lake Algonquin covered sec. 32 & 29 and considerably farther up North Branch valley. We went N. on E. side the river in sandy land to S. side sec. 20 and there entered undulating till which rises to about 730' in SE part of sec. 20. There is considerable complication from here N. and E. past Cathro?? and Bolton. Some knolls being above the lake and considerable land below it. A ridge N. of Cathro 1/2 mile is 750-755' and has gravel at N. end with a pit in it. It may be a glacial feature, however. There are gravelly cobbly deposits in sec. 13 that seem to be lake work. The aneroid makes their alt. about 745' but it read too high when I reached the shore line at corner secs. 16, 17, 20 & 21. So they may be only 730'. The N-S road crosses one near S. end of line secs. 13 & 14 and there is a pit in one in S. part of sec. 13 near the E-W road on line of secs. 13 & 24.

Features in Central Alpena County

There is a sharp ridge W. of center of sec. 13 that we did not examine but it is about the same height as the ones near the road. There is a flatter surface than usual along line of secs. 18 & 19, T 32 R 8 E but I am not certain it was covered by L. Algonquin. I passed an exposure of striae on this line W. of the quarter post. Bearing about SSE. There is 30' descent from W. to E. end of this sec. line. The swamp in secs. 17 & 20 seem to be 25' lower than the beach in SW part sec. 16 or about 690' A.T. My

aneroid read 720 on it and 745-750 on the beach - yet when I got back to camp in sec. 23 it read correctly.

August 23, 1924. An. 29.285 - 640-645' at camp in sec. 23 near SE end of Long Lake at 7:00 A.M. I read 910 on strong beach east of quarter post secs. 16 & 21 (An. 29.210). On gravel beach about 70 rods from west end of line secs. 16 & 21.

An. 29.175 - 735' where my work Aug. 19 made it 715.
An. 29.190 at corner secs. 16, 17, 20 & 21 - 725'-f
An. 29.175 at summit on line secs. 20 & 21 at 7:45 A.M. - 740' bar
An. 29.190 at corner secs. 20, 21, 28 & 29.

Gravel beach on line secs. 21 & 28 about 80 rods from west end An. 29.185.
29.190 on reef in SE part sec. 21.
29.185 on gravel bar 120 rods from west end of line secs. 21 & 28.
29.180 at corner secs. 20, 21, 28 & 29.
29.170 at corner secs. 19, 20, 29 & 30 at 9:30 A.M.
29.160 about 100 rods east on summit of reef. Striae here SSW.
29.170 at corner secs. 20, 21, 28 & 29 at 9:45 A.M.
29.145 1/2 mile north
29.155 at gravel ridge SW corner sec. 16 by pit.
29.155 at track in NW part sec. 16.

The high part in west part of the sec. is 8-10' higher. This is probably 740' and the bar on SW part of sec. 16 is 730' instead of 715'. 29.255 at Long Lake - 640'.

Algonquin Beach 730'

29.150 on swamp line of secs. 17 & 20 - 705'. The corner of secs. 17, 18, 19 & 20 is 715'. A ridge 60-80 rods N. is 725-730' - a rock reef. There are reefs to the W. and SW into NE part of sec. 19. To the N. all was covered by lake waters. We come to the old shore on line secs. 18 & 19 at 3/10 mile from E. end at 730'. The land is this high only in N. part of sec. 19. The NE corner of sec. 24 is above 730 the reading at corner of secs. 18, 19, 13 & 24 being 742'. The land drops off rapidly at 40-50 rods south of this corner. We went N. on the range line 2 miles and crossed reefs up to 770' A.T. on line of secs. 7 & 12 near middle.

The Algonquin shore cuts across the NE corner of sec. 12 and runs SS^{E} for a mile from there crossing the line of secs. 7 & 18 E. of the middle.

It runs NW across sec. 1 to the corners of secs. 1 & 2, 35 & 36 and to a lake in sec. 35, T 33 R 6 E in Presque Isle Co.

Lake Algonquin up to 730'

The shore is along a rock reef from sec. 11? ~~???~~ near center NW to this lake. The alt. reaches 755-760 in S. part of sec. 1 and N. part of sec. 12 and maintains this alt. northwestward into sec. 2, T 32 R 7 E. 29.095 on range line corner 7 & 18, 12 & 13 at 330 where it read 13' lower Alt. an hour ago. We set aneroids at 742' and drive westward - soon reading to 730'. The surface above this alt. is not wave washed like it is below so we feel pretty confident of this being the highest Algonquin level. The land is up to 730' or more in sec. 24 only on N. edge of NE¼. We come to a gravelly bar with pit in it near middle of line of secs. 13 & 24. It was built by current running SE along the shore. There is a cut bank where it ties into the higher land at the north.

The west part of sec. 13 is largely swampy land about 715'. The swamp runs north into sec. 12. In SE part sec. 14 is a small island of Lake Algonquin only a few acres with a gravelly cobbly bar running west from the sec. line of 13 & 14 fully 80 rods on S. side of island. Another island is just N. of Cathro on line of secs. 14 & 15. A gravel bar skirts its W. side from near quarter post of secs. 14 & 15 in a course W. of S. across line of 15 and 22 at D & M RR and dies out in NE part sec. 22. There is a gravel pit in its N. end and it here stands 15' above land each side. The N. edge of the lake at this time was near line of secs. 11 & 14, and the shore runs NNW across E½ of sec. 10, then turns westward in SW¼ sec. 3 into sec. 4. This whole stretch from SE part of sec. 11 to sec. 4 is in view from the island N. of Cathro. We saw a gravel pit in the beach in S. part of sec. 11 but did not go to it.

We drove S. from Cathro and came to a lower shore line at about 700'

A.T. that is along or near the angling road in sec. 26. There is a gravel pit in it at line of secs. 26 & 35. It curves around across NE corner of sec. 35 and runs into sec. 36 only a short distance to a swamp. This is 700' at its SE end on line of secs. 35 & 36.

There is sandy land along the beach in sec. 26 from center SW but in NW part there is till and there is till SS? & SW from Cathro to where swampy land sets in. This 700' shore probably runs along border of swamps in secs. 22 & 23. South from here the soil is rather sandy clear to the Thunder Bay River but boulders are not rare and rock sets in at slight depth. We are not able to distinguish the Nipissing shore N. of Thunder Bay River but it probably runs from sec. 17 into sec. 9.

Lake Nipissing

August 24, 1924. Long Lake, Alpena County. We drive S. 3½ miles and then go E. to Huron Beach at center of sec. 3, T 31 R 9 E. There is swamp at level of 640' on line of secs. 2 & 11, T 31 R 8 E. E. of which is a cobble slope at 645-650'. We find a good beach E. from here on line of secs. 1 & 12 at 645-650'. This runs through NE part of sec. 12. There are reefs up to 660' along E. part of line of secs. 1 & 12. The road leaves the line of secs. 6 & 7 near quarter post and turns ENE rising over nearly bare rock to 675' in E. part of sec. 5. There is an abrupt descent to Lake Nipissing level in W. part of sec. 4. The shore runs southward from here a mile or more into sec. 9 and seems to be near the corner of secs. 8, 9, 16 & 17 being W. of the railroad that runs N. in NW¼ sec. 16. It may lie in N. part of sec. 17 but does not come to the road on the E-W quarter line of sec. 17. Rock is at surface in W. part of sec. 16 and in sec. 17 and the alt. on the road is 605-615'. There is a reef in SE part of sec. 10 that is 615' and rock is near the surface westward across secs. 10 & 9.

The long peninsula east of Alpena that ends at North Point is reported to have considerable cover over the limestone and there are some sandy ridges in SE part. None of it seems to reach the level of Lake Nipissing. We found gravelly bars near the present shore from Huron Beach in sec. 3 around to the railroad in sec. 16 at about 600-605' or less.

