PADDLING UP A MELTWATER CHANNEL: A LATE-WISCONSINAN ICE-MARGINAL CRUISE NEAR FREDONIA, NEW YORK

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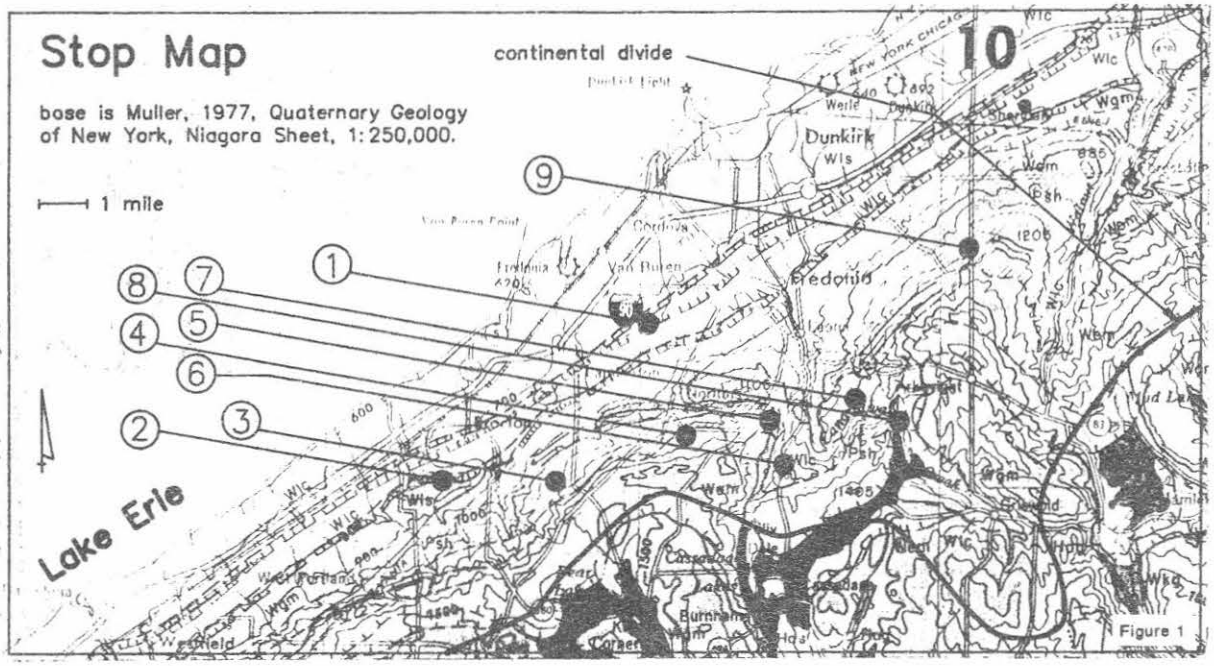
INTRODUCTION

Although the area near Fredonia was glaciated several times during the Pleistocene (see, for example: Leverett, 1902; Fairchild, 1907; Muller, 1963, 1977; Muller and Fahnestock, 1974; Schooler, 1974; and Cadwell, 1988), it was the most recent Late Wisconsinan ice margins, active here between 14,000 and 12,000 years B.P. (Calkin and Feenstra, 1985), that left some of the more dramatic erosional and depositional marks on the landscape.

Staying within eight miles of the college and on the Lake Erie side of the nearby St. Lawrence - Mississippi continental divide, this trip will climb the hydraulic gradient of a glacial meltwater system that incised deep channels through Devonian bedrock, depositing sediment as deltaic gravels and lake clays.

We will begin at beaches of two of the large ancestral pro-glacial lakes of the Erie basin that are locally 170 feet and 240 feet, respectively, above the water level of present Lake Erie. The trip will ascend another 300 feet, then another 100 feet, as we follow a sub-marginal meltwater channel to the levels of two smaller lakes that were imponded along the ice margin.

Stops 1, 2, and 7, on the map below, will allow hands-on inspection of glacially-derived gravels, and stop 6 will be in lake clay. The rest of the stops will be to view a channel that is now relatively dry, but would have been actively carrying meltwater during one or more glacial phases. The diagrams on the next two pages offer background on local glacial history and a schematic view of the subject channel.



