GLACIAL FEATURES OF THE WESTERN FINGER LAKES LANDSCAPE

BRUCE GILMAN
Department of Environmental Conservation/Outdoor Recreation,
Finger Lakes Community College, 4355 Lakeshore Drive, Canandaigua, New York 14424

INTRODUCTION

During the Pleistocene Epoch, repeated episodes of continental glaciation affected the Great Lakes region of eastern North America. The most recent ice advance, known as the Wisconsin Stage (65,000-12,000 years B.P.) is largely responsible for the appearance of our modern western Finger Lakes landscape, although there is little doubt that it followed the pattern left by earlier glaciations. During Wisconsin time, ice filled the Lake Ontario basin, split into sublobes and flowed southward across western New York. Distribution and movement of these sublobes has been deduced from the orientation of striae and drumlins (Dreimanis and Goldthwait 1973). As the ice margin retreated across the Finger Lakes region, glacially scoured valleys were filled with trapped meltwater. Drainage to the north was blocked by the ice sheet, and to the east and west by higher ground. The first proglacial Finger Lakes, with their southern drainage, had come into existence. Fairchild (1909) wrote about these glacial lakes. Their names are not as familiar as the modern Finger Lakes: Lake Hall near Dansville in the Genesee Valley, Lake Naples in the southern Canandaigua Valley, and Lake Italy in the Italy Valley to name a few. These lakes were short-lived, for as soon as the ice margin retreated farther north, lower spillways were uncovered. In the Canandaigua Valley, Lake Naples was replaced by Lake Middlesex as soon as an eastern drainage outlet was free of glacial ice. Today the signs of the historic presence of these lakes can be found in hillside shorelines (strandlines because these beaches are located some distance from the modern lake beaches) and gravelly delta deposits at the mouths of abandoned spillways. Perhaps, too, the fertile lacustrine sediments of a valley floor where no lake stands today will serve as a reminder of our recent glacial past.

The glacial geology of the western Finger Lakes region will be discussed at several stops on this field trip. The road log provides background figures and brief explanations for each stop. Two types of illustrations are presented for each stop: a photocopy reproduction of the relevant portion of a U.S.G.S. topographic quadrangle sheet and a digital elevation model (DEM) of the entire quadrangle sheet. For the former, the contour interval is 20 feet and north is at the top when the map is oriented to read. Map scale varies as each photocopy was enlarged in order to accentuate the glacial features. For the latter, DEM files were selected from Cornell University's geographic information resources library (search on the worldwide web for cugir). Relevant files were decompressed and extracted. For each DEM, the image file has been projected through ArcView's © Spatial Analyst Extension accepting the hillshade default settings.

ROAD LOG FOR GLACIAL FEATURES OF THE WESTERN FINGER LAKES LANDSCAPE
FULL DAY EXCURSION

CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
0.0	0.0	Intersection of Routes 5 and 20, Rte. 14 in city of Geneva, turn north on Rte. 14
6.4	6.4	Intersection of Rte. 14 and Rte. 318, turn east on Rte. 318
7.9	1.5	STOP 1, Junius Ponds

STOP 1. JUNIUS PONDS AS VIEWED ALONG ROUTE 318

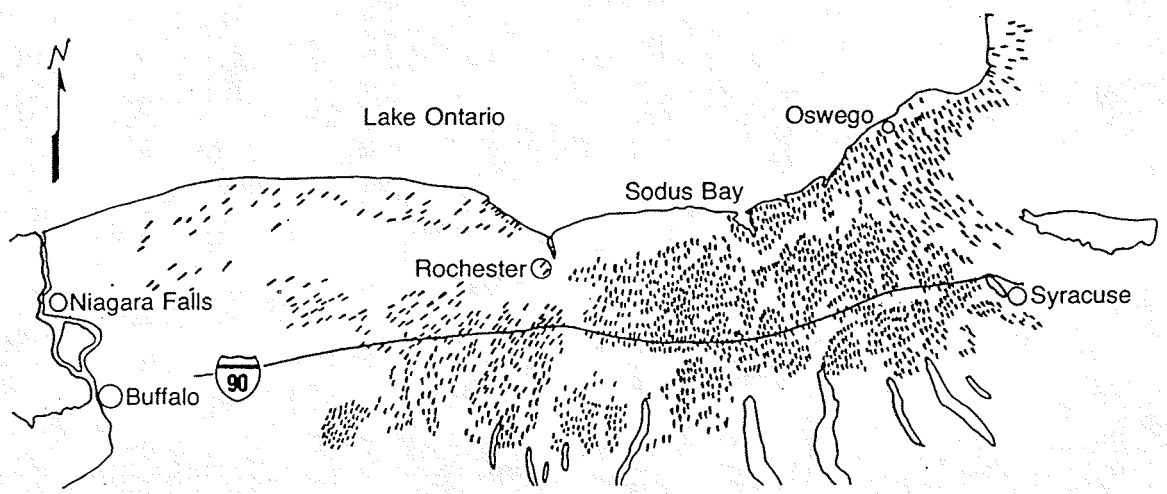
This disintegration landscape of stagnant ice features contains kettles and kettle hole lakes within a large and rather unique kame moraine complex. Chunks of glacial ice, varying in size, were buried here. When melting occurred, depressions were formed. Several basins are springfed today - the Junius Ponds complex. The complex consists of eight inter-connected basins separated by wetlands or sediment sills. The basins range in total depth from 8 to 17 meters, with the deepest basin exhibiting meromictic water circulation conditions. Original work on the limnology of the basins was published in 1931 by Burkholder. Since then, several unpublished graduate studies have been conducted (Principle 1981, Pendl 1982, Besse 1984 and Schloss 1985).

The surrounding kame moraine is composed of stratified (washed) sand and gravel that was deposited on, against, or immediately in front of the glacial margin. It is unusual and distinctive from other kame moraine complexes in New York State. Exposures in highway cuts and adjacent gravel pits indicate that portions of the moraine were affected by a major ice readvance. Sediment structure was distorted and the surface was remolded by the ice sheet overriding previously formed features. In addition to this site's unique glacial history, the natural communities here support several New York State rare species. Wetlands are particularly diverse, with some developing acidic bog-like conditions while others exhibit marly fen-like conditions apparently associated with calcareous seepage.

CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
9.4	1.5	West on Rte. 318, return to Rte. 14, turn north on Rte. 14
27.6	18.2	Intersection of Rte. 14 and CR 143 (Ridge Road) in hamlet of Alton, turn east on CR 143
31.4	3.8	Intersection of CR 143 and CR 154 (Lake Bluff Road), turn north on CR 154
33.0	1.6	Intersection of CR 154 and CR 155 (Lummisville Road), turn east on CR 155
33.8	0.8	Intersection of CR 155 and East Bay Road, turn north on East Bay Road
37.0	3.2	STOP 2, Chimney Bluffs parking lot at end of East Bay Road

STOP 2. CHIMNEY BLUFFS ALONG THE SOUTHERN SHORE OF LAKE ONTARIO.