Nipissing

The only rock seen is a reef in SE part of sec. 10 that is 615' at crest in road. This is less than 1/4 mile from the present shore. We went N. on road in sec. 18 into sec. 7 and came to the Nipissing shore on sec. 7 about 40 rods S. of the E-W quarter line road. This is within 80 rods of W. line of sec. 7 according to a record on a survey by Henry Ford. We went N. 10 rods from the E-W quarter line on the Henry Ford Survey line and reached the highest part of the rock ridge at 650'. This is the same as it read on the E-W road 1/2 mile north. The Nipissing shore seems to run W. across the S½ sec. 12 as shown by notes on line of secs. 11 & 12. It crosses that line about 1/4 mile from the S. end.

Algonquin Beach 732-734

We returned to the camp at Long Lake for dinner. I then run hand levels to the beaches on line of secs. 16 & 21. I reach 680' at a low ridge near corner of 15, 16, 21 & 22. The gravel ridge 30-40 rods E. of quarter post of secs. 16 & 21 is 705' at house N. of the road and 702' at house S. of the road.

There is a sort of notching of slope W. of this at 713-715'. The base of the highest Algonquin is 718' and crest 732-734'. It is 732' at Cadarette's house in sec. 21 and 734' in the field in SW part of sec. 16 where it doubles around to the W. I am told by the man who lives on the 705' beach in S. part sec. 16 that this ridge runs W. of N. in a pretty direct course and comes to the N. line of sec. 16 about 80 rods from W. end. It

then forms the strong bar noted in SW part of sec. 9. We go back to camp and take Grand Lake road to the county line, then go E. In about 80-100 rods we rise to a gravelly area 675 to 685' A.T. that runs NSW about to the line of secs. 1 & 2. There is an abrupt drop E. of this to 645' at corner of secs. 1 & 2, 35 & 36.

Lake Nipissing

We follow an old road winding eastward and in about 1/2 mile are down to 625'. There is a reddish clayey shely soil from 645' down to 625' with scarcely any water-worn material on it. It probably was covered to at least 630' by Lake Nipissing but we do not find gravelly or sandy beach ridges after going 1/2 mile at a level about 625'. Dr. Ver Wiebe went on by compass course eastward with barometer to test the readings at the lake. He came into cobbly strips within 1/8 mile and they extend to the edge of a cliff NW of Rockport that is about 615' at top. Probably Lake Nipissing covered the E½ sec. 1 and a little of NW¼ sec. 12, T 32 R 8 E.

Strice

August 25, 1924. Camp at Long Lake. An. 29.210 - 640'. We examined the striated exposure near N. end of line of secs. 34 & 35, T 32, R 8 E. The bearing is S 30 - 32° E for magnetic variation. The cherty places have ribs in the bar extending for several inches SSE from them in the best cases. This makes it certain the ice was moving <u>toward</u> Thunder Bay SSE instead of away from it to NNW. Dr. Ver W or Viebe took a view of this exposure but may have overtimed it. We turned W. on line of secs. 3 & 10, T 31 R 8 E rising from 648 at corner to 660' 30 rods W. Another reef near S. end of line secs. 3 & 4, is 660'. The corners of 8,49 & 10 is 645'. There is another reef in view 1/2 mile north.

Features near Thunder Bay River

We come to sand dunes on line of secs. 4 & 9 near Michels at 645-650' on the ridges. We read 640 at D&M RR at sec.corners 4 & 5, 8 & 9.

We took road NW along RR and at 8 miles we find a cut in cobble at 675' A.T. A beach runs ENE from here at this altitude. There is a beach at 695-700' at corner of secs. 5 & 6, 31 & 32. It is a strong cobble beach and runs ENE across sec.32 crossing into sec. 33 a little N. of quarter post. It curves around through N. part NE¼ sec. 6 and comes back into sec. 31 near quarter post of 6 & 31 and runs into sec. 36 near quarter post.

We find it dies out about 60 rods W. of the sec. line. The beach is forked at NW end and is only 690-695' at this sec. line. The alt. is 675' at twp.corners. This is near a stream and has bouldery loamy soil. About 1/2 mile S. is a strip of sand with low sand ridges at about 660'. South of this rock is at surface to Thunder Bay River at the new dam under construction. The aneroid reads 655' here.

We go up the river road. The alt. is 665 at line of secs. 1 & 2, T 31 R 7 E and we read the same at line of secs. 33 & 34 T 32 R 7 E where we turn N. There is a beach of sandy gravel at 690' a short distance N. of corner of secs. 27, 28, 33 & 34. It runs around the border between rock and dry land NE to center of sec. 27 and then E. to center of sec. 26 to where we traced it Aug. 23 in SE part of sec. 26. Probably the wet land of sec. 28 was also covered at this stage. The land is good farm land N. from here a mile with till of more thickness than usual. There are several drumlin shaped ridges crossed by the line of secs. 22 & 27, 23 & 26, the easternmost one being just W. of D&M RR. They trend NW-SE and stand 15'-/ above the border land.

Algonquin Shore near Cathro

We noted wave washing at W. base of the one W. of the D&M crossing at line of secs. 23 & 26 about at the level of the RR and 5-6' below the level of the drumlin. The lake probably covered wet land NE from here into sec. 24 and all of sec. 25 except the NE corner. It also extended into SW of sec. 30 and W. part of sec. 31, T 32 R 7 E to where the bar runs W. that we noted this morning.

We went N. through Cathro and found the shore just N. of corner of Secs. 10, 11, 14 & 15. The E. part of sec. 10 is above the highest Algonquin shore but the rest may have been covered. We go W. on line of secs. 10 & 15 and find a gravel bar on W. slope of a hill near middle of sec. line. A pit in it exposes 4-5' of cobble and gravel. The aneroid read 745' here and 735 at Bolton Station. My map has Bolton marked 730' so this bar seems to be about 740'. There is a wave-washed plain W. of it 5-10' lower. The NE part of sec. 9 is above Algonquin level but most of the sec. is a little below 730'. The main shore runs E-W across SE¼ sec. 4 and curves around through SW of sec. 3 and runs SSW to SE corner of sec. 10.

There are small areas above this in S. part of sec. 5 and NE of sec. 8. W. of the latter is a gravelly beach running from S. part of sec. 5 in a W. of N. course for 1/4 mile into sec. 8 where it ties onto the till tract E. of it. This beach has gravel pits in it both in sec. 5 and sec. 8. It is about 735'. There are wave-washed limestone ledges W. of it up to 730' - both in sec. 5 and 8.

Peninsula at Algonquin Stage

There is an extensive swampy plain W. from here to beyond North Branch of Thunder Bay River probably nearly to the N-S center road in T 32, R 6 E and northward into the edge of Presque Isle Co. I can see high land with hardwood timber on the W. side of this wet tract.

We crossed over the peninsula that stood above Lake Algonquin in secs. 4 & 3, T 32 R 7 E. The SW part of sec. 4 is on the Thunder Bay side and the NE of sec. 3 on the Lake Huron side. This shore runs S. of a lake in secs. 33 & 34, T 33 R 7 E in Presque Isle Co. The N. part of sec. 2, T 32 R 7 E is below the Algonquin shore. There is a gravel bar running NW from the NW part of sec. 2 into sec. 34 that is about up to the highest Algonquin level - 735'.

The land on this peninsula reaches about 800' A.T. in N. part of sec. 4, T 32 R 7 E and as far SE as the N. part of sec. 11. I read 780' on a summit on line of secs. 2 & 11 and the land is 20' higher within 1/4 mile SW.

There are small till islands S. & SW of Bolton in secs. 16 & 17 that rise to about 750'. There is a ridge in view to the W. near line of secs. 17 & 18 that may have been an island. It is nearly up to Algonquin level.

On our return we passed over the ridge NW of Gathro Station and found it is till and about 5' above Lake Algonquin with a notch on its W. slope. The gravel bar 1/2 mile NNE near N. quarter post of sec. 15 ties on to the till island to the S. within 50 or 60 rods from the N. end.