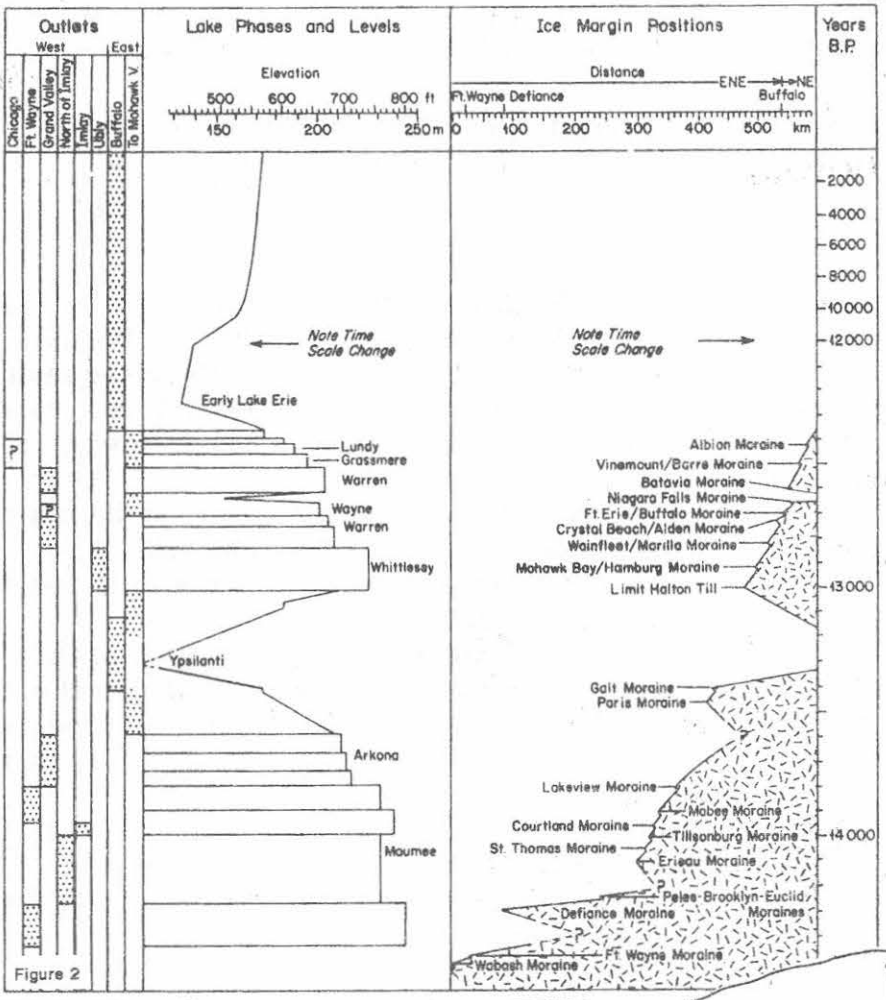


Figure 2

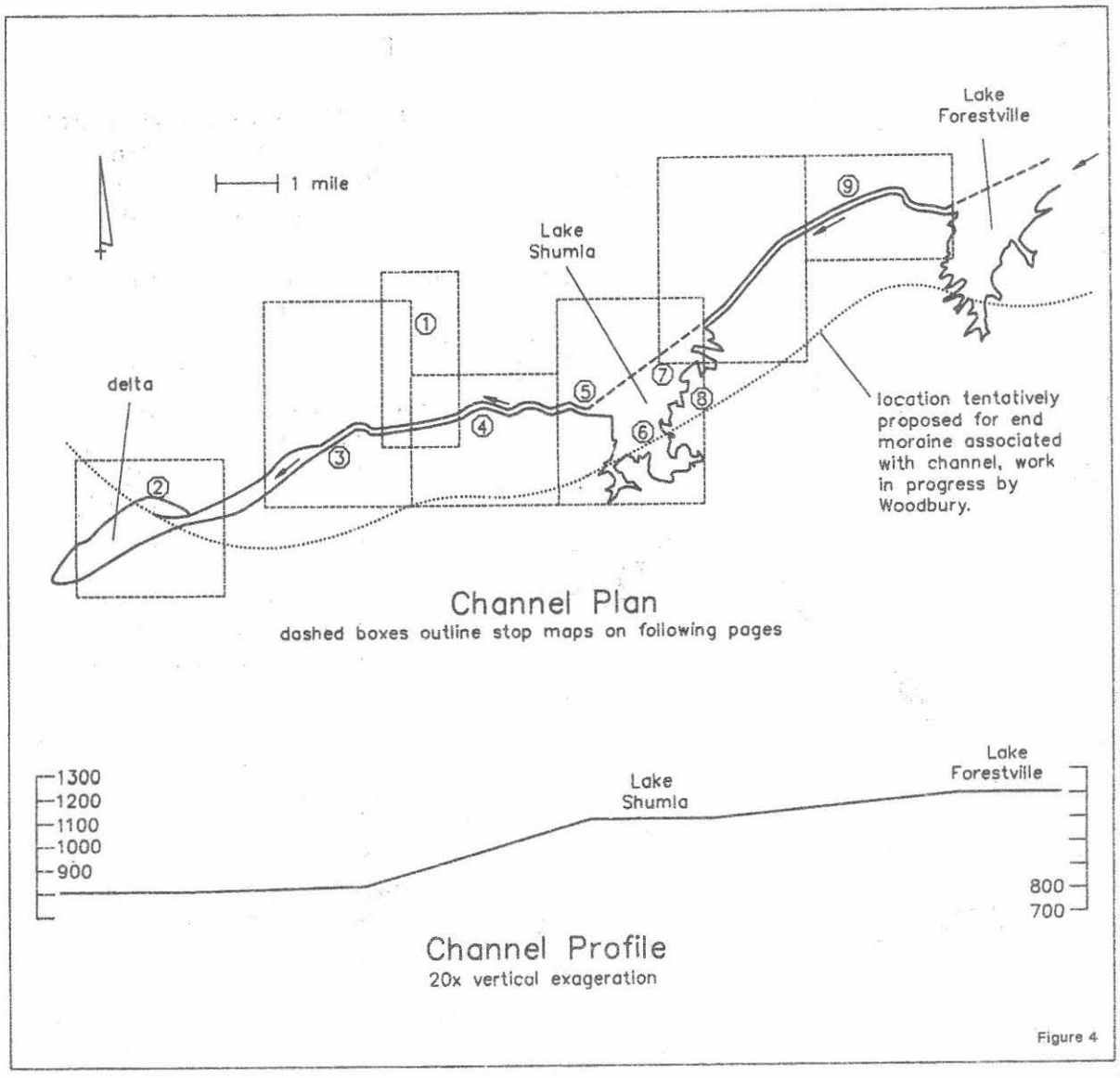
LEFT: The preferred chronology from Calkin and Feenstra, 1985, for the succession of ancestral lakes in the Erie Basin.

Elevations on the preferred chronology differ from those found in western New York, as this area was isostatically depressed by the weight of the glaciers. Our field trip will consider elevations to be relative, ignoring local isostatic differences (only about one contour interval from Stop 2 to Stop 9).

1. Carlton
2. Albion
3. Barre
4. Batavia
5. Niagara Falls
6. Buffalo
7. Alden
8. Lackawanna
9. Marilla
10. Hamburg
11. Rock Glen
12. Gowanda
13. Springville-Nunda
14. Lake Escarpment
15. Eagle
16. Farmersville
17. Findley Lake
18. Clymer
19. Randolph

Figure 3

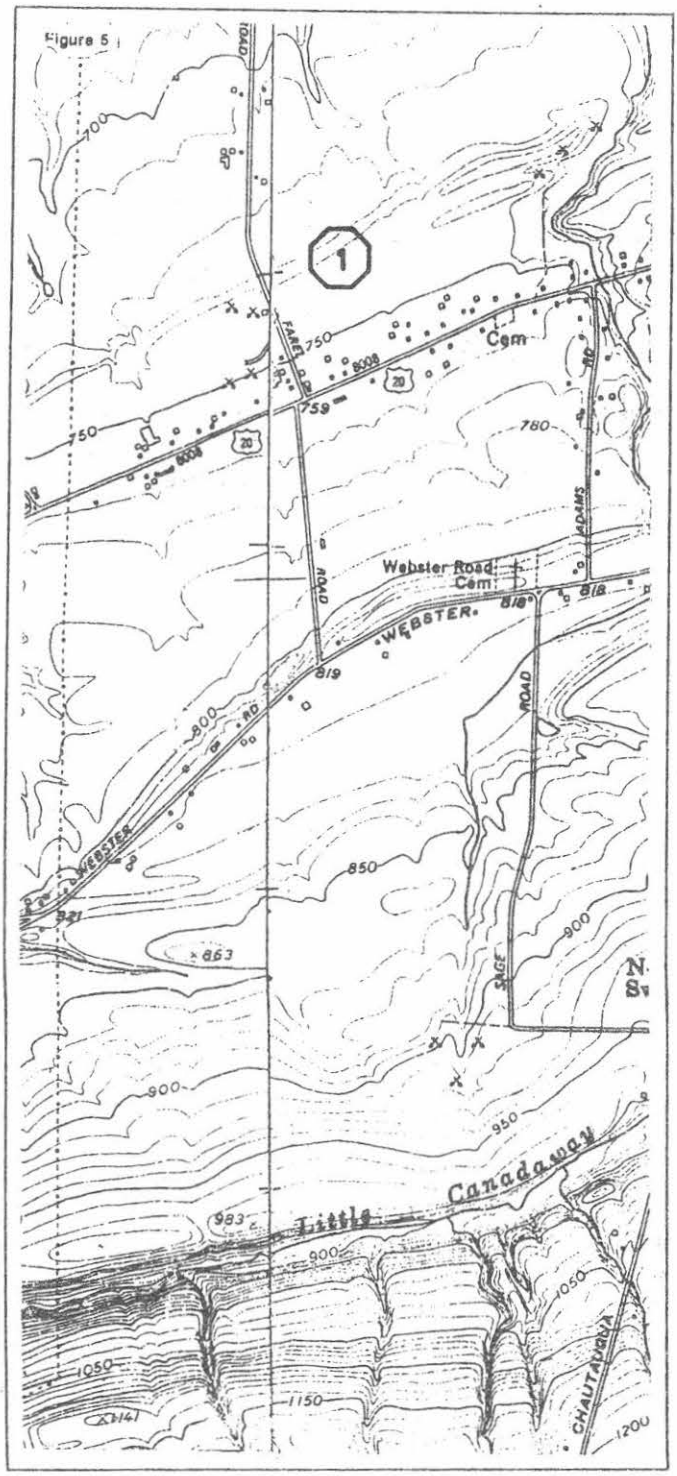
RIGHT: Generalized Ice Margins for western New York, younger south to north (Cadwell, 1988).