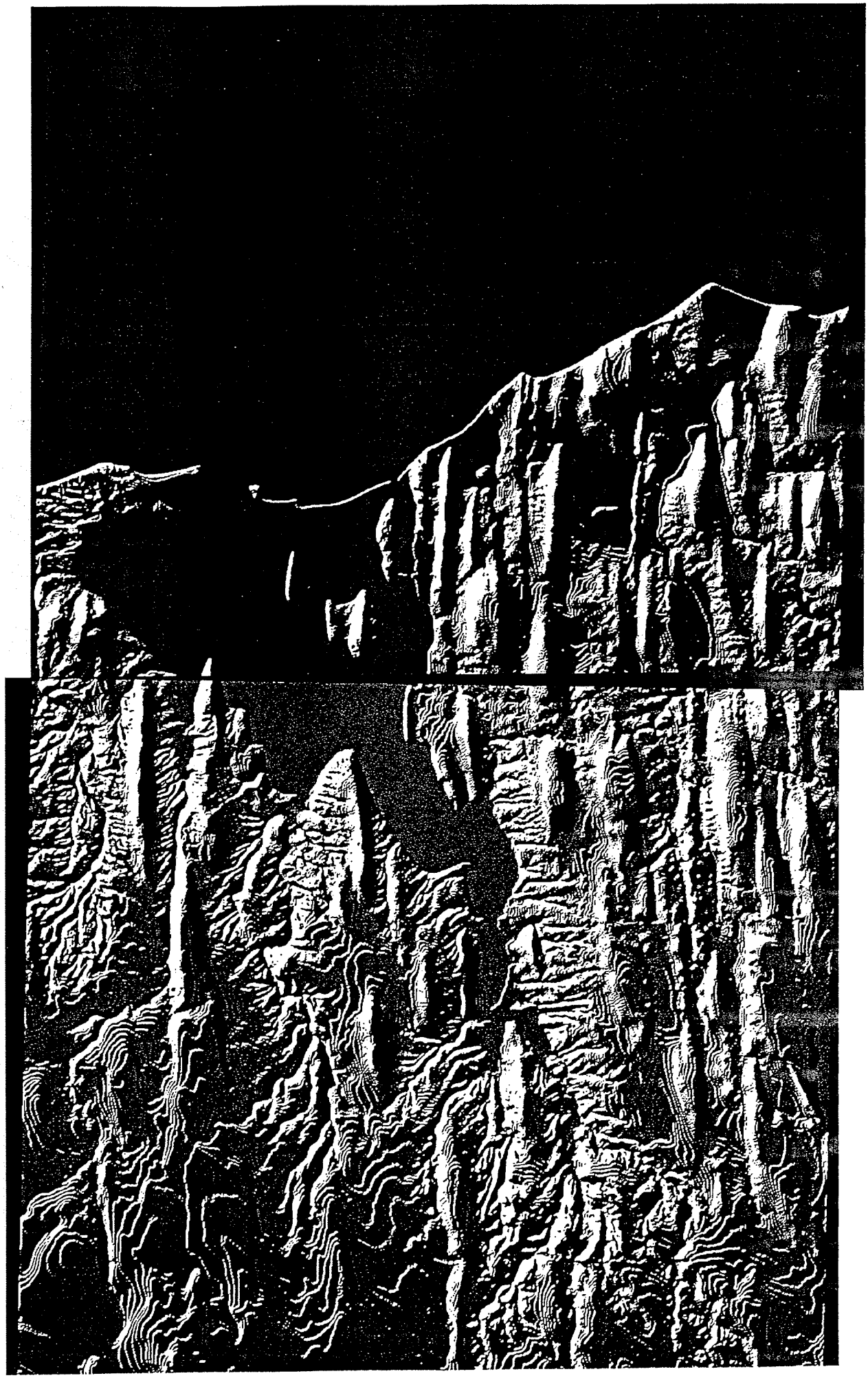
Over 10,000 drumlins lay in the plain between Lake Ontario and the Finger Lakes...the largest field of drumlins in the world!



(Source: VanDiver 1985)

The processes that form drumlins is complicated and involves a certain amount of rational guess work. Most drumlins are built up with concentric layers of gravel bound together by an excess of clay. It is widely agreed that drumlins are built by accretion, a subglacial plastering and lodgement of till as the ice sheet moved forward. A fairly flat landscape and thin ice are required. At this site, it is thought that a reduced lobe of ice occuping the future basin of Lake Ontario radiated out over the adjacent land. The basal debris in this ice was pulverized shale from the lake basin - hence the high content of clay. The thin ice margin was not exerting as great a pressure on the landscape as before. With a thrust from behind (a slight readvance), the ice tended to slip, or slide over the ground without digging in. Where it passed over a slight obstruction, the clay at the bottom adhered and was added to, layer by layer. The obstacle may have been a heap of glacial till or a small protrusion of bedrock. Later, when the Lake Ontario basin rebounded from the loss of ice mass, water levels began to rise. The bluffs were formed as the rising waters eroded the toe of the slope in the surf zone. Today, the "badlands" topography is maintained by several processes. Ongoing wave action loosens till fabric at the beach. Wind and rain combine to sculpture exposed bluff faces. Water that percolates downward near the rim of the drumlin contributes to slumping wherever it re-emerges along the bluff face. Freezing and thawing cycles may exacerbate these processes. It has been estimated that the bluffs erode up to five feet per year. Differences in composition and compression account for the more resistant strata features at the lakeshore.

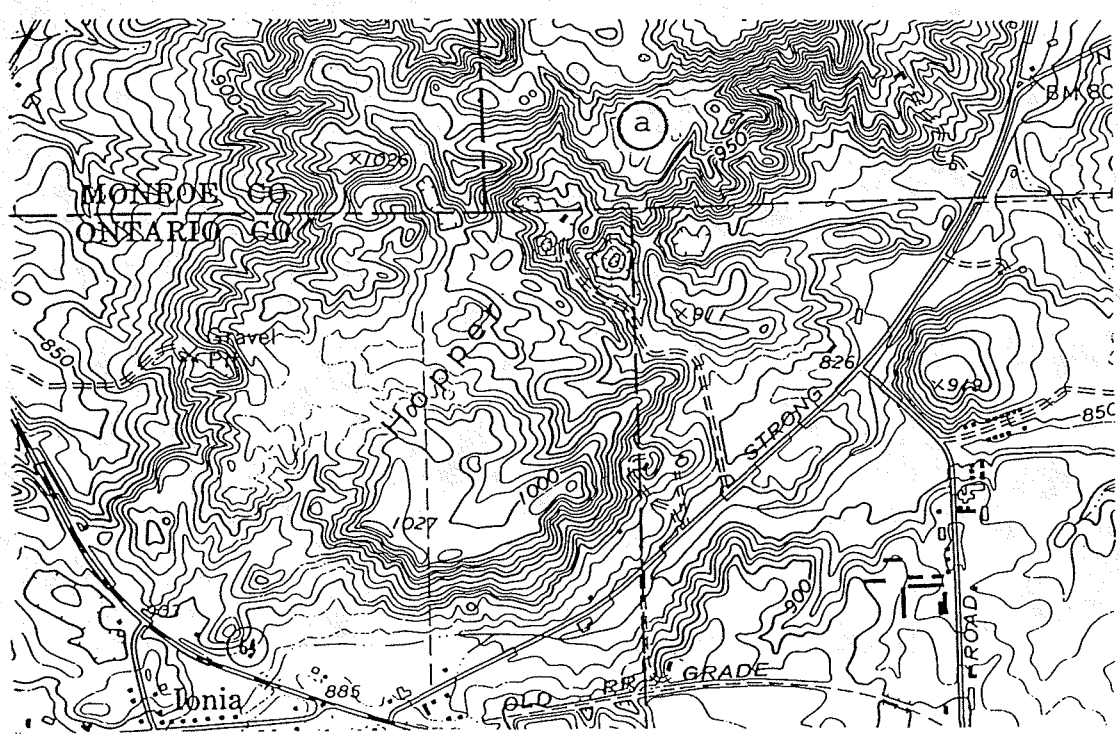

18
6
250
BM
281
ROAD
St Johns
Chapel
254
276
Root Swamp
e Bluff
GARNER
300
350
400
396
252
LAKE
H U R



CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
40.2	3.2	Leave parking lot heading south on East Bay Road to intersection with CR 155, turn west on CR 155
41.0	0.8	Intersection of CR 155 and CR 154, turn south on CR 154
42.6	1.6	Intersection of CR 154 and CR 143, turn west on CR 143
46.4	3.8	Intersection of CR 143 and Rte. 14, turn south on Rte. 14
65.0	18.6	Intersection of Rte. 14 and Rte. 96, turn west on Rte. 96, passing through the village of Phelps
71.2	6.2	Intersection of Rte. 96 and Rte. 488, turn south on Rte. 488, passing through hamlet of Orleans
80.7	9.5	Intersection of Rte. 488 and Rte. 21 in Chapin, turn south on Rte. 21
84.0	3.3	Intersection of Rte. 21 and Rte. 332 (Main Street) in Canandaigua, turn south on Rte. 332
84.2	0.2	Intersection of Rte. 332 (Main Street) and West Avenue, turn west on West Avenue
85.6	1.4	Intersection of West Avenue and Routes 5 and 20, continue west on Routes 5 and 20
92.8	7.2	Intersection of Routes 5 and 20 with Rte. 64, turn north on Rte. 64
96.0	3.2	STOP 3, Hopper Hills in hamlet of Ionia

STOP 3. KAME MORAINE, LOCALLY KNOWN AS THE HOPPER HILLS, VIEWED FROM STRONG ROAD NEAR THE HAMLET OF IONIA.