We noted a gravelly deposit in the road N. from Bolton where we ascended in sec. 4 to the upland at an alt. 20' too high to match the beach that we are considering the highest Algonquin. It is about 755-760'. The gravel has a depth of 3-4' and is shaped like a low flat bar 12-15 rods wide that runs 20-30 rods W. from the road. If there was a lake stage at this height it was so short lived as to have very few traces. The beach at 735' is well defined and unmistakable. Such a bar as this at 755-760' may prove to be due to glacial outwash - rather than a lake feature.

Mapping in Southern Alpena Co.

August 26, 1924. We went into southern part of the county to map border of till plain and moraine. We find secs. 2 & 11 are not morainic but have smooth swells elongated NNW-SSE but scarcely well shaped drumlin forms. On Schultz brothers' farm in secs. 10 & 15, T 29 N 7 E, a boring NE of NE of sec. 15 went 160' in rock. Alt. about 735. No flow. There is a flowing well in SE part of sec. 10, only 60'. The alt. is 730' at the flowing well. The till plain covers the NW of sec. 14 and NE part of sec. 13. The moraine covers the greater part of each section. It is a more sandy drift than the

till plain as well as of rougher surface and has much higher points on it being about 900'. The E. border runs through W. edge of secs. 19, 30 & 31, T 29 R 8 E. The highest part runs near W. side secs. 13 & 29, T 29 R 7 E and near line of secs. 25 & 26, 35 & 36. Points on it may reach 925-930'. We crossed one 915' near corners of secs. 25, 26, 35 & 36. There is a bog of 100 acres or more in SW¼ sec. 25 that is about 870' A.T.

We went diagonally across sec. 25 and then W. on line of 26 & 35. We descend to 800' at a swale near W. end of the sec. line. W. of this in E. part of SW¼ sec. 27 and NE of sec. 34 are rather smooth till ridges with N-S trend about 825'. There is a rather steep slope W. of them down to 50' lower or 775' and then a gentle descent westward to Hubbard Lake Village. We read 750' at the cross roads in Hubbard Lake Village at noon. The SE part of sec. 34 is hummocky moraine. This runs S. past the E. side of Hubbard Lake.

There is a strong moraine on the W. side of the lake which continues N. into Alpena Co. covering most of secs. 31 & 32 and W. part of secs. 19 & 30 T 29 R 7 E. There is an isolated hill in sec. 29 extending into SW of sec. 20 and edge secs. 30 & 19 which has till plain around it. The hill has gravelly sandy loose textured drift while the till plain has reddish clayey till. It is about 875'.

In the NW part of sec. 32 is a drumlinoid hill with NNW-SSE trend of smooth slopes and composed of red clayey till. At its S. end the hummocky loose textured drift sets in. Two other drumlinoid hills were noted in sec. 17, one being in S. part and the other in W. part, extending a little into sec. 18. These trend NNW-SSE. These hills have a relief of about 30' above border plains.

Around the corner of secs. 7, 8, 17 & 18 there is another isolated hill with loose textured drift. It is about 880' A.T. or 60-70' above bordering plain tracts. It is over 1/2 mile long N-S and about 1/4 mile wide.

The surface all around it is plane and drift clayey till. We find there is only a narrow strip of swampy land along Wolf Creek in secs. 11 & 12, T 29 R 6 E, mainly S. of the stream. There is some sandy land around the corners of secs. 1, 2, 11 & 12 at about 750'-40' above the creek. There is a rapid rise northward from it to 790' in NW part of sec. 1.

Moraine to the N. & W. is about 800' at base and 850' on the high points. It extends slightly into the W. part of sec. 36, T 30 R 6 E, and covers secs. 26 & 35 except E. side. It also runs S. into W. part of sec. 2 and over much of sec. 3, T 29 R 6 E & W across S. part of T 30, through secs. 34, 33 & 32 and S. part of secs. 27, 28 & 29. Rather wet land N. of it is crossed by an E-W gravelled road in secs. 22 & 23. We here noted a thin deposit of pebbleless red clay only a foot or so thick over a sand deposit. Where the sand is slightly ridged the clay arches over it. It looks like a ponded water sediment.

The esker that I traced from near Thunder Bay River SSW into this twp. is crossed by the gravel road in E. part of sec. 21, T 30 R 6 E and is very sharp here with gravel suitable for road use. It seems to continue a mile or so farther to NE part of sec. 28 but is not so sharp and is rather sandy. There is sandy land each side for a short distance E to W. A till plain then sets in. This has drumlinoid ridges one being near line of secs. 20-21 and another in W. part of sec. 20. We drove back E. on the gravel road and noted a strip of dame in NE¼ of sec. 25 and NW of sec. 30, T 30, Rs 6 & 7 E and another in central part of sec. 19, T 30 R 9 E that reach 850 to 895'. They are of looser textured drift than the bordering till plains. There is a gravel pit in the one in sec. 19.

Artesian Well

Aug. 27, 1924. There is an artesian well back of the Fletcher Co. Bldg. across street from the post office in Alpena. It was made about 35 yrs. ago.

Features between Flanders & Hillman

We drove out on North Point and found it made of low ridges of rather sandy type only a few places being gravel and cobble. The highest ridges are about 610'. There are some small lakes as well as the Crooked Lake stream on highway map. The percentage of swamp is rather low - a large part being occupied by sandy gravel shore lines. We went W. on M 10 ~~kgk~~ highway to highway 32 near Lachine and then W. to Hillmen. We passed ~~over~~ drumlins to W. part of sec. 24, T 31 R 5 E from Flanders. Then after crossing the branch of Thunder Bay River that comes in from Turtle Lake, we were in a tract with looser textured drift and some sharp knolls in sec. 23 and NW of sec. 24. These have pine timber while the drumlin areas have beech and maple.

In secs. 22 & 27 there is a smoother surfaced tract with several drumlinoid ridges. One near corner of secs. 22, 23, 26 & 27 has its long axis NNW-SSE but others trend W. of S. There is a very prominent moraine S. of here in secs. 33 & 34, T 31 R 5 E. This moraine strip extends S. about to the BCG&A RR in secs. 8, 9, 10, 17 & 18, T 30 R 5 E. It covers secs. 5 & 8 except NW of sec. 5 which has a drumlinoid ridge on it that runs a little into sec. 31 on the N. and sec. 6 at the SW end. E. of this is a hummocky tract, partly lower but mainly higher than the drumlin.

Clay Beds in Sand Ridges

The drumlin is 790-800' and the moraine gets up to 830' on line of secs. 4 & 5. W. of the drumlin is a swamp 740'. There is another drumlinoid ridge about 780' on highest part that runs NNE-SSW past the corner of secs. 29, 30, 31 & 32, T 30 R 5 E. This and the one to the S. are each nearly a mile long and nearly 1/4 mile wide in widest part.

We found a puzzling feature on line of secs. 29 & 30 near N. end where the road cuts across a sharp sandy ridge that we supposed to be a dune ridge but the road cut shows thin beds of sticky red clay a foot or less thick interbedded with sand deposits and capped by several feet of sand. The deposit seems to be a water rather than wind deposit but being in a sharp ridge its deposition is difficult to picture. Along highway 32 W. from here are low clay hummocks 5-6' high with swampy strips among them. The clay seems to have no pebbles in it and carries calcareous concretions. It is mottled with pale greenish places in a red material. The cause for the peculiar hummocks is not apparent to us. Were the deposit flat surfaced we would refer the deposit to local ponding of waters outside the ice sheet. The slopes of these clay hummocks and ridges is steeper than clay usually stands. Whether glacial advance over a lake bed would give this topography we do not know. North of this clay hummock area and of the ridge with sand & clay interbedded, there is a flat sandy plain covering sec. 19 except a small area in SW corner and extending into N. part NE¼ sec. 30 and NW¼ sec. 29 and also covering much of sec. 20, T 31 R 5 E. It is about 740' A.T. The district S. of the sand ridge in sec. 30 & 29 has few if any boulders in the part outside of the drumlins, but the drumlins are thickly strewn with them and the material is stony till. Strikingly different from the clay just noted.