THE CHANNEL

During the waning stages of the Late Wisconsinan, glaciers in the Erie basin passed over the Chautauqua County area several times (see the diagrams at left). With ice over the Buffalo area blocking easterly drainage of the ancestral Great Lakes, water level rose to spill westerly into tributaries of the Mississippi drainage system. It was during one or more of these westerly-draining lake phases that the ice margin for the Erie lobe glacier stood near the continental divide several miles south of Fredonia, and remained there long enough for glacial meltwater to incise a sub-marginal channel flowing westerly into the ancestral lake(s).

The chart above shows this meltwater channel and where we will stop to have a look at it. During which glacial phase(s) the channel was formed and used is a focus of work in progress. It may correlate with the Lake Arkona period; and it may correlate with a westerly projection of the Gowanda end moraine, or part of the Lake Escarpment end moraine complex. The subject is open for discussion.



STOP 1

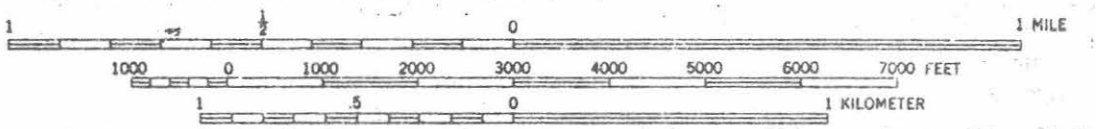
This gravel pit displays typical deposits of a Lake Warren shoreline. U. S. Route 20 is constructed primarily of this material and follows the beach ridge for several hundred miles from northern Ohio to Batavia, New York. Lake Warren deposits are typically cross-bedded, well washed sands and gravels. They were deposited within the high energy beach environment associated with each Lake Warren shoreline. The northward dipping beach face is well exposed on the western and eastern pit walls.

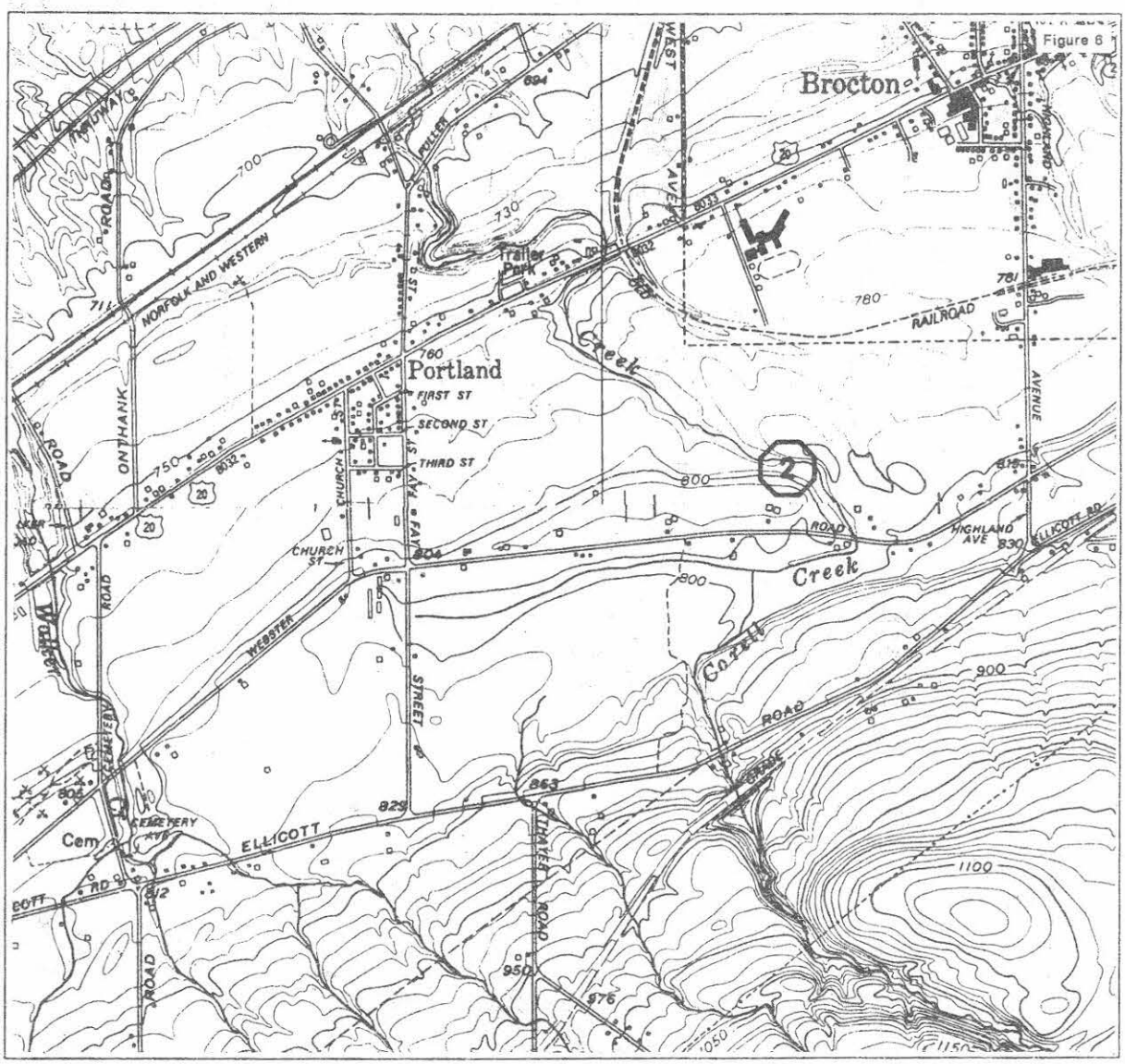
Lake Warren deposits differ from the corresponding Lake Whittlesey deposits which lie further to the south and about 70 feet higher in elevation on the lake plain (found along the ridge through Webster Road Cemetery on the map at left). Lake Warren deposits are generally finer grained and better washed than typical Lake Whittlesey deposits. This may have been a function of higher wave energy and/or a longer occupation of the Warren beach.