These kames were heaped upon the landscape during Lake Warren time (a predecessor to Lake Erie that extended across western New York) and their striking contrast to the flatter land surrounding them suggests an exceptionally debris laden ice front at this particular site. In adjacent sand and gravel pits, the internal structure of the kames can be seen. They are stratified and show evidence of land-water contact (ripple marks) throughout their layers but especially towards their base.



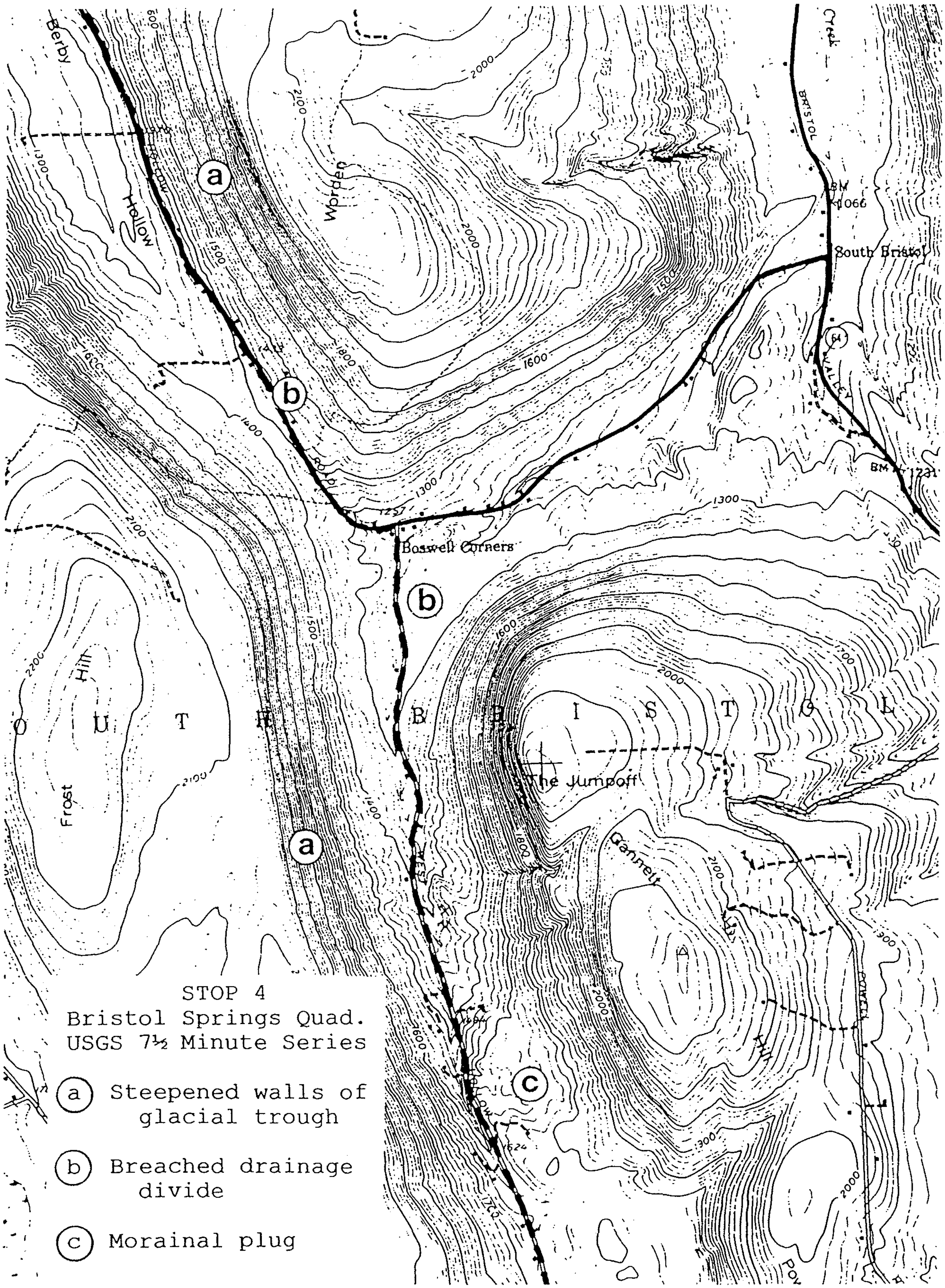
CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
103.2	7.2	Leave Hopper Hills, heading south on Rte. 64 to intersection with Routes 5 amd 20, turn east on Routes 5 and 20
106.3	3.1	Intersection of Routes 5 and 20 with Rte. 64, turn south on Rte. 64
119.2	12.9	Intersection of Rte. 64 and Gannett Hill Road, turn west on Gannett Hill Road
120.5	1.3	STOP 4, Entrance to Ontario County Park at summit of Gannett Hill Road, turn right to reach Jumpoff parking lot

STOP 4 THE JUMPOFF AT ONTARIO COUNTY PARK ON GANNETT HILL.

The main road to the Ontario County Park ascends up the west flank of the glacially carved Canandaigua trough (broad U-shaped valley). Along the road, a small stream has carved a ravine that exposes a thin glacial ground moraine underlain by Upper Devonian shales and sandstones. Looking southward from the top of the hill one can see the Appalachian Plateau with its near alignment of summits believed to have resulted from water erosion of the preglacial peneplain. The ice sheet then selectively eroded the pre-existing north-south streams into the wide troughs that separate these flat hilltops.

The Jumpoff overlook in the park is at an elevation of 2100 feet above sea level and almost 700 feet above the valley floor! Looking northwest (right) into Berby Hollow the graceful curved cross-section of a glacially carved trough can be seen. On clear days, the city of Rochester located on the Lake Ontario plain is visible in the distance. Below the Jumpoff and to the south (left) is a hummocky valley floor composed of a recessional moraine plug containing lower Silurian sandstones whose nearest source is in bedrock outcrops near Rochester. Glacial transport can be the only explanation. Other transported rocks and boulders, known as glacial erratics, are common in the woodlands of Ontario County Park.

Small glacial lakes once situated in Berby Hollow and the Bristol Valley had to drain eastward into the Canandaigua trough, breaching the drainage divide near Boswell Corners. Recall, the margin of the ice still blocked any northward escape of meltwater. At the bottom of the hill along the main entrance road to the park is a small hamlet known as Bristol Springs. Just beyond it is a gravelly delta, deposited where these small lakes drained into Glacial Lake Naples occupying the Canandaigua valley thousands of years ago. The delta deposit is stratified, clearly indicating sorting by glacial meltwater. Cross-bedding of the layers suggests that water altered its drainage pattern across the delta many times. The particle sizes and texture of the deltaic material is coarse; the finer silts and clays are absent. They were probably carried by the raging meltwater currents out into Lake Naples, eventually to become varve deposits along the bottom of the Canandaigua trough. Drifting icebergs along the lake surface added dropstones to the accumulating bottom sediment.