There is some hummocky moraine land in SW¼ sec. 21, NW¼ sec. 28 and E. part of sec. 29, T 31 R 5 E. The drift is looser textured than on the drumlins and swales each side but the hummocks are small with gentle slopes. They are perched on a massive ridge that runs NNE-SSW from center of sec. 21 to S. part of sec. 29, T 31 R 5 E. From here we drove back through Lachine and Long Rapids and Cathro to the camp on Long Lake.

Beaches at Orchard Hill

August 28, 1924. Aneroid 29.320 at Long Lake - 640'-f. 703 at base of bluff at Orchard Hill, at second beach 731 at bar at top of hill.

The terracing W. of here where bar turns N. shows ordinary lake level to have been at 723'. There is a slight bar at 728' where the bar runs N. and had an exposure to W. There was an island in S. part SW¼ sec. 30, N. part NW¼ sec. 31 and NE part of sec. 36 that occupied about 80 acres whose highest part is about 745' A.T. Rock is near the surface but there is a thin coating of reddish till. The leveling was from the bridge on Thunder Bay River on line of sec. 36 & 31 which is 679.6 as determined by Prof. Wisler (See p. 36).

We determined the limits of Lake Algonquin on the W. in T 32 R 6 E The shore features are very distinct all the way from Thunder Bay River a mile E. of Long Rapids Northward into Presque Isle Co. Only a few acres in W. part of sec. 34 stood above the lake. The shore passes near the quarter post and curves around in W. part NW¼ and crosses the NE corner of sec. 33. It has a gravelly sandy bar where it crosses M 10 highway about 60-80 rods from N. end of the line of secs. 33 & 34.

Limits of Lake Algonquin N. of Thunder Bay River

A bay extended NW into sec. 28 toward the center of the section. The shore comes from sec. 28 into sec. 27 a few rods N. of this quarter post. A bar runs from it SE across the E-W quarter line rosd to a small island in SW¼ sec. 27 of 10 acres-/. The shore crosses into sec. 22 about 60 rods from W. end of line of secs. 22 & 27 and swings W. crossing into sec. 21 within 40 rods of S. end of line of secs. 21 & 22. It runs back only a short distance into sec. 21 and then returns into sec. 22 S. of the quarter post of 21 & 22. It curves around to the N. and runs across the NW¼ sec. 22 and comes to the corner of secs. 15, 16, 21 & 22. There is a bar E. of here nearly 1/4 mile that runs N-S from S. part SW¼ sec. 15 into NW¼ sec. 22.

The shore is along or near the line of secs. 15 & 16 nearly to the quarter post. It then runs into sec. 15 about 60 rods and turns N. and runs into SW part of sec. 10. It there turns W. into sec. 9 near S. end of the

section line and bears NW passing a few rods E. of the center and then N. into sec. 4. It crosses the SW part of sec. 4 and leaves Alpena County in NE part of sec. 5. E. of North Branch of Thunder Bay River are islands of Lake Algonquin. One in NE¼ of sec. 4 extends into Presque Isle Co. Another is mainly in SW¼ sec. 34, T 33 R 6 E but runs into E. part of sec. 33 and also SE to N. part of sec. 3, T 32 R 6 E.

Glacial Features

We did not work out the limits in Presque Isle Co. but returned to Long Rapids on a road coming in from the N. on line of secs. 8 & 9, 16 & 17, etc. The till seems to be morainic or at least hummocky in topography where it rose above Lake Algonquin level in secs. 4, 5, 8 & 9, T 32 R 6 E but seems to have a till plain topography much of the way S. to Long Rapids. There are a few hummocks in E. part of sec. 20 and NW¼ sec. 21. The till plain topography is found along the road a mile E (M 10 highway) all the way from Thunder Bay River to the North Branch but morainic knolls appear on north side of North Branch in sec. 4 and 34 as noted above.

Kames

From Long Rapids we drive S. past Lachine and over the kame area. The summit in road is 875' in a cut 15' deep. The N. slope is mainly gravel but the S. has some clayey till.

We turned E. at the township line and then S. across sec. 3, T 30 R 6 E. The barometer read only 715' at the swamp on Bean??or Bear?? Creek swamp in sec. 3 one of which has a gravel pit opened in it. These knolls are longest N-S but do not make a continuous esker ridge. They seem better classed as kames.

Moraine

We find a widespread sandy deposit between Bear??or Bean?? Creek and the esker in secs. 9 & 10 but a till swell of considerable prominence occupies much of sec. 3 E. of the creek. There may be sandy soil between it

and the esker in W. part of sec. 2. There is sandy and gravelly swampy land between two forks of Bear or Elk in secs. 8 & 17. The ridges 8-10' high are covered with tamarack, as much as the depressions between them. We find till sets in near W. end of line of secs. 8 & 17. There is a cut in a low ridge on S. side of the road that shows 3' of ordinary clayey till over sandy gravel. We find a moraine with loose textured hummocky drift as far N. as the S. part of sec. 19, T 30 R 6 E. There is till plain W. of it extending S. to Beaver Lake. W. of that is moraine as far N. as secs. 22 & 23, T 30 R 5 E. This is separated from moraine in the N. part of the twp. by a swamp 2 miles wide. The moraine reaches nearly 900' on highest points in SE part of sec. 22 and NE of sec. 27. There is strong moraine from here S. to the SW corner of the county past E. side of Turtle Lake. The moraine E. of Beaver Lake and Beaver Creek runs S. nearly to the county line or to where Beaver Creek turns E. to enter Wolf Creek. We went S. on this moraine to S. part of secs. 19 & 24, T 29 Rs 5 & 6 E. This is a loose textured till part of it with sharp knolls but some gently undulating. There are several ridges above 900' and one on line of secs. 13 & 18 is 975'. The moraine W. of Beaver Creek has points that seem to be still higher or 1000' or more.

There is an extensive swamp E. from this moraine bordering the N. flowing part of Wolf Creek. It extends N. about to secs. 4 & 5, T 29 R 6 E. There are some farms in these sections. N. of this is moraine of strong expression in secs. 32, 33 and S½ of secs. 28 & 29, T 30 R 6 E. The moraine expands eastward to cover sec. 3 and part of sec. 2, T 29 R 6 E and most of secs. 26, 27, 34 & 35, T 30 R 6 E. It is very prominent in sec. 3 and to the NE into sec. 26. It is also prominent around corner of secs. 28, 29, 32 & 33.

Striated Boulder

We returned through Flanders & Lachine to the camp S. of Long Rapids. Dr. Ver Wiebe took a photo of a striated boulder in the road opposite the camp which shows striae straight across the top but curving around the

west edge. These curving striae turn from slightly W. of S. to several degrees E. of S. Those on the top of the boulder are nearly due S.

Gravel Pit

August 28, 1924. Dr. Ver Wiebe and I drive W. from Long Rapids stopping at the gravel pit 2 miles W. that we noted on a previous trip. This is in a ridge that curves around from a westward to a southward course in the NW part of SW¼ sec. 31, T 32 R6E and ties onto a prominent knoll at the range line which extends SSW into SW¼ sec. 36, T 32 R 5 E. The gravel is 790-795' and highest part of the knoll 805' by barometer, being the highest point in this vicinity. The gravel pit is at the curve as shown in sketch and it dips very steeply to the NW from the top of the ridge. It is excavated to depth of 10 - 12'.

The dip is steeper than the slope of the ridge and shows a building out toward the NW. There is also gravel at the SW end of the ridge but not opened so well. An old pit was opened in it. There are pockets of gravel on the till along the road. This is probably to be classed as a kame but it has not much relief (15-20') above bordering plane tracts. We continued a mile W. then S. 1/2 mile to corner secs. 35 & 36, 1 & 2. Alt. 755' A.T.