Notice the swallow nests bored into the firm silt deposits near the upper wall of the pit.

The beach of Lake Warren is the youngest glacial feature we will visit today, with Lake Whittlesey about 500 years older, and our subject meltwater channel (seen as Little Canadaway Creek on the map) older still.

SCALE FOR TOPOGRAPHIC MAPS, 1:24,000, NORTH IS UP FOR ALL MAPS





STOP 2

This is one of two gravel pits near Portland that were recently opened for construction of a State prison in Brocton. While the elevation and nature of the gravel correspond to a Lake Whittlesey shoreline, the original deposition may have been into an earlier lake. Notice on the map that the 800-foot contour outlines a possible relic spit, formed by wave currents moving sediment easterly from the area near Cemetery Road at Webster Road.

The gravel here is widespread, forming a wide plateau between Webster Road and Ellicott Road. Much of the sediment is locally-derived, with large clasts of siltstone, apparently from Devonian strata higher in the escarpment to the south and east. The feature we are in has been recognized as a delta by Fairchild (1907), who considered that the sediment might be primarily rock excavated from the meltwater channel to the east and northeast. The southerly wall of this channel can be seen on the map as the ridge where Ellicott Road meets Highland Avenue.

EVIDENCE FOR ICE MARGINAL FLUCTUATION IN AND NEAR A RELICT MELTWATER CHANNEL IN CHAUTAUQUA COUNTY, NEW YORK | Nº 57772

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The escarpment southeast of Lake Erie in western New York, with relief of about 300 meters, is drained by stream networks generally trending northward. Anomalous flow directions (along with other supporting evidence) may indicate a glacio-fluvial origin for the stream valley; e.g., Little Canadaway Creek which flows to the west and is recognized as a relict sub-marginal meltwater channel and outlet of a pro-glacial lake. Little Canadaway Creek is roughly V-shaped, with about 30 m of relief and is parallel with and about 3 km north of the Lake Escarpment terminal moraine complex of late Winsconsin age. The channel, holding an under-fitting stream, was apparently incised in the flat-lying Devonian shales and siltstones during one or more glacial stands. Although much of the valley floor is exposed bedrock with a westerly inclined gradient, subsurface borings where Chautauqua Road crosses the channel through a topographic gap in the north valley wall reveal anomalously deep bedrock covered by about eight m of sediment. Fluvio-lacustrine clay and silt deposits are among the sediments recovered here. Peat and twigs collected from 5 m below present creek level yield a radio-carbon date of 8,520+ 200 years BP. Palynological analysis of this horizon indicates a predominanceof hemlock (Tsuga). The anomalously low bedrock elevations, the fluvio-lacustrine sediments, and refraction seismic data suggest that the natural topographic gap used by Chautauqua Road may be the junction point for a deeper, drift-filled branch or former outlet of the upper channel. This gap separates two different geometries in the channel: sinuous westward meanders upstream and southwestward linear downstream. It appears to be a nodal point around which ice margin conditions pivoted, burying one section of the meltwater channel and cutting or reopening another. The radio-carbon and pollen data indicate post-glacial filling of the exposed junction to the buried channel.

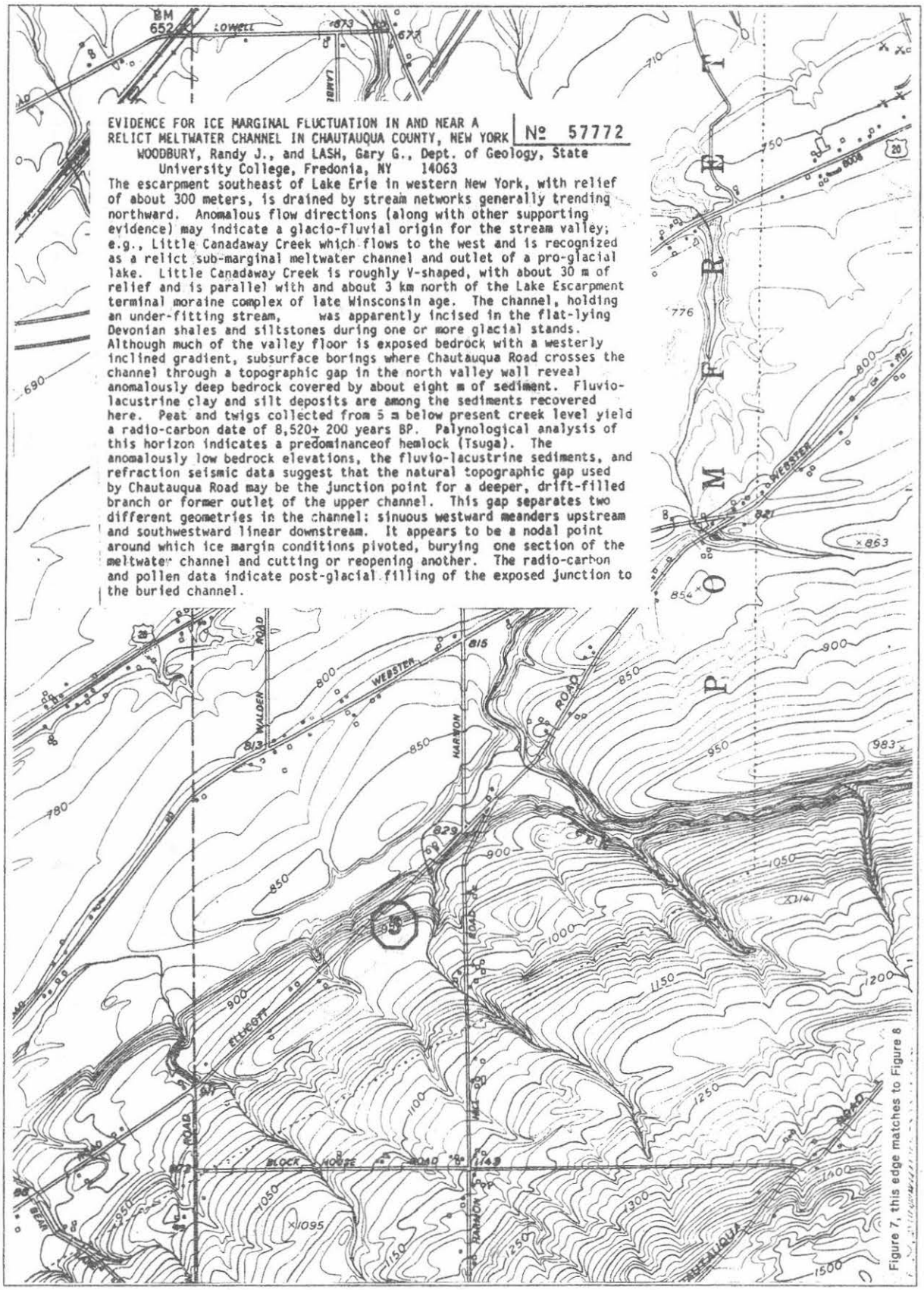
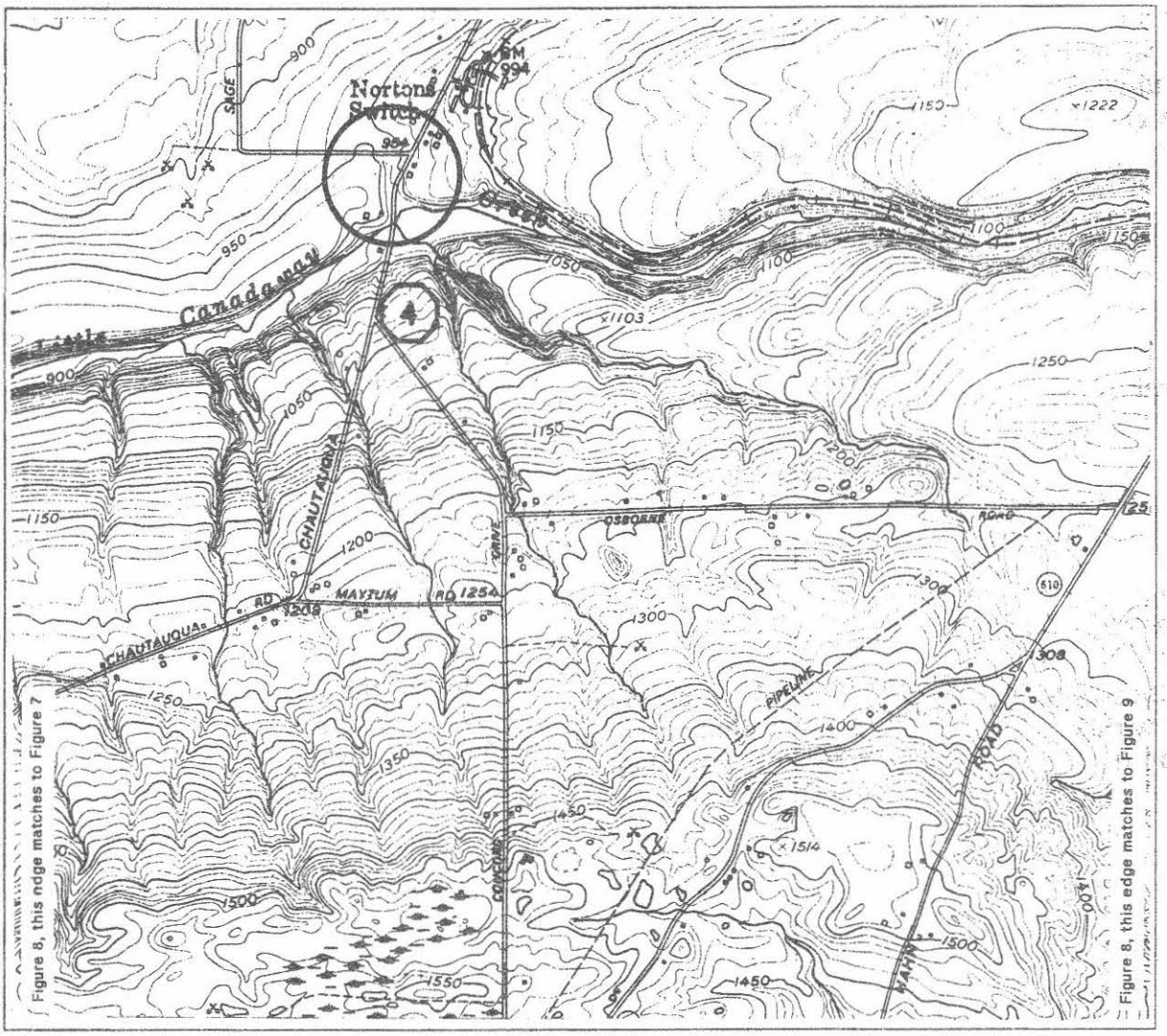