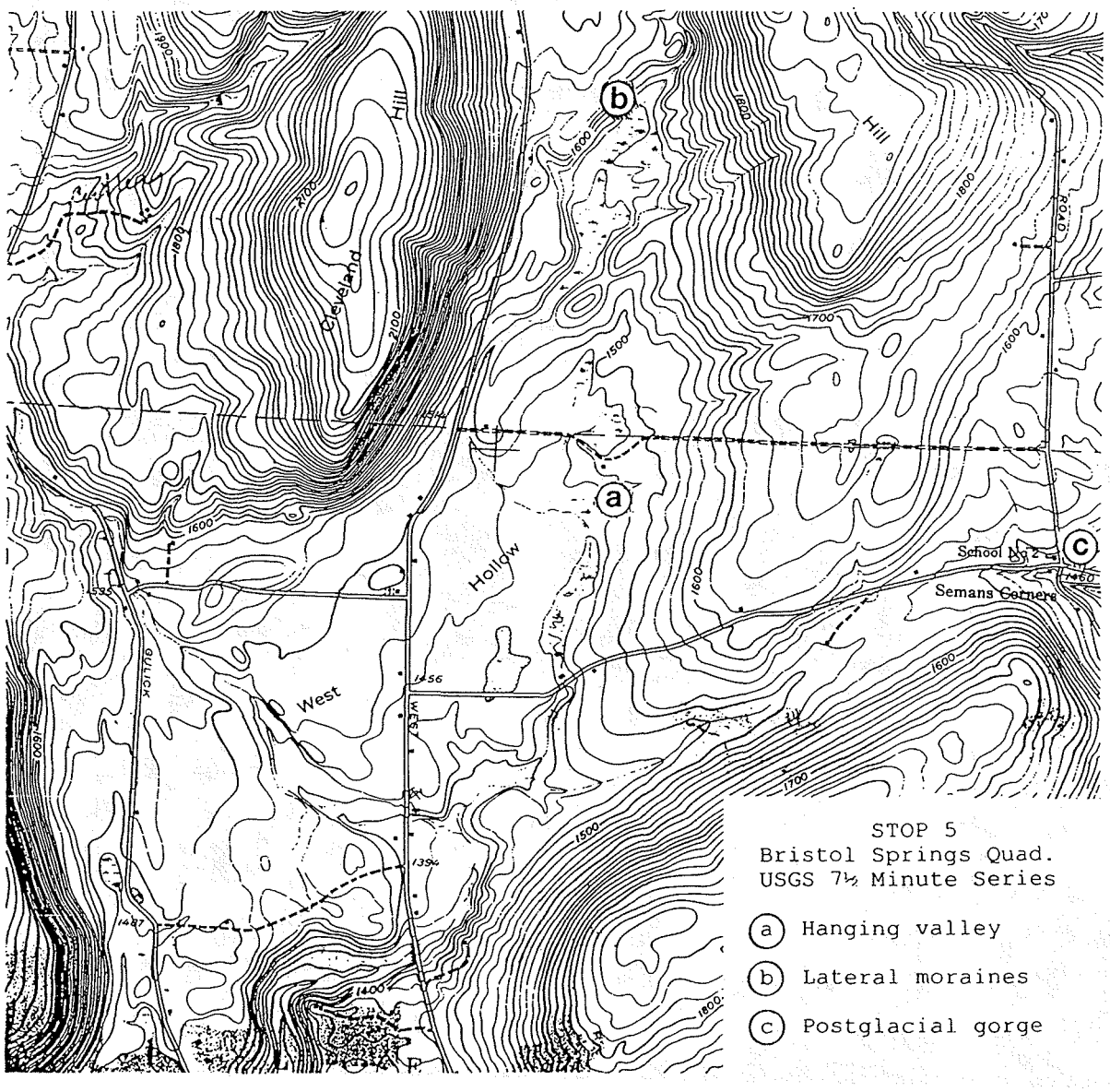

STOP 4
Bristol Springs Quad.
USGS 7½ Minute Series
(a) Steepened walls of glacial trough
(b) Breached drainage divide
(c) Morainal plug
Worden
Hollow
Berby
South Bristol
Boswell Corners
Frost
Hill
The Jumpoff
Gannett
S O U T H B R I S T O L
BRISTOL
VALLEY
Creek
2000
2100
1600
1500
1300

CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
123.8	3.3	Leave Ontario County Park, turn south on Gannett Hill Road staying along top of hill to STOP 5

STOP 5 THE WEST HILL HANGING VALLEY VIEWED FROM GANNETT HILL ROAD NEAR THE INTERSECTION WITH SEMAN ROAD.

Glacial striations produced as the ice advanced over native bedrock in the western Finger Lakes landscape have a compass orientation within a few degrees of south. The ice sheet selectively eroded pre-existing north-south valleys because they aligned with the basal ice flow direction. In this regard, the Canandaigua Valley, originally V-shaped and occupied by the "Canandaigua River", was extensively scoured along its bottom and its sidewalls transforming it to a typical U-shaped glacial trough.

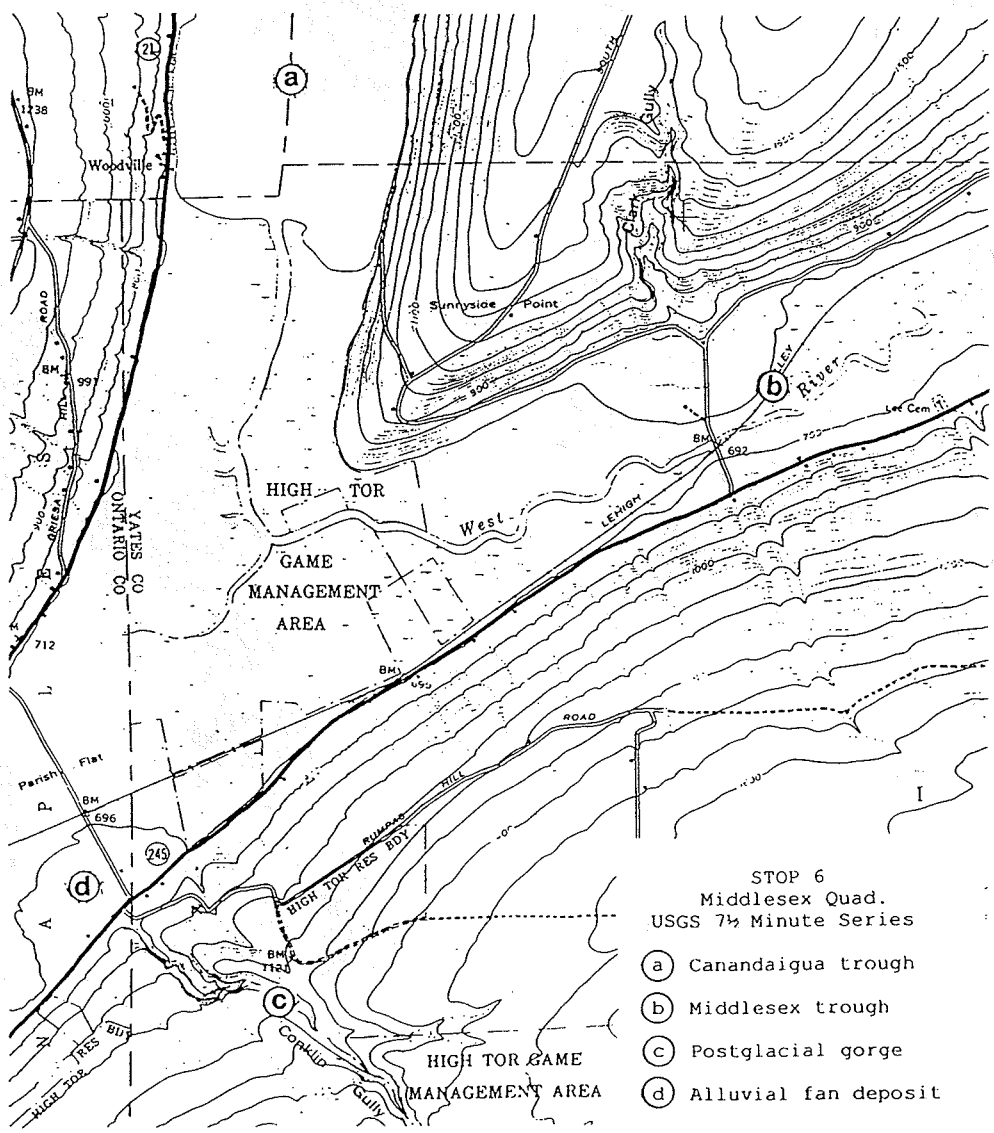
Preglacial, east-west tributaries were not as deeply scoured during the Pleistocene. After ice sheet retreat, these tributaries were left elevated above their preglacial outlets (the now deeply eroded north-south valleys). Spectacular, scenic gorges trace the course of these hanging valley streams as they cascade down into the over deepened glacial troughs (a gorge will be visited at stop 9).



CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
124.0	0.2	Gannett Hill Road changes name to Rhine Street at the intersection with Seman Road, continue south on Rhine Street
124.6	0.6	Intersection of Rhine Street and CR 12, turn south on CR 12
124.9	0.3	Roadside pull-off on CR 12 for STOP 6

STOP 6. CANANDAIGUA LAKE OVERLOOK AND BARBED TROUGH JUNCTION WITH THE MIDDLESEX VALLEY AS VIEWED FROM COUNTY ROAD 12.

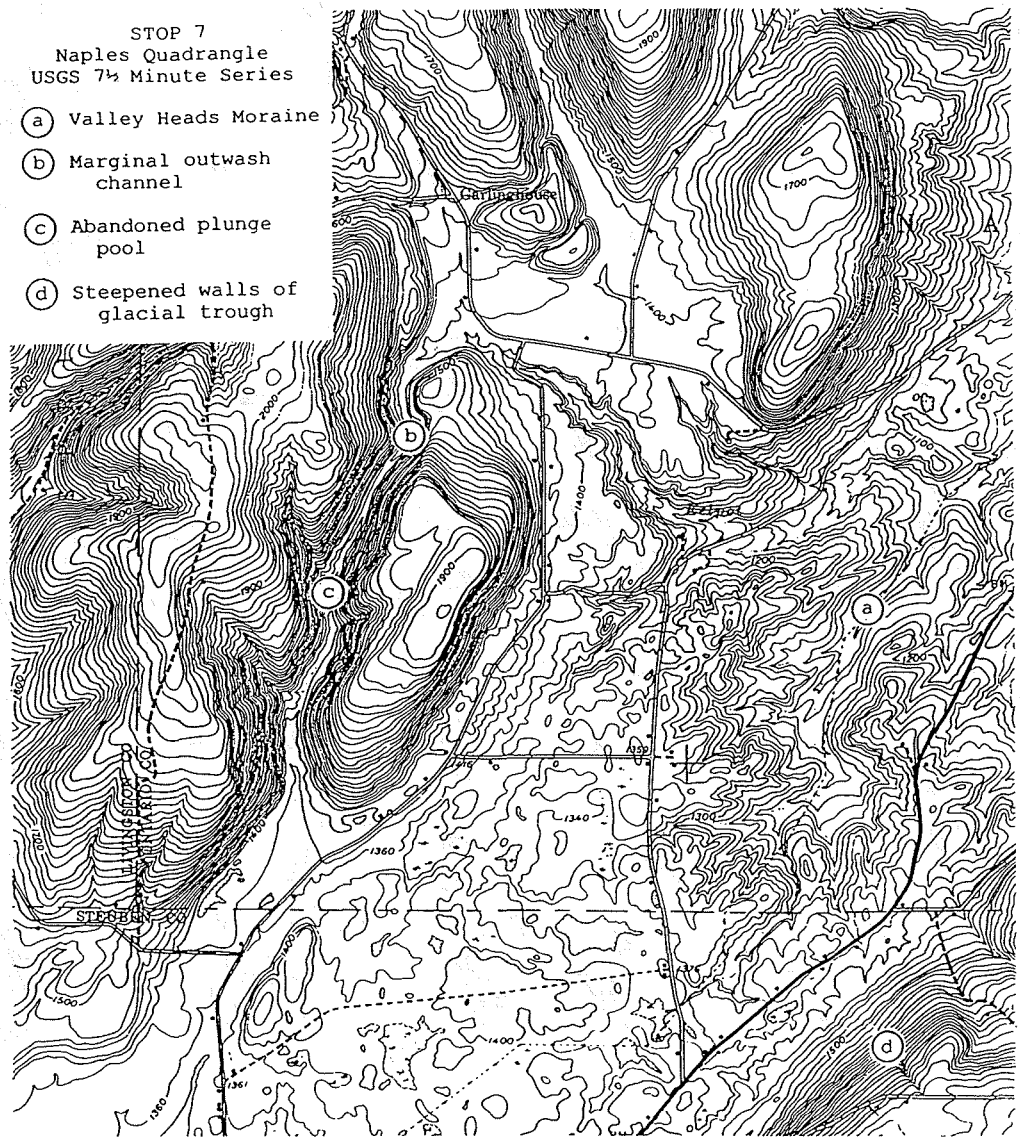
To the north (left) is the large, water-filled Canandaigua trough with its glacially scoured and steepened walls. Initially, erosion may have been enhanced simply due to faster ice flow but it soon was assisted by increasing thickness of ice as the valley was deepened. Joining the Canandaigua trough from the east is the Middlesex trough (today occupied by the meandering West River). This trough is also the product of glacial scour. The barbed trough junction at the confluence of the two valleys closely resembles the shape of modern Keuka Lake and supports the idea of a south flowing pattern for the western Finger Lake valleys during preglacial times (Fairchild 1909). Just south of Naples, a similar barbed trough junction is present where the Italy Valley joins the Canandaigua Valley. Some geologists theorize that the drainage then turned westward into the north flowing "Dansville River", an ancient predecessor of the Genesee River. Others suggest the drainage continued southward eventually joining the Susquehanna basin. Conklin Gorge may be seen along the far wall of the Middlesex trough. The gorge is postglacial and has built a considerable alluvial fan (locally known as Parish Flats) on the valley floor.