There is till for 1/2 mile or more W. on the line of secs. 35 & 2. A swamp is then entered which seems to be underlaid with sand for the few dry places along the road are sandy. The alt. of the swamp is 745 to 750' on the line between Twps. 31 & 32, R 5 E. It is called the "Five Mile Swamp" because it has a width of about five miles.

We come to clayey soil near corner of secs. 31, 32, 5 & 6 but it is a pebbleless red clay and has a thin sandy coating. About 40 rods from the county line we come to bouldery till. We turned S. on the county line

and found scattered boulders for 1½ miles to a prominent ridge 815' A.T. This ridge has low sandy knolls on its crest. South of this is a steep descent to about 775' and we saw no boulders in the next mile south to corner of secs. 13 & 24, 18 & 19. But within 1/4 mile W. we found boulders on line of secs. 13 & 24 and again near W. end of the line.

Features near Hillman

There is a rather smooth surfaced till here with points up to 800' A.T. The Hillman depot in Thunder Bay valley is 752.5'. We went north from Hillman 3 miles. The till has nearly plane surface or smooth slopes, except in a sharp knoll in W. part of sec. 12 which rises to 835' or 40' above bordering plane tracts. This knoll is thickly strewn with small boulders. S. from here on line of secs. 13 & 14 and S. part of line of secs. 11 & 12 there is a pebbleless clay which is in places ridged to height of 10-15' as sharp as an esker.

There are sandy ridges and knolls of pebbleless clay on line of secs. 1 & 2, T 31 R 4 E. The NE part of sec. 1 and E½ sec. 36, have kame-like knolls with sharp contour, the highest being 30' or more.

We went N. on the line of secs. 31 & 32, T 32 R 5 E - across a sandy wet plain that covers the E½ of sec. 31 & SE part of sec. 30 as far NE as a stream. N. of this stream there is clay and till clear to North Branch of Thunder Bay River. It is nearly plane or has smooth surface except in NW part of sec. 20 and W. of sec. 17 where sharp knolls 26-35' high occur.

We are told that the river passes through a chain of sharp knolls in sec. 8, T 32 R 5 E. We went W. on line of secs. 18 & 19, across a clay plain with few boulders. Then we went N. to a commanding viewpoint on the county line near N. end of line of secs. 13 & 18 standing 800' A.T. From here we could see sharp knolls to the NNE in sec. 6 and to the E. in sec. 8 and SE in secs. 17 & 20. There is a smooth surfaced district to the N. as far as the river. We returned through secs. 24, 25 & 36 to the road on

which we came and then went back to Long Rapids for lunch. I went with L.R. Schoenemann a mile W. from Long Rapids and then S. 1 3/4 miles. There is a bouldery till a little beyond the corner of secs. 5, 6, 7 & 8. S. of this is fine sand with few if any pebbles. The aneroid indicated 730 -35 as its alt., or a little higher than the usual barometric readings on the highest Algonquin beach. The aneroid, however, is working toward low barometer so it may be no more than 720'. We returned to Long Rapids and went N. on M 10 highway to within a mile of Posen crossing island-like tracts on line of secs. 33 & 34, T 33 R 6 E and rising above Lake Algonquin level on line of secs. 27 & 28. The land is hummocky and very bouldery and the drift is cobbly and rather loose textured.

We went E. a mile to D & M RR midway between Posen and Pulaski over hummocky drift. We then went N. about a mile to the highway that winds around in sec. 23. It is over rock knobs and drift hummocks. We turned S. on line of secs. 23 & 24 and came to a strong gravel beach near corner of secs. 23, 24, 25 & 26 that runs SE into sec. 25 and westward in S. part of sec. 23.

Algonquin Beach at Pulaski

South from here in the NE part of sec. 26 there is a smooth swell on the W. slope of which a strong beach was formed. This swell dies out just N. of Pulaski Station. The shore line is about 5-7' above the station. My aneroid read 758' at the station and 765' on the Algonquin shore. Probably this is too high.

We went S. from Pulaski and came to another till swell about at level of highest Algonquin beach on the line of secs. 35 & 36, T 33 R 6 E. It was terraced on W. slope by Algonquin waves. The main shore seems to be about a mile E. from here probably on E. side of a lake on line of secs. 36 & 31. It is not far from the D&M RR in secs. 25 & 31, T 32 Rs 6 & 7 E.

We came back past Bolton to mouth of North Branch. The aneroid seems to be subject to sudden quirks today so readings are not reliable. Pulaski station is only a few rods S. of corner of secs. 23, 24, 25 & 26, T 33 R 6 E. The RR runs a few rods W. of center of sec. 23 and of corner of secs. 22, ~~24~~ 23, 14 & 15. Cross roads at Long Rapids 717' - 771.38' on the road survey profile.

Summit 1/2 mile east	739' - 7929 on profile
Swale east of there	714' - 768.4
Turn in M 10, 1 mile east of Long Rapids	735' - 789.5

Features near Leer - Aug. 30, 1924. Long Rapids, Mich.

We drove W. 2 3/4 miles then northward to corner secs. 13, 14, 23 & 24 and W. 2 miles to corner secs. 15, 16, 21 & 22 across till plain all the way. It extends W. to North Branch of Thunder Bay River and N. into Presque Isle Co. to the river. Boulders are numerous in spots but some fields are nearly free from them. There are wet tracts 5-15' lower than the general level of the till plain. We crossed one for 3/4 mile mainly on line of secs. 15 & 22.

I left Dr. Ver Wiebe at the range line near quarter post of sec. 24 & 19, T 32 Rs 5 & 6 E and walked N. to middle of line of secs. 1 & 6 through till plain. There are two sharp knolls - one in NW corner sec. 18 and another near line of secs. 17 & 18 N. of quarter post. They are about 20' high. Aside from these there are only gentle swells 5-10' high. Rock is outcropping in a few places, one being near middle of line of secs. 7 & 12, another S. of quarter post of 18 & 13 and another near Leer. It is probably at slight depth all through this country.

My aneroid read 865' at Leer, 825 at county line N. of Leer and 725 in bottom of large sink in W. part of sec. 32, T 33 R 6 E, the one into which North Branch emptied at flood stages until prevented by a dam. There is a deep open sink a few rods W. of the large one 30'-/ lower - with rock in its run. There is considerable red nearly pebbleless clay on N. side of

the large sink up to where aneroid reads 790'. This has calcareous concretions. Its surface is nearly plane. We read 770' at North Branch about 3/4 mile N. of the sink near corner of secs. 29, 30, 31 & 32. The stream here cuts a narrow passage about 40' deep. There is a swampy broader tract to the W. above a dam at about 790'. We continued N. to a road that leads east into Posen.

Features near Posen

The aneroid read 850' two miles W. of Posen and the same at Posen at 11:30 A.M. It read 875' at 12:30 - it is probably about 785'. We drove S. and came to the Algonquin shore about 2 miles from Posen at a large swamp that the highway crosses on line of secs. 27 & 28. This is 60' lower than Posen and about 725' by previous readings. The swamp extends ___? into SE¼ sec. 22 and around corner of secs. 20, 21, 4, 28 & 29. There is considerable land in sec. 28 from near center southward that is above Algonquin level. There is also a strip in W. part of sec. 34 that extends into sec.33. North Branch appears to have entered Lake Algonquin below the place where I crossed near corner of secs. 29, 30, 31 & 32. The E. part of sec. 32 is low and so is NE part of sec. 5. Much of secs. 28 & 33, T 33 R 6 E is swampy and low enough to have been covered by the lake. The greater part of the SE¼ T 33 R 6 E is low enough to have been covered.