Figure 7, this edge matches to Figure 8

STOPS 3 & 4

Stop 3 is an overview of channel morphology; envision a river of meltwater raging through the now-dry valley. Stop 4 takes us to the channel's intersection with Chautauqua Road, where a drift-filled valley running northwesterly has been proposed in the area circled (Woodbury and Lash, 1985, abstract is inset on facing page). The natural gentle slope over the buried valley provided the least treacherous route for early settlers to cross the deep meltwater channel; Chautauqua Road is one of the county's oldest roads, commissioned by the Holland Land Company in the very early 1800s to connect Fredonia (then known as Canadaway) with the county seat in Mayville. At stop 4 we will visit one of several 40-foot waterfalls that are characteristic of the streams running northerly into the relic channel. The waterfalls are recessed about 1000 feet southerly from the meltwater channel, apparently marking the extent of post-glacial headward erosion away from the "hanging" positions they would have had along the channel wall when the glacier melted away.

The swampy knob and kettle terrain to the south represents an end moraine near the crest of Concord Drive.



STOP 5

This is the outlet col for pro-glacial Lake Shumla (Fairchild, 1907), formed as ice dammed the northerly flowing Canadaway Creek. The outlet elevation, controlling the lake surface, is 1105 feet. Visibility permitting, we will use a surveying instrument to view an inlet channel that brought a flood of meltwater into Lake Shumla; the inlet can be seen as a shallow topographic dent along the hilltop located about 3 miles to the northeast.

For a wider perspective of the outlet channel, fold the map on the preceding page into this page and match it to the map at right.

Also on the map, note the notch in the hillside northwest of our stop. This could have been an outlet for a lower level of Lake Shumla.

STOP 6

We are 130 feet under the water surface of Lake Shumla where fine clay particles settled to the bottom. Some investigators have classified the clays as varved, interpreting the rhythmic laminations as seasonal variations in depositional environment. The roadway is "Old Route 60," while present Route 60 is located over the knoll to the east and is also cut through lake clays. The slump-prone sediments have been a problem for highway engineers for nearly 30 years, and we will drive through a clay cut that has yet to be worked into a stable angle of repose.

Lake Shumla was formed several times and at several water levels during the Pleistocene glacial oscillations, so the clays we see are not likely the result of just the most recent glaciation.

STOP 7

This gravel pit is near Lake Shumla's inlet. We appear to be in a delta deposited and worked by meltwater flowing from the channel and upper lake located northeast of here. Lake Shumla provided a quiet "sink" for sediments in the meltwater chain: the coarse-grain sediments settled at the delta, and the fine-grained clays deposited at mid-lake, while little or no sediment was carried by the meltwater just as it spilled out the channel to the southwest.

STOP 8

This stop presents a rather spectacular overview of the outlet channel of Lake Shumla. It appears as a dramatic V-notch in the hilltop about 2 miles to the west.

As you view the channel, mentally re-construct a mountain of slushy ice overhead, thickening northeasterly, toward Buffalo, and thinning to an end moraine gushing with meltwater within 2 miles to the south. We are about 150 feet above the lake, looking down on the 2.5 square-mile surface of frigid water. Can you spot any icebergs?