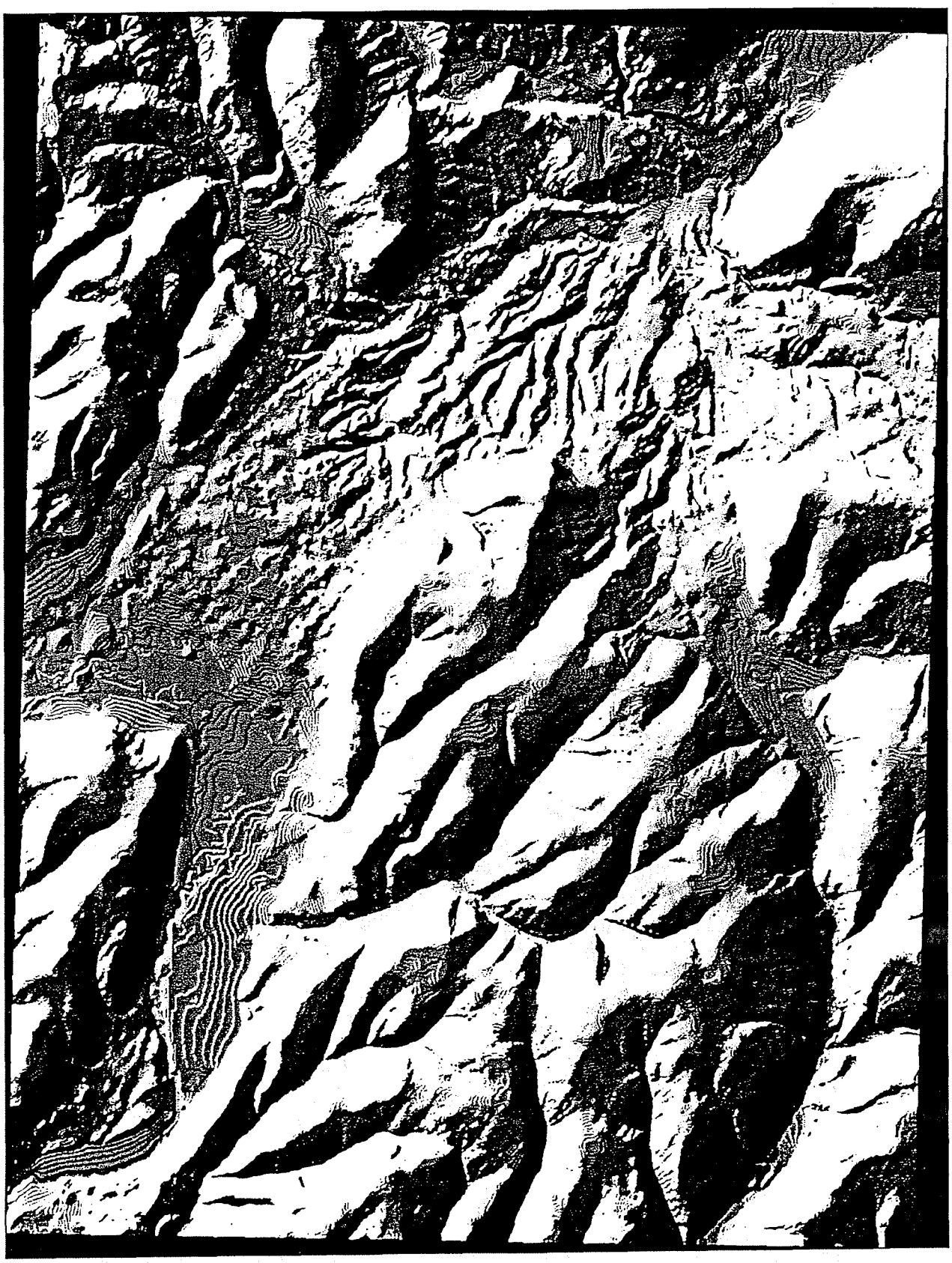


CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
126.7	1.8	Continue south on CR 12 to intersection with Rte. 21, turn south on Rte. 21
131.1	4.4	Pass through village of Naples, a few miles south watch for a safe roadside pull-off as Rte. 21 ascends the Valley Heads Moraine, STOP 7

STOP 7. THE VALLEY HEADS MORAINE AS VIEWED ALONG ROUTE 21 SOUTH OF THE VILLAGE OF NAPLES.

Just south of the village of Naples, Route 21 ascends from the valley floor of the Canandaigua trough. The landscape becomes hummocky, composed of small rolling hills and valleys, called a knob and basin morphology by glaciologists. This is a recessional moraine, a massive glacial deposit that accumulated from drainage off the Appalachian Plateau. It was banked up against the stagnant ice front reaching a thickness of over 600 feet! It is a somewhat stratified deposit, affected by the presence of trapped meltwater along the ice sheet margin. As the ice downwasted, kames and kettles were formed on the surface of the moraine. The Valley Heads recessional moraine is estimated to be between 13,500 and 15,000 years old. Today, the Valley Heads moraine marks the major drainage divide between the St. Lawrence Seaway and the Susquehanna River. It effectively dams the southern end of the Finger Lake valleys, trapping water in eleven of the glacial troughs, and forcing their modern drainage northward.





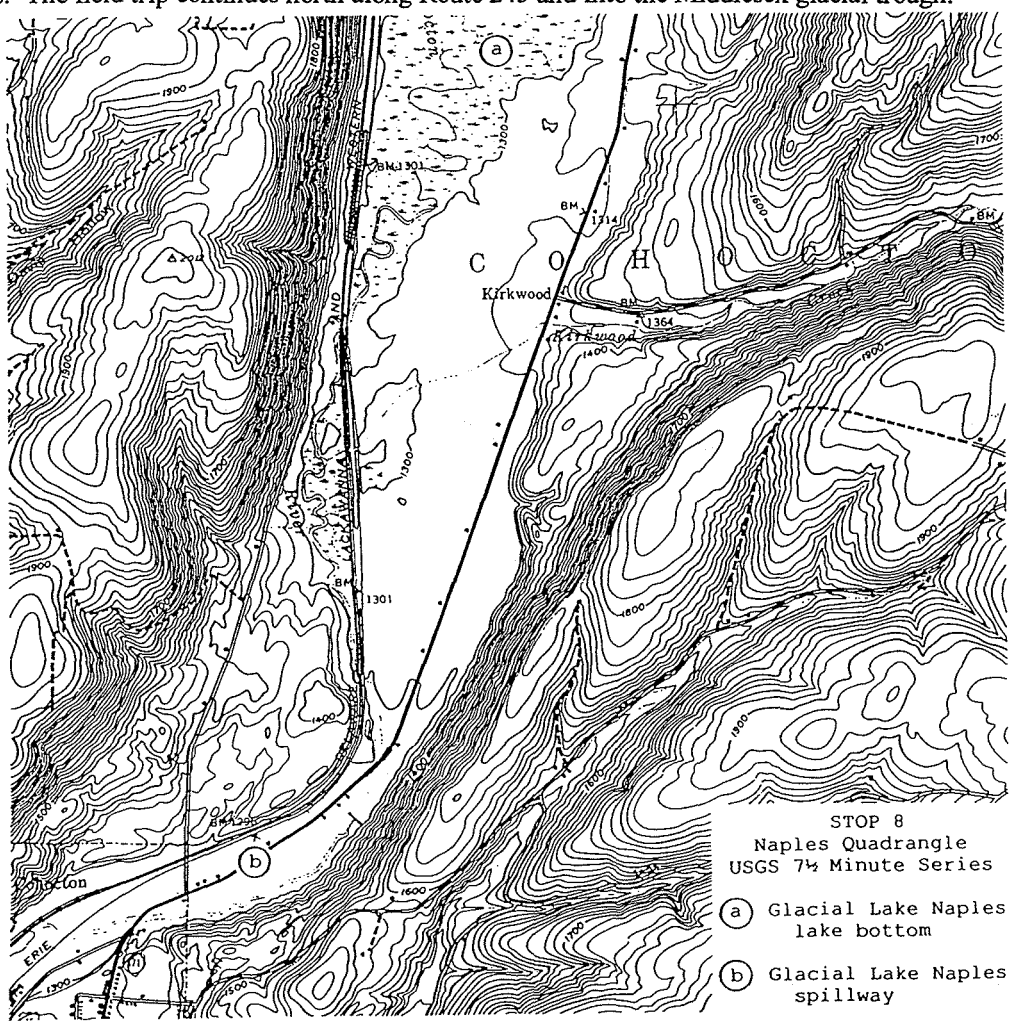
CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
133.1	2.0	Continue south on Rte. 21 to intersection with Rte. 371 in the village of North Cohocton, turn south on Rte. 371
137.1	4.0	As valley narrows, park in roadside lot to the left where river crosses beneath, STOP 8

STOP 8. THE GLACIAL LAKE NAPLES SPILLWAY ALONG ROUTE 371 BETWEEN NORTH COHOCTON AND COHOCTON.