Beach near Pulaski

The lake seems to have covered parts of secs. 21, 22, 23 & 24 as well as secs. S. to the county line. There is a low tract E. of Pulaski that seems to be lower than the shore line a mile N. of the station. I do not find definite shore lines on the W. side of a swamp in sec. 19 though the aneroid indicates an alt. 25-30' lower than the beach N. of Pulaski. I read 755' (probably it is not over 750') on that beach and about 745' at the State road near E. end of line of secs. 13 & 24 and the swamp is 15' lower than the road. The swamp runs E. about 3 miles I am told. There is a

strip of smooth surfaced rather sandy land in E. part of sec. 24 that stands higher than the State road in secs. 24 & 19 perhaps 10' or nearly up to the level of the gravel beach in NW part of sec. 24. There is a ridge near corner of secs. 19 & 30, 24 & 25, that has a smooth plane all around it which seems to have been an island in the lake. It is higher than the State road in N. part of sec. 30. There is a more elongated tract about 800' that the State road rises to near line of secs. 29 & 30. It covers the E. part of sec. 30, S. part of 29 and NE part of sec. 32, T 33 R 7 E. The State road in secs. 29 & 32 overlooks a low tract within 1/2 mile N. that was carried by Lake Algonquin and a low tract on the S. Within a mile and in NW part of sec. 32 within 1/4 mile, only a few acres in SW part of sec. 28 is above Algonquin level. The NE¼ of sec. 33 is also largely below the lake level & all of sec. 34 except about 100 acres in SW part.

The aneroid readings are unreliable as a low pressure is coming in. The highest shore in SW part of sec. 28 may be up to 750'. There are bars?? about 20' lower or 730-/ that extend west across the road in sec. 28 that runs N. through W. part of SW¼ of the sec. The N. part of the sec. is swampy and below Algonquin level. We went E. between secs. 4 & 9, T 32 R 7 E and S. on line of secs. 9 & 10 largely in hummocky drift that may be a little above Algonquin level. There is a low strip E. of it in SW part of sec. 3 and across middle part of sec. 10 that was covered by Algonquin waters. There is a short bar in SW¼ sec. 10 about 10' lower than the one on the hill on line of 10 & 15 that seems to be 740' A.T.

Berckley??Buckley?? 21' Long

We took a view of a gneiss boulder on E. side of the State road near line of secs. 24 & 19, T 33 Rs 6 & 7 E that is 21' long and stands 5½' above ground and probably is sunk into the ground several feet. There is great contortion in the banding of the gneiss. It is by far the largest boulder we have seen in this part of Michigan. It is on till a short

distance W. of the great swamp in T 33 R 7 E at the level where we are surprised to find so slight an indication of shore action.

Striae

We passed a striated ledge on E. side of the road where we ascended to the high country in NW part of sec. 30, T 33 R 7 E that bears a few degrees E. of S. There is about 5' of drift over the rock. The polishing of rock surface here is exceptionally fine for the whole length of the exposure about 50'. We went into Alpena for auto repairs and then out to Lachine where I stopped at hotel.

With Ver Wiebe from Hillman to Roscommon

August 31, 8:00 A.M. An. 28.980 - 732' at Lachine, Mich. We drive to Hillman and then take M33 Highway past Rust Station on BCG&A RR to Camins??, Fairview & Mio. There is good soil on the moraines both N. & S. of Rust in T 30 R 4 E. The aneroid read 930 near center of sec. 11 but only 785 at Rust at corner of secs. 15, 16, 21 & 22. It is 925' on line of secs. 28 & 29. We turned W. at corner of secs. 28, 29, 32 & 33 at alt. 900'. Two miles west at range line on a plain it read 825'. At Gilchrist Creek it only read 725' which is evidently too low for the stream is that alt. at Hillman. The bluff is 25' higher. The barometer read 750 at corner of secs. 25, 26, 35 & 36, T 30 R 3 E. There is a sandy plain for 4½ miles S. We there enter moraine. It is sandy gravel in secs. 24, 25 & 26 but becomes more clayey near the county line. The aneroid read 1000' at county line and 980 at Camins station. Within a mile S. a rise of 105' is made in the highway. Near Fairview it reads 1200'. At Mio hotel it reads 935' at noon. This is about 75' above the river below the big dam. The true alt. is likely to be not less than 1000'.

We went W. to Luzerne and then SW through considerable back pine country into Roscommon. Some of this jackpine land is boulder strewn and

gently undulating but has little or no clayey till. There is clay with few if any pebbles in it on bluffs of small streams in the vicinity of Luzerne. In some cases sand several feet deep rests on such clay.

Along the county line for several miles E. of Roscommon there is boulder strewn nearly plane surfaced jackpine land with loose textured sandy gravelly drift. This sort of land seems to occupy the bend of the South Branch of Au Sable River in N. row of secs. in T 24 R 2 W and the S. row in T 25 R 2 W. There is definite morainic topography in T 25 R 2 W from near corner of secs. 25, 26, 35 & 36 eastward. In sec. 1, T 24 R 2 W there is a ridge 50-60' above the level of South Branch in the SE part of the section. There are also knolls in sec. 6, T 24 R 1 W and adjacent part of sec. 31, T 25 R 1 W that nearly connect to the NE with prominent moraine in secs. 32, 33 & 34 and 29, 28 & 27, T 25 R 1 W. The gravel pit in sec. 27, T 25 R 2 W to which a spur of the railroad has been laid from Roscommon is in the gently undulating land at a level 25-35' above Roscommon. Some of this land is 40-50' above Roscommon.

With Ver Wiebe in Roscommon County

Sept. 1, Roscommon, Mich. An. 28.790 at 8:30. There is a rise of 40-45' to the county line on highway 76. An. 28.745. This higher land is nearly plane with Norway pine. There are boulders in it as noted yesterday. The land S. of South Branch from Roscommon eastward is flat jackpine outwash with some slight depressions occupied by huckleberries or by grass. The MC R" traverses such a plain entirely across T 24 R 2 W though it comes close to morainic ridges in sec. 36 and in sec. 22. Dr. Ver Wiebe has mapped the NE twp. of Roscommon County with some care and checked up with the soil men. He found some bouldery sandy loam land in N½ sec. 6 and over all but the SW¼ of sec. 5 and in NE¼ sec. 8 that has only a gently undulating surface. There is a strong moraine E. of it from E. side of sec. 5, NE of sec. 8 eastward along and S. of the county line.

South of this moraine there is considerable land with clay or clayey till near enough surface to make fair farm land though usually having a sandy coating. I found considerable sand in secs. 10, 11 & 14 in my studies 3 yrs. ago. The morainic ridges in SW part of the twp. and in secs. 25, 26 & 27, I mapped with some care 3 yrs. ago. The one in SW part of the twp. only extends a little into secs. 24, 25 & 36, T 24 R 2 W. In places this is fully 100' above bordering plain. On its SE border some clay is found in wet places in secs. 18 & 20 and N. part of sec. 29. But farther S. is a sandy plain - clear to Lake St. Helen's. We examined the district between Roscommon and Higgins Lake and S. from Higgins Lake to within 1½ miles of Houghton Lake. There is a remarkable number of boulders on a plain S. of the strong moraine in Markey Twp. in secs. 9 & 16 yet it has sandy gravelly loam soil. To the SW from there in secs. 8 & 17 there is a stiff clay soil in places and this extends to the swamp in secs. 7 & 18. It is in gently undulating till with a moderate number of boulders. This land is good hay & oats land while the looser textured land to the E. is good potato land and corn land. The swamps on the border of Houghton Lake in secs. 18 & 19 are said to be sandy and so are these bordering the outlet of Higgins Lake and Backus Creek. In the district E. of Higgins Lake most of the level land is sandy but some clayey till is found in secs. 14 & 23 & 24.

There are some small knolls and ridges of sandy gravelly bouldery drift south of the main moraine in secs. 14, 15, 22 & 27, T 24 R 3 W. The highest points on the moraine are 75' or more above Roscommon and above Higgins Lake for the lake is of similar alt. to the village. There are shallow flowing wells along the small stream in E. part of Roscommon about 20-25' deep. The catchment area may be to the SE on the morainic strip that lies W. of this stream.