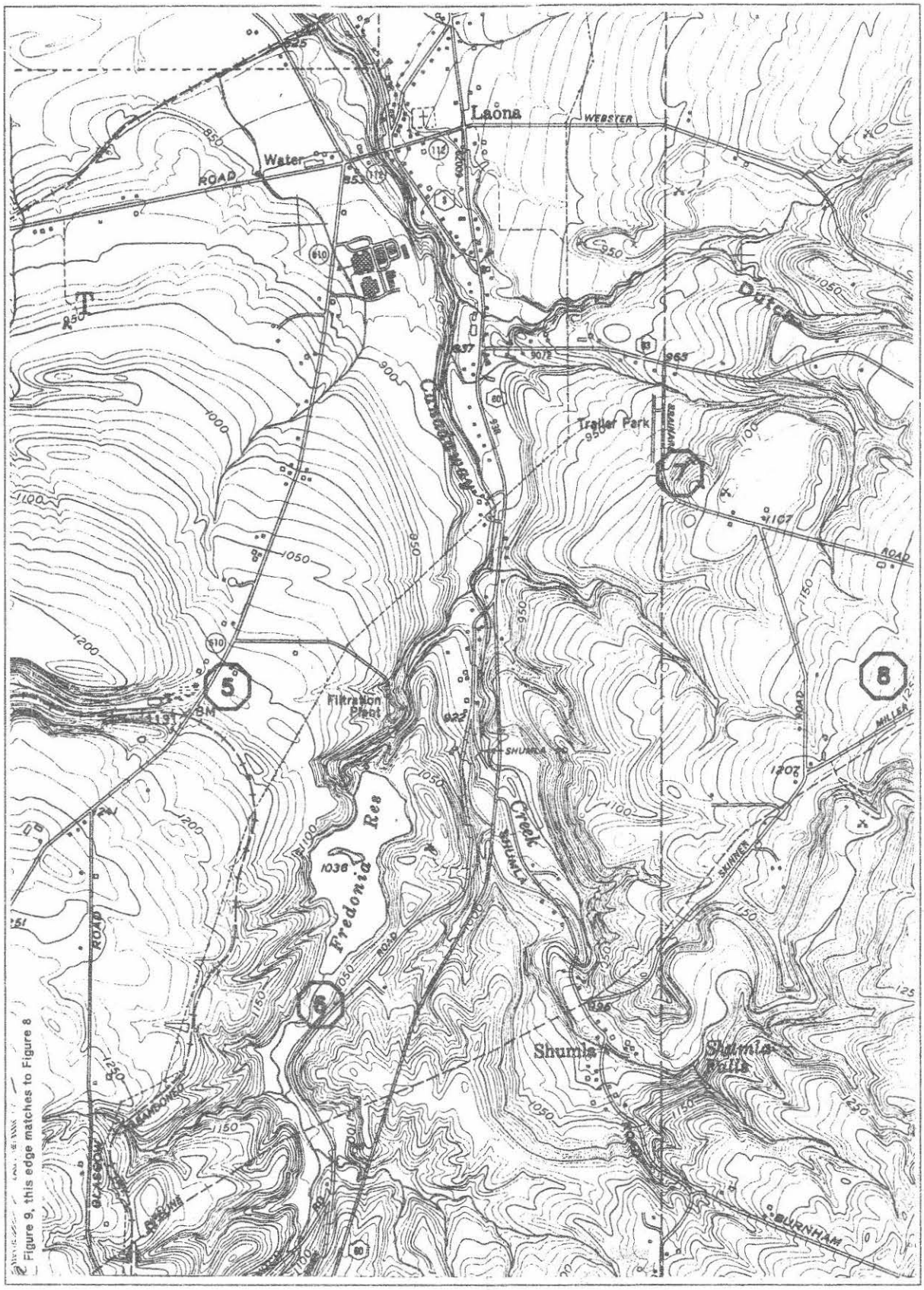
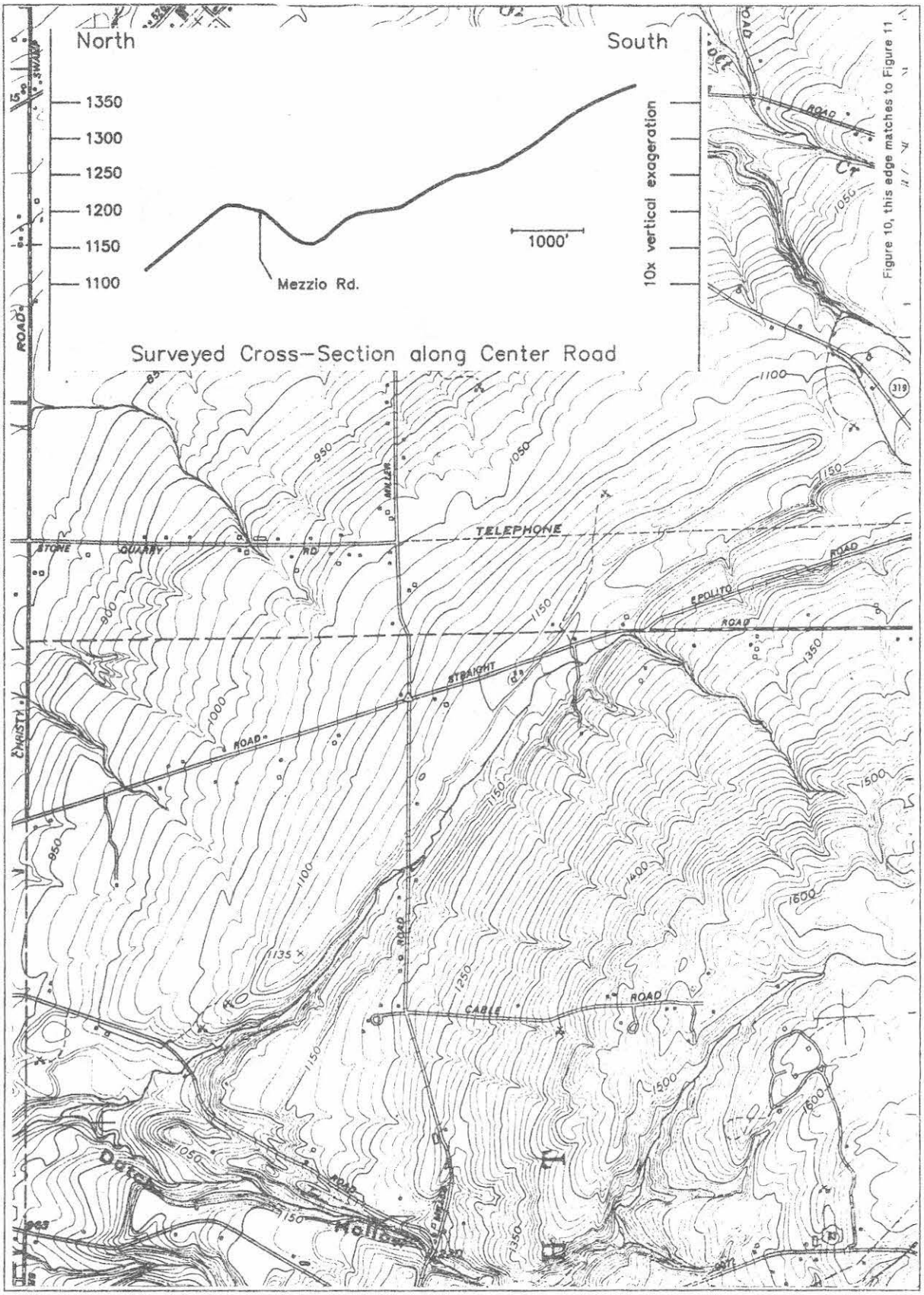
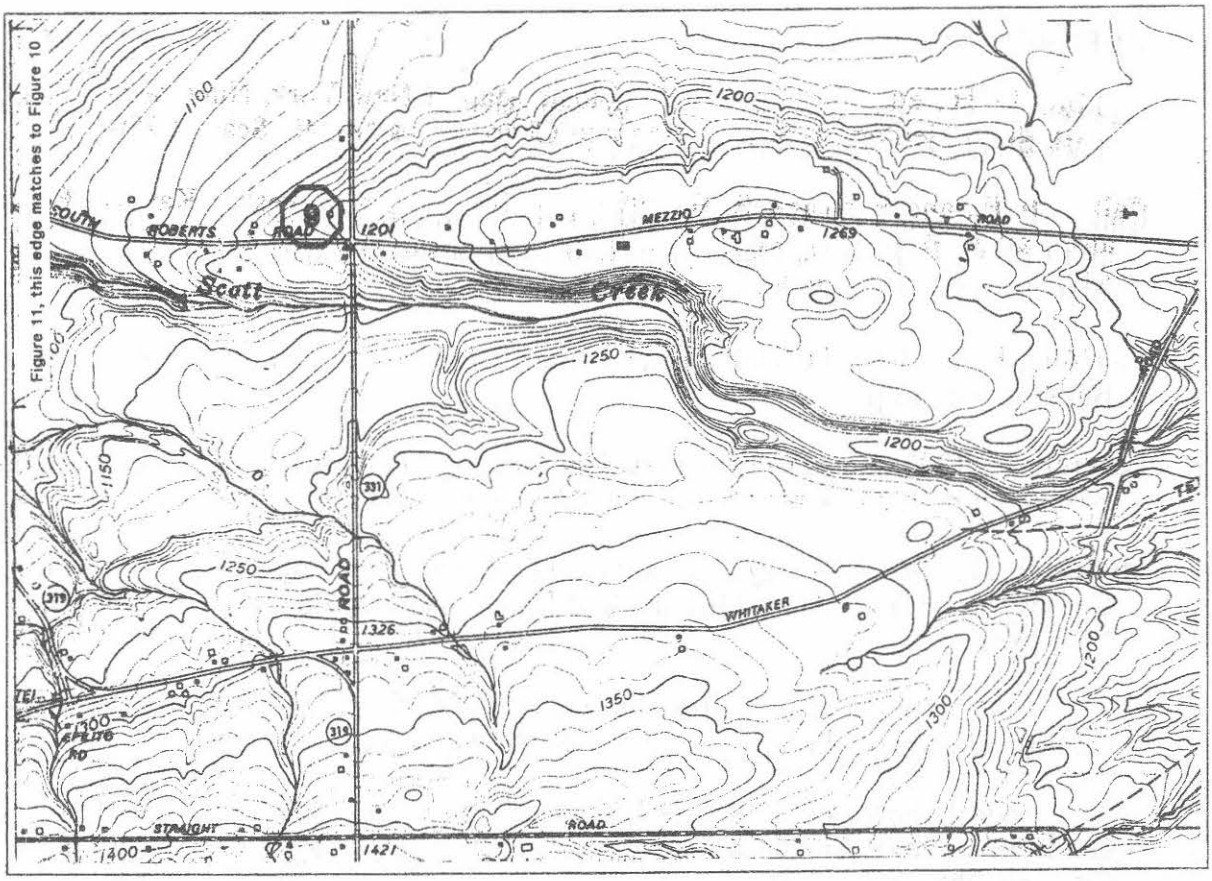