Traveling farther south, the hummocky surface of the Valley Heads moraine gives way to a flat plain of virtually stone-free soils. This is the bottom sediment of Glacial Lake Naples! A silty and productive farm soil, coring would undoubtedly reveal buried varves that tell the story of seasonal accumulations of silt and clay. Lake Naples is estimated to have been 13 miles long, 2 miles wide and over 800 feet deep! It had a surface elevation of 1340-1350 feet above sea level. Glacial Lake Italy, at an elevation of 1370 feet above sea level, drained into Lake Naples forming the Tannery Glen delta.

Watch along the valley wall for evidence of this ancient lake's shoreline. Often small sand and gravel pits on local farms, or elevated deltas along tributary streams pinpoint the location. Travelling south and just before entering Cohocton, the lake bottom and valley floor suddenly narrow...the entrance to the Lake Naples spillway. This outlet is about 1000 feet wide and must have been impressive when torrents of water drained through it. Today, a much smaller Cohocton River slowly meanders southward to join the Chemung River.

On the return to Naples, take a moment to appreciate the view from the top of the Valley Heads moraine. Notice the barbed trough junction (STOP 6) where the Canandaigua and Middlesex troughs join just north of the village. Remember, this Y-shaped junction supports the idea of a south flowing preglacial drainage system for the western Finger Lakes. The field trip continues north along Route 245 and into the Middlesex glacial trough.

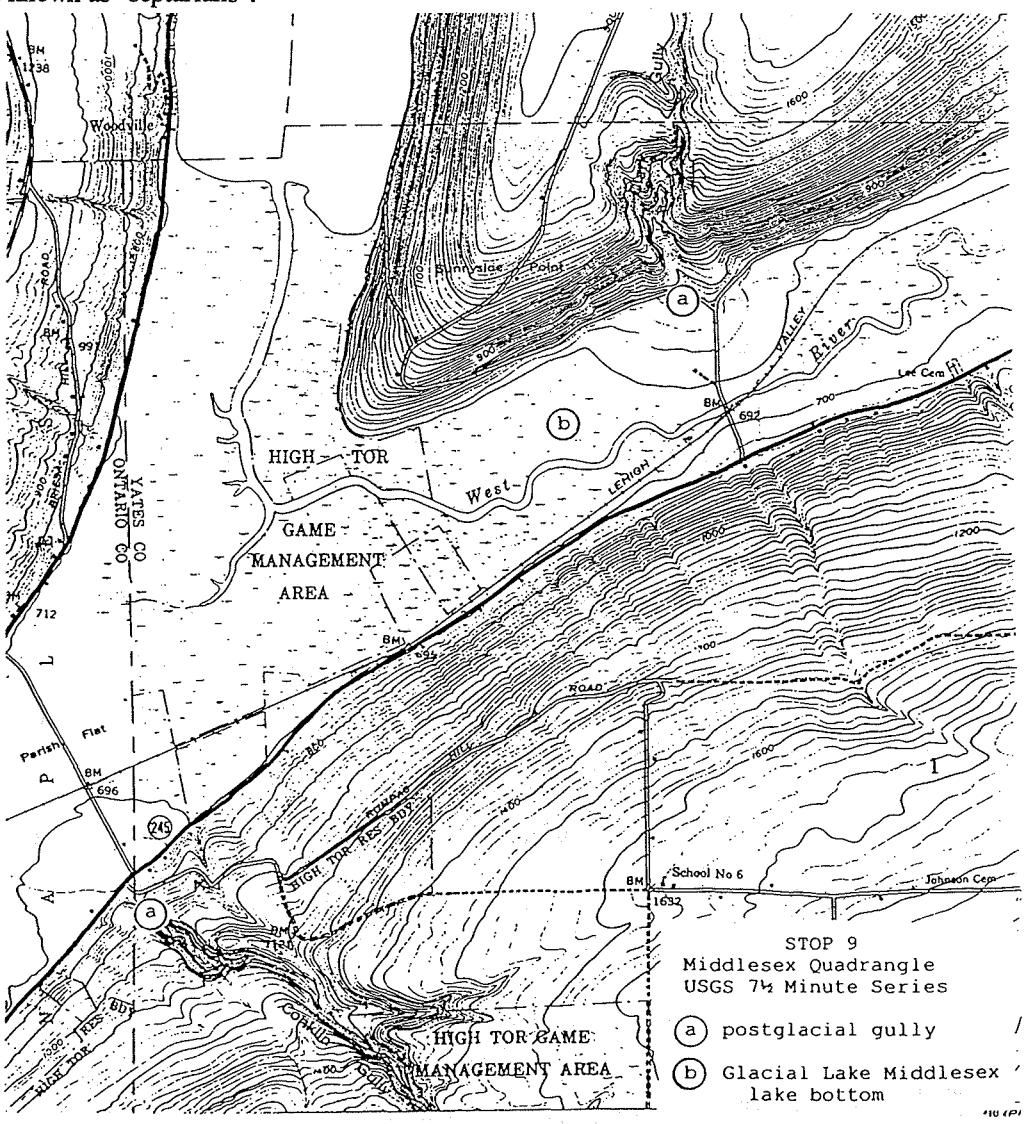


CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
141.1	4.0	Leave roadside parking lot, return north on Rte. 371to intersection with Rte. 21 in village of North Cohocton
147.0	5.9	Intersection of Rte. 21 and Rte. 245, turn north on Rte. 245
151.1	4.1	Intersection of Rte. 245 and Sunnyside Road, turn west on Sunnyside Road
151.7	0.6	Travel along Sunnyside Road, just past intersection with West Avenue to small gravel drive on the right, STOP 9

STOP 9. POST-GLACIAL GULLY EROSION, A TRIP INTO CLARK'S GULLY ON STATE OWNED-LANDS OFF WEST AVENUE.

Steep, narrow V-shaped gullies are common wherever hanging tributaries retrace their course into over deepened glacial troughs. Each Finger Lake has excellent examples, including the popular Watkins Glen, Enfield Glen and Taughannock Falls. North of Naples along Route 245, Conklin Gorge may be seen along the east at the barbed trough junction. Despite being post-glacial, and therefore geologically young, it has built a considerable alluvial fan on the valley floor locally known as Parish Flats.

Just ahead on the west side of the Middlesex trough is a magnificent post-glacial gorge called Clark's Gully. All the land here is part of the state-owned High Tor Wildlife Management Area. Walk the lower section of the gully. Watch for exposed shale and limestone in the gorge walls. Notice glacial erratics in the stream and peculiar concretions known as "septarians".