Sept. 2, 1924, Roscommon, Michigan. We drive S. on main highway to E. end of Houghton Lake crossing a moraine 1½-3 miles S. whose highest points

are 100-125' above Roscommon. It contains very little clayey till. There is a gap S. of here scarcely 1/2 mile wide standing about 20' above Roscommon. It is partly marshy land and partly sandy plain. S. of this is a small moraine ~~xxxx~~ area nearly?? in sec. 30 that rises 50-75' above Roscommon level. It runs as a low smooth ridge into sec. 25. The swamp S. of it is about 20' above Roscommon. There is a small moraine W. in secs. 31 & 36 about 50' above border swamp land. It extends slightly into secs. 1 & 6 of the twp. S. There is a more prominent glacial ridge SW of here in W. part of sec. 1 and SE of sec. 2 between 75-100' above bordering swamp land.

On the swamp in secs. 1 & 6 the aneroid registers 15' above Roscommon. It is probably fully this low for it extends to the outlet of Higgins Lake and that as noted yesterday is nearly the same alt. as Roscommon.

The road crosses morainic hills on line of secs. 13 & 18, T 23 Rs 3 & 2 W. to an alt. 100' above Roscommon. Their highest points are about 25' higher. These are composed of gravelly and sandy drift with a few boulders as in the morainic areas to the N. No first-class farm land in tract.

The swamp S. of these morainic hills in secs. 19 & 24 is 5' above Roscommon by aneroid and Backus Creek seems to be same as Roscommon and Houghton Lake 10' lower than Roscommon.

The clay exposed on banks of Backus Creek seems to have very few pebbles and is of gummy character. There is a thin deposit of pebbly sand over it 5-6'+. We went from Prudenville to Houghton Lake Village on the new highway. It crosses narrow ridges of sandy material with few stones in it on line of secs. 17 & 20. They are much lower than the moraine to the S. being perhaps 35-40' above Houghton Lake while the moraine has points up to fully 150' above the lake. I saw no boulders. They seem about like eskers for size and they trend directly toward the moraine. The road crosses two of them 1/4 mile+ apart. We crossed over the moraine directly S. of

Houghton Lake Village and rise to 150' above the lake in S. part of line of secs. 13 & 14, T 22 R 4 W. This has a gravel pit on N. slope and another on line of secs. 13 & 24. The SW part of sec. 24 and much of sec. 23 and the N. part of secs. 25 & 26 have bouldery, gently undulating surface much lower than the moraine and with fainter expression. The alt. is only 30 to 40' above Houghton Lake (by aneroid) - Dr. Ver Wiebe calls it "Ground moraine" and restricts the use of "till plain" to more clayey drift. This is of loose texture with little clay where we crossed it. West from here it passes into a more clayey drift in secs. 22 & 21 and southward into secs. 33, 34 & 35, T 22 R 4 W. There is morainic topography in secs. 29 & 30 about in line with the westward continuation of his "ground moraine" and separated from it only by a marsh along Bear or n Creek. We turned E. of corners of secs. 23, 24, 25 & 26 and crossed over the moraine that parallels the S. side of Houghton Lake reaching an alt. about 120' above the lake near corner of secs. 19, 20, 29 & 30, T 22 R 3 W. There is some clayey till W. from here on the NE slope of the moraine in secs. 20 & 29. Some wet land is crossed on line of secs. 21 & 28. We then enter a sandy plain about 30' above Houghton Lake. We continued E. and crossed narrow strips of wet land on borders of each of the streams that drain to Houghton Lake. The land between is dry sand only a few feet above the marshes as a rule. We came to the strong moraine of the Saginaw Lake just west of the range line of T 20 Rs 1 & 2 W. there being several??some???small?? moraine on the SE corner of sec. 24 and NE of sec.25. The road here is about 1/4 mile S. of the corners of secs. 24, 25, 19 & 30. There is a morainic spur S. of here along line of secs. 25 & 36 that dies out at the W. near middle of the section line.

Features near West Branch

The road winds around through a narrow gravel plain between these two morainic spurs for 4 miles E. or to within 2 miles of the county line and makes a rather rapid ascent being nearly 1300' at the place where the glacial

waters issued that formed this plain. The moraine reaches an alt. of 1450' or more on the highest point. The aneroid indicated 1420' at the highest point crossed by the road (not far from the county line). The drift is loose textured and stony to within 4 or 5 miles of West Branch. There is a more clayey till sets in on the SE or inner slope of the moraine, and good farms are developed on it. This clayey till has an alt. of about 1300' at the W. where it gives out and the looser textured drift sets in. Dr. Ver Wiebe left me at West Branch to return to work in Alpena County. I took the afternoon train S. on MC RR to Bay City and then continued to Jackson. My previous work carries somewhat detailed notes all along this railway line. I found that the moraine crossed NW of Sterling is about 50' higher than the plain that lies between it and Alger and about as high as the one crossed NW of Alger (850')-4. There are sandy wind drifted ridges on each of three moraines up to their highest points. Long wind drifted sand ridges occur N. and NW of Sterling at an alt. but little above the village. The beach of Lake Warren runs through Sterling and is about 750' A.T. there.

Notes on Profile of Det.& Mackinac RR Alpena to Posen.

		Ft.A.T.
MP 120	in south Alpena	615.
MP 121.6	Millman Jc	600.73
MP 122	Alpena depot	601
MP 123	Bridge on Thunder Bay River	603.77
MP 123.1	Alpena Jc	605.
MP 124	Near highway	622
MP 125		635
MP 125.25	Ridge (Nat Surface 644)	643.27
	Swale north of ridge	640
MP 126	Near Fletcher Jc (road intersection)	656
MP 127	With parallel highway	672.5
MP 127.5	Road intersection at township line	704.43

		Ft. A.T.
MP 128	On a low ridge	710
MP 129	In a valley	702.9
MP 129.3	Bluff of valley	709.55
MP 130		718
MP 13016	Low ridge nat surface	723
MP 131		718.79
MP 131.6	Cathro (crest SE of) nat surface	729
	" Station about	726
	Low ground NW of depot??depth?? (nat surface)	720
MP 132	Near SE end of cut	727.56
	Natural surface in cut	736
MP 132.66	Valley - natural surface	709
MP 133		727
MP 133.35	Ridge natural surface	733
MP 133.5	Draw or swale nat. surface	722 - 24
MP 133.9	Bank of swale	731
MP 134		730
MP 134.15	Bolton track	731.5
MP 134.7	Ridge nat. surface	736
MP 135.	Ridge 300-500' NW of MP 135	726
MP 135.3	Low ground natural surface	711
MP 135.5	Ridge	725
MP 135.6	Ridge	727
	Swale between ridges 135.55	720
MP 136	(Nat. surface 721) track	724
	Very flat for 3/4 mile	721 - 722'
	Ridge 400' SE of MP 137 nat. surface	733
MP 137		727
	800 - 2300' NW of MP 137 low ground	719
Near 137.5	Ridge	733
	Valley near MP 138 nat. surface	718
MP 138.15	Ridge nat. surface	731

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		Ft.A.T.
MP 138.6	Ridge	745
MP 138.7	Swale	733
MP 138.85	Pulaski ridge nat. surface	751
	" track	749.33
MP 139		740
MP 139.2	Swale	730
MP 139.5	2 ridges	742-43
MP 139.6	Swale NW of ridges	739-740
MP 140	Ridge near, nat. surface	759
MP 140.15	Ridge	765
MP 140.25	Swale (This is near the E-W road)	753
MP 140.8	Ridge nat. surface	781
MP 141	Ridge 400' SE of	782
	" 600-800' NW of	787
MP 141.85	Posen This is NW of main street intersection	795
	Summit in NW part of Posen	802

Question as to location of shore lines

Notes were made about 1902 (See notebook 182) on the D&M profile which show about 2' lower alt. than this profile.