Figure 9, this edge matches to Figure 8


North
South
1350
1300
1250
1200
1150
1100
1000'
Mezzio Rd.
10x vertical exageration
Surveyed Cross–Section along Center Road
Figure 10, this edge matches to Figure 11
TELEPHONE
ROAD
STRAIGHT
CABLE
STONE QUARRY RD
EPOLITO
Dutch Hollow

Sun. G10



STOP 9

We have just driven through the meltwater channel and are parked near its northerly crest. Our route is depicted by the cross-section inset at left. Compare the section to your view looking southerly, down into and across the channel. Note the terraces on the southerly wall, which were apparently cut by ice-marginal streams walled by the glacier on their northerly sides.

On the map, note the deep, dry channel easterly and southeasterly from our stop. This was the spillway for a pro-glacial lake, with a surface elevation of 1205 feet, that formed over the Forestville area as ice dammed the northerly flowing Walnut Creek. Our field trip ends here, so we'll save Lake Forestville and its inlets for a new day and a fresh paddle.

Before we depart, examine the brass disk set in concrete near the southwestern corner of the road intersection. It is a horizontal ground control station for the photogrammetrically-produced 7.5-minute-series topographic sheets. USGS designates it "TT 38 WX 1952," with position determined at 42°27'07.544" north latitude and 79°14'12.489" west longitude.

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AUTHORS' NOTE

This trip has been a tour through graduate work in progress by Woodbury under advisement by M. P. Wilson. The general glacial history and the lake deposits are the forte of Jensen who has studied under P. E. Calkin at the University of Buffalo. Woodbury is primarily responsible for the graphics and text from the introduction through the stop descriptions, while Jensen is responsible for the road log narrative and the description of Stop 1.

ROAD LOG FOR PADDLING UP A MELTWATER CHANNEL

CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
-1.1	0.0	Assembly area at the large limestone erratic near Houghton Hall.
-0.8	0.3	Turn left (west onto Temple Street Entrance Road)
-0.75	0.05	Turn left (south onto Temple Street)
0.0	0.75	Intersection of Temple Street and US Route 20, turn right (proceed west on US Route 20).
0.2	0.2	Passing over Canadaway Creek. This valley formed embayments for proglacial Lake Whittlesey and Lakes Warren.
0.5	0.3	Intersection US Route 20 and Chestnut Street. Continue west on US Route 20. US Route 20 follows the Lakes Warren strandline from Central Ohio into Western New York. Gravel pits close to the highway provide an abundant source of aggregate for the highway.
1.0	0.5	View of the Escarpment to the left of the highway. There are no resistant units to account for the formation of this cuesta. Abundant grape vineyards are growing in the well drained sands and gravels of Lakes Warren and Whittlesey beach deposits to the south.
2.1	1.1	A cemetery to the left. There are many cemeteries located in the well drained deposits because they can be dug in almost year round.
2.6	0.5	Turn right (north onto Farel Road)
2.9	0.3	Turn right (east into Ron Morse Gravel Pit)

STOP 1. GRAVEL PIT IN LAKES WARREN BEACH DEPOSITS.