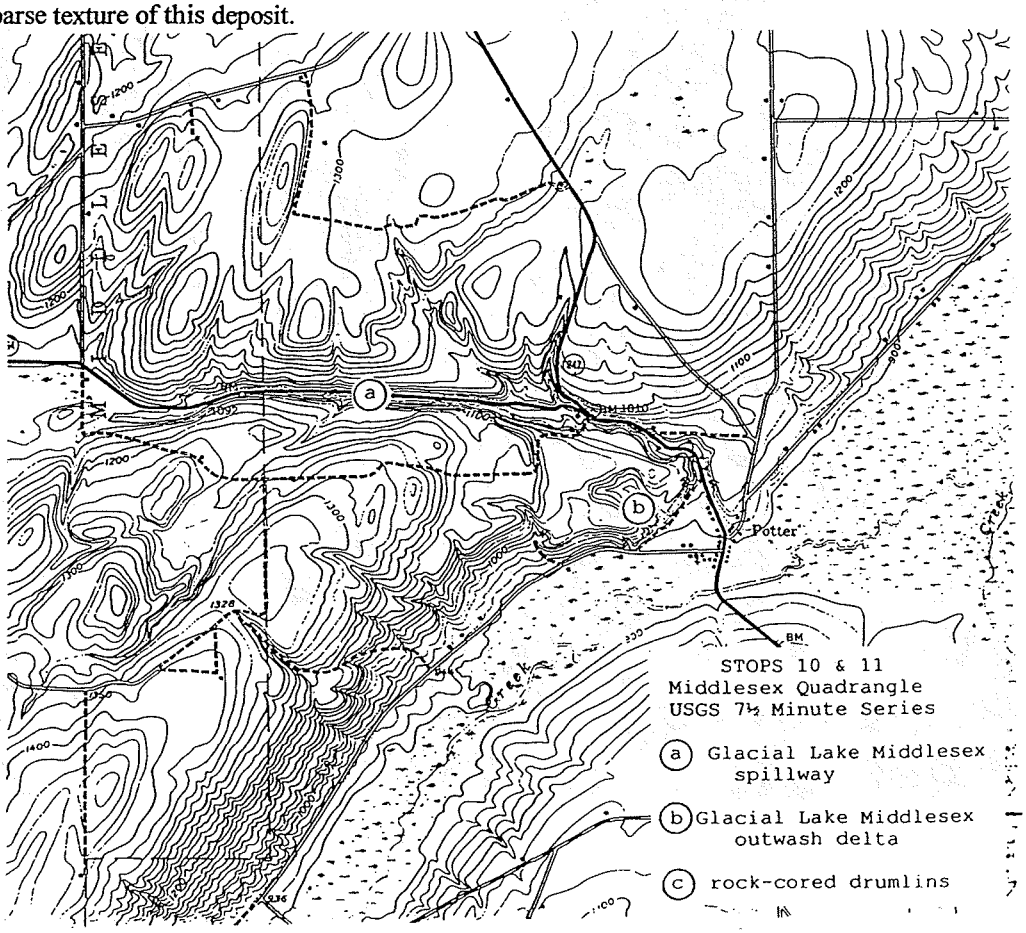


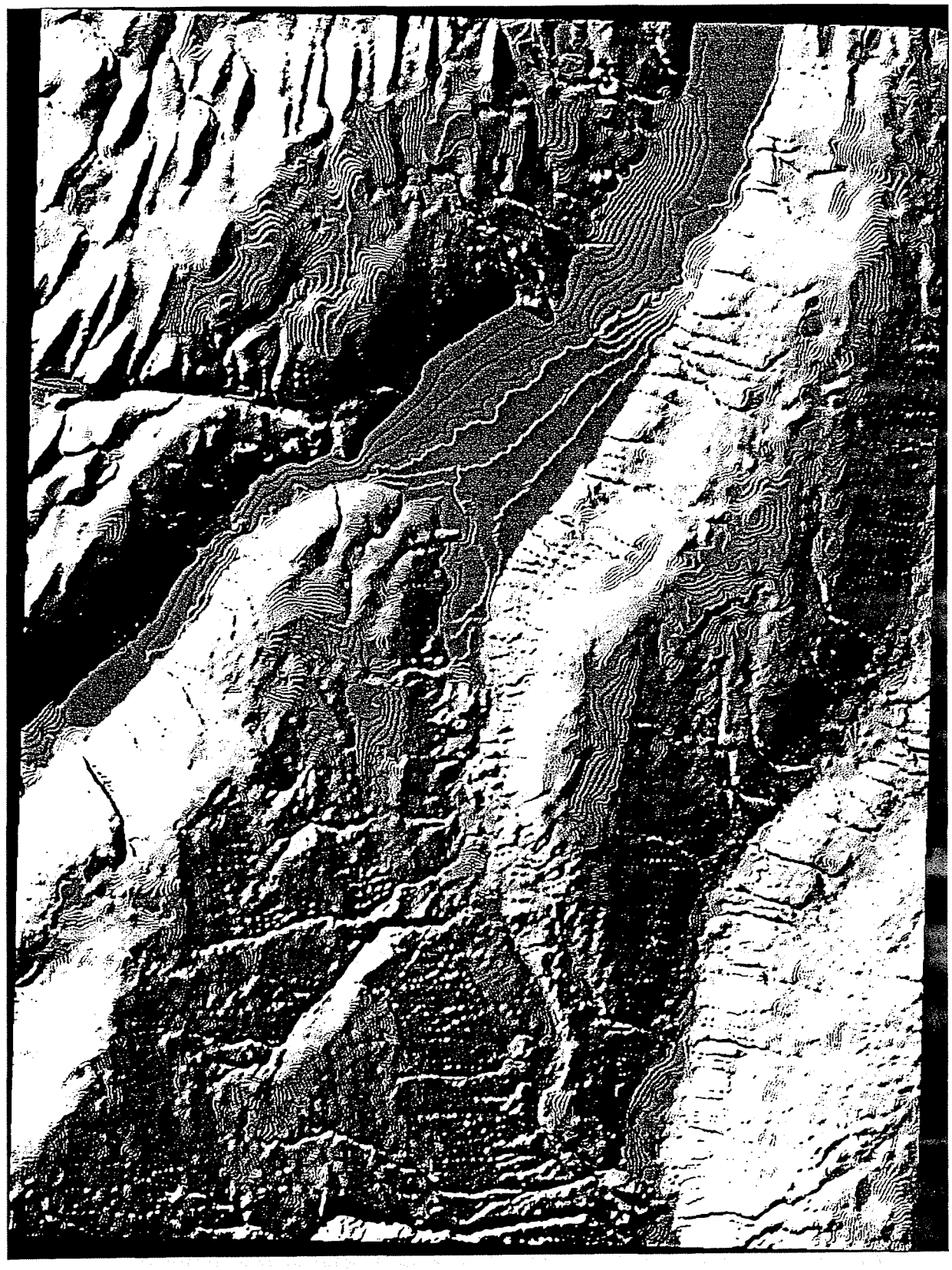
CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
156.1	4.4	Leave Clark's Gully, travel north on West Avenue to intersection with Rte. 364, turn east on Rte. 364 passing through the village of Middlesex then heading strongly uphill
159.0	2.9	Watch for small waterfall along south side of Rte. 364, spillway portion of STOP 10
159.6	0.6	Continue east on Rte. 364 to intersection with Rte. 247, stay on Rte. 364
160.3	0.7	Intersection of Rte. 364 and Phelps Road in hamlet of Potter, turn south on Phelps Road
161.0	0.7	Gravel pit, delta deposit portion of STOP 10

STOP 10. GLACIAL LAKE MIDDLESEX SPILLWAY ALONG ROUTE 364 EAST OF MIDDLESEX.

Some 11,000 years ago, the Middlesex and Canandaigua troughs were jointly occupied by the same body of water. Then, ice sheet retreat uncovered a hilltop notch east of Middlesex that was 220 feet lower than the Cohocton spillway used by Lake Naples. Suddenly and catastrophically, the surface elevation of Lake Naples fell and a new lake came into existence...Glacial Lake Middlesex! South Hill emerged as a large island in this 600 feet deep lake.

The conspicuous spillway is traversed by Route 364 between Middlesex and Potter. Notice the depth, width and unusually straight form of this spillway. The small stream now found in the hilltop notch could not have had the erosive power to produce a channel of these dimensions. We will stop briefly by a small waterfall eroded by this same stream and let you make the visual comparison. One can also notice the forest damage caused by a localized tornado (microburst?) in 1996. Continuing down the spillway, we arrive at the next glacial trough, the broad expanse of the Potter Swamp (now largely converted to muck farming). A large, gravelly delta deposit is located here where waters draining from Lake Middlesex entered this valley. Cross-bedding of the layers is very evident due to the coarse texture of this deposit.





For return trip to Geneva