The alt. near Pulaski may be used now in determining the highest Algonquin shore in that vicinity especially that one mile N. near road intersection. My aneroid indicated the alt. of the shore there to be 7' above Pulaski, but leveling should be done to settle the matter. I have laid the matter before State Geologist R. A. Smith, who will visit the locality in the near future. He will try to determine whether the Lake Algonquin waters surrounded an island of several square miles to the E. of Pulaski (the island being partly in Presque Isle and partly in Alpena County). Mr. Smith has found shore lines in Presque Isle Co. at places not shown on my field map and he thinks there is some error in the location of those shown on my map. He may be able to correct these errors this fall.

Sept. 10, 1924. Ann Arbor to Cincinnati via AA RR to Toledo and B&O to Cincinnati. Some cuts near Sidney, Ohio, show alternatives of blue and brown till as if there might be two or more drifts of different ages exposed. Occasional cuts from there southward past Dayton also show similar alternations. The cuts seem important enough to warrantan careful examination.

Molding Sand in Newport, Ky.

Sept. 11. From Cincinnati I went over to Newport and examined again the hill E. of the South Gate car line at bluff of Ohio River on which molding sand occurs at a much lower level then that on the uplands back of Covington, a hill Fenneman and I examined in July. The thickest deposit seems to be at a swale back of a Catholic institution and perhaps 40-50 rods NE from the car line. It is exposed there to a depth of fully 25'. The top is about at 620' contour and base as exposed at 600' or less. The deposit shows along W. side of the car line down to about 580'. The hill NE of this that catches 700' contour has rock nearly to top, but there is a fine sand at the top as noted by Fenneman and myself in July.

The interpretation of the molding sands of this region seems difficult to work out. In Newport the sand occurs at various levels from 580' up to over 800'. In Covington it seems restricted to ridges that are over 800'. Perhaps the Newport sand is later then that near Covington. The latter seems to be older than a very old glacial deposit and perhaps antidates the valley trenching but the sand in Newport does not seem to have any glacial material over it and is later than the valley trenching.

Molding Sand near a Plane near Ft. Thomas

I took car to Ft. Thomas and then walked down to Brent Station. I saw no erratics along the bed of the small stream that I went down. I went up another valley S. from Brent and found a deposit of sand on the upland, some of it is molding sand. It shows definite water bedding.

The top of deposit is about 860' A.T. I found a few small chert pebbles in the loam that overlies the sand. This loam is very highly weathered and kaolinized. Some of it is of reddish color and some pale. In places it is grassy and fully kaolinized. It seems likely to be at least early Pleistocene in age. The deposit proves to be an extensive one on the ridges all around Cold Spring. Probably over all the ridges that rise above 810' contour.

Near Cold Spring

Cold Spring receives its name from large springs on E. side of Alexandria highway between Cold Spring P.O. and the cemetery and church at a level about 820' A.T. A well across street from the Post Office on ground above 860' contour struck rock at about 30' and lost the supply of water it has above the rock. Some wells are obtained in the sand in this vicinity at 12-20' depth. Some springs issuing from the deposit have soft water but the big springs have hard water.

The well at Cold Spring schoolhouse on ground above 860' contour is 100' deep and goes some distance into rock. This old weathered deposit may antidate the cutting of the deep valleys of this region. It seems most easily accounted for if it is interpreted to have been laid down on a nearly plane surface or one with shallow valleys. It does not seem likely that the deposit was bulky enough to fill deep valleys like the present ones and spread over the intervening ridges after aggrading to their level. This highly weathered sand and also the highly weathered glacial deposits that overlie the sand W. of Covington seems restricted to land above the 800' contour. If the valleys were here prior to the deposition of this weathered sand and weathered drift there ought to be conspicuous remnants of them in the valleys.

Old Divide at Dayton

Sept. 12, 1924. I go by electric car from Cincinnati, Ohio to Dayton, Ky. and inspect the place where the Ohio is thought to have crossed a divide. The col evidently was E. of the ravine that comes in by the C&O depot on the Ky. side. The position on the Ohio side is less certain. It may have been W. where the 800' contour is on the brow of the bluff. The trend of ravines on the Ohio side seems to favor the latter as those nearly N. from Dayton point southeastward.

Till in SE Campbell & NE Pendleton Counties

I took C&O train to Mentor. I find there are deposits of Illinoian till in this SE corner of Campbell County and NE of Pendleton Co. There is both yellow and blue till and an underlying blue silt in a ravine that comes into the Ohio valley less than ½ mile N. of the county line. The till extends over a low divide between this ravine and one in northeastern Pendleton Co. This divide is scarcely 100' higher than Mentor Station. I took a specimen of the blue till. There are several granite and granular boulders in the bed of the ravine within 40 rods above the point where it opens into the Ohio valley. Two granites are about 3' in diameter. One greenstone about 1' and several granites less than a foot were noted. I did not find any drift in a western tributary up which a road runs about 1/3 mile N. of the county line. The drift seems to end abruptly in this thick till deposit in the main room.

Conglomerate near Flag Spring

There is till on the low divide between the head of Twelve Mile Creek and the Ohio directly back of Mentor and about 100' above Mentor station. There is a lowland here extending W. to a mile beyond Flag Spring that is drained through a high tract to the NW instead of directly E. into the Ohio.

There is a glacial conglomerate just W. of Flag Spring store on this lowland. This conglomerate as well as the till at border of Ohio valley seems likely to be Illinoian drift. It is probable the Illinoian ice sheet ended in this lowland for I see no signs of drift after I pass the conglomerate outcrops near Flag Spring store. Victor Williams in Alexandria has two wells - one with soft water and the other hard - both of which stop at top of rock. The soft water well is 29'. There is 8' of water in it. The hard water well is on ground about 10-12' lower - 16' to rock. Other wells in Alexandria show about 30' to rock (limestone). In places shale over it.

Shallow Wells in Alexandria

There is a hard clay to about depth of cellar 8' and below this a loose sand extending to shale - probably 10-15' of sand.

I find some of this sand thrown out from a cellar at a new house about 60 rods N. of the Court House and take a sample. It is a rusty weathered looking sand. A mile N. of Alexandria on about the same level a well on E. side of road is 35' deep but the owner has no record and cannot say whether it stopped in the sand or went into rock. The water is rather hard.

At telephone poles still farther N. I find small water worn pebbles of white quartz carnelian and chert in the material thrown out of the post holes. These are only 6 or 7' deep. The surface clay in this vicinity is full of iron oxide balls and seems referable to the white clay phase of the loess.

Features near Alexandria

At 1½ miles N. of Alexandria the road turns into a ravine that drains to Four Mile Creek at Stevens (Silver Grove). It gets down below 580'

contour and then rises 860 about 1/2 mile W. of Cold Spring St. The ridge road W. of this highway as shown by the East Cincinnati topographic map drops to 780'. This ridge is about 840' at S. edge of map. By Morning View map Alexandria is above 860'. It is thought by residents to be on the highest land in Campbell County. Ridges in SE part of the county are 900-920'-+. The county clerk at Alexandria says he has seen boulders of glacial derivation along Twelve Mile Creek up to within 1/2 mile of the place where I turned away from the creek to ascend to Alexandria. One is a short distance above a store and he thinks this is the farthest up he has noted them in this lower part of the valley. He has seen them on the hillsides a mile farther down where a road leaves Twelve Mile Creek to cross over a ridge to New Richmond. The farthest W. he has noted is about 3 miles from the Ohio River.

At the south of the paving S. of Mentor is a molding sand pit in a terrace of Wisconsin age 15'-+ higher than Mentor station. On the same level as Mentor there is a brickyard using the Wisconsin? silt or yellow clay, or possibly a post-Wisconsin alluvium.

NOTEBOOK 283 CONTAINS EXPENSE ACCOUNT FROM 7/16/24 to 9/3/24.

"On Sept. 3 I went to Lansing and conferred with State Geologist Smith on results of work and on need of more work in Presque Isle Co. near Pulaski and Posen. My expenses were as follows: Electric car from Ann Arbor to Lansing & return - $4.00; Dinner 60¢; supper 50¢."