2.9	0.0	Turn left (south onto Farel Road from the entrance to the gravel pit)
3.1	0.2	Turn right (west back onto US Route 20)
3.2	0.1	To the south the apparent wave cut terrace just north of Webster Road is the southern wall of an abandoned gravel pit.
6.7	3.5	Village of Brocton, New York.
7.25	0.55	The Brocton Arch. Prior to World War 2 several of the villages in Chautauqua County had similar arches in their villages. However, all of the villages but Brocton removed theirs to provide scrap metal for the war effort.

8.8	1.55	Turn left (south onto Fay Street)
9.3	0.5	Turn left (east onto Webster Road). Webster road follows the Lake Whittlesey Strandline for several miles from the Town of Portland east through the town of Pomfret).
9.8	0.5	Turn left (north into gravel pit (PLAN A)).
10.2	0.4	Turn left (north into gravel pit (PLAN B)).

STOP 2. GRAVEL PIT IN LAKE WHITTLESEY BEACH DEPOSITS.

10.4	0.2	Stop for a beer at the Castle.
10.7	0.3	Turn right (south onto Highland Road)
10.8	0.1	Turn left (east onto Ellicott Road)
10.9	0.1	To the north notice the fine surficial expression of the meltwater channel.
11.3	0.4	Proceed straight (west) through the left side of the fork towards the stop sign.
11.5	0.2	Proceed through the right side of the fork and continue to bear west on Ellicott Road.
11.7	0.2	Notice the gas well just off to the north of Ellicott Road. Gas wells are very common throughout Western New York. They are drilled primarily into the highly productive sandstones of the Silurian Medina Group which dip gently towards the southwest at approximately 50 ft/mi.
13.2	1.5	Pull off the road onto the right shoulder out of away from traffic.

STOP 3. OVERVIEW OF THE MELTWATER CHANNEL.

13.5	0.3	Turn left (north onto Harmon Hill Road)
13.6	0.1	Passing through the channel towards the Lake Whittlesey strandline at Webster Road.
14.0	0.4	Turn right (east onto Webster Road)
14.8	0.8	Bear left at the fork in the road at the stop sign. Webster road is still following the ancestral shoreline of Lake Whittlesey.
15.6	0.8	The southern wall of the abandoned gravel pit mentioned previously within this roadlog is just left (north) of the road.
16.1	0.5	Turn right (south onto Vine Road.) NOTE: This intersection is not marked but is just east of the sign for the Webster Cemetery.
17.0	0.9	Bear left (east at "L" intersection)
17.4	0.4	Passing over a buried channel indicated by seismic profiles and core samples.
17.4	0.0	Turn right (south onto Chautauqua Road)

17.5	0.1	Dropping into the channel and passing over the misfit Little Canadaway Creek which currenly occupies the meltwater channel.
17.6	0.1	Passing up the south wall of the meltwater channel.
17.7	0.1	Turn left (east onto Concord Drive)
17.8	0.1	Pull off the road onto the right shoulder away from traffic.

STOP 4. A WALK INTO THE ANCESTRAL MELTWATER CHANNEL PLUS A VISIT TO ONE OF ITS "HANGING" TRIBUTARIES.

18.2	0.4	Turn left (west onto Osborn Road)
19.6	1.4	Turn left (north onto Fredonia-Stockton Road)
20.5	0.9	Pull off the road onto the right shoulder away from traffic.

STOP 5. A GLIMPSE OF THE DISTANT INLET CHANNEL AND A PANORAMIC VIEW OF PROGLACIAL LAKE SHUMLA.

21.9	1.4	Turn right (east onto Webster Road)
22.0	0.1	Turn right (south onto Portage Street)
22.4	0.4	Turn right (south onto NY Route 60)
23.3	0.9	Turn right (west onto Spoden Road)
24.7	1.4	Pull off the road onto the right shoulder away from traffic.

STOP 6. DITCH EXPOSURE OF LAMINATED (VARVED?) CLAYS WITH DROPSTONES AS DEPOSITED INTO PROGLACIAL LAKE SHUMLA.

24.7	0.0	Continue west on Spoden road.
25.7	1.0	Turn left (north onto NY Route 60)
26.5	0.8	OPTIONAL STOP: This is an optional stop due to the safety constraints put on us by a large group. This is a Fine exposure of laminated clays which were deposited into Lake Shumla. When NY Route 60 was initially cut through this area the engineers placed a 90 degree roadcut through this materiel. Over the following years the materiel slumped every time it was water laden until it reached the much stabler shallower exposure that appears today. As you climb up the exposure you will see beautiful clean clay littered with abundant dropstones.
28.6	2.1	Turn right (east onto NY Route 83)
29.2	0.6	Turn right (south onto Brainard Road)

29.5	0.3	Turn left (east into Conti's Gravel Pit)

STOP 7. GRAVEL PIT IN THE DEPOSITS OF A PROBABLE DELTA BUILT INTO LAKE SHUMLA.

29.5	0.0	Turn left (south on Brainard Road)
29.8	0.3	Turn right (west onto Skinner Road)
30.5	0.7	Turn left (north onto Miller Road)
30.7	0.2	Pull off the road onto the right shoulder away from traffic.

STOP 8. SPECTACULAR VIEW OF THE COL WHICH WAS THE OUTLET OF PROGLACIAL LAKE SHUMLA.

31.6	0.9	Proceed straight through the intersection of Miller Road and NY Route 83.
32.6	1.0	Proceeding down the south wall of the channel.
32.9	0.3	Passing through the botton of the channel.
33.0	0.1	Passing up the north wall of the channel.
33.3	0.3	Turn right (east onto Straight Road)
33.7	0.4	Passing down the south wall of the channel.
33.8	0.1	Passing through the bottom of the channel.
34.0	0.2	Passing up the north wall of the channel.
34.5	0.5	Proceeding up a long slope onto the Escarpment which is the northern edge of the Allegheny Plateau.
35.4	0.9	Turn Left (north onto Center Road)
36.1	0.7	Passing over an asymetrical terrace above the south wall of the channel.
36.3	0.2	Passing over a terrace which is the crest of the southern wall of the channel.
36.5	0.2	Passing through the bottom of the channel.
36.55	0.05	Passing up the north wall of the channel.
36.6	0.1	Turn left (west onto S. Roberts Road)
36.65	0.05	Pull off the road onto the right shoulder away from traffic.

STOP 9. CROSS-SECTIONAL VIEW OF CHANNEL AND TERRACES.

36.65	0.0	Continue (west on S. Roberts Road)
38.4	1.75	Optional stop and picnic at the Woodbury Winery.
38.5	0.1	Proceed straight (north) through the stop sign.
39.4	0.9	Turn left (west onto US Route 20)
40.7	1.3	Turn right (north onto NY Route 60)
41.3	0.6	Turn right onto New York State Thruway (Interstate 90) Interchange Number 59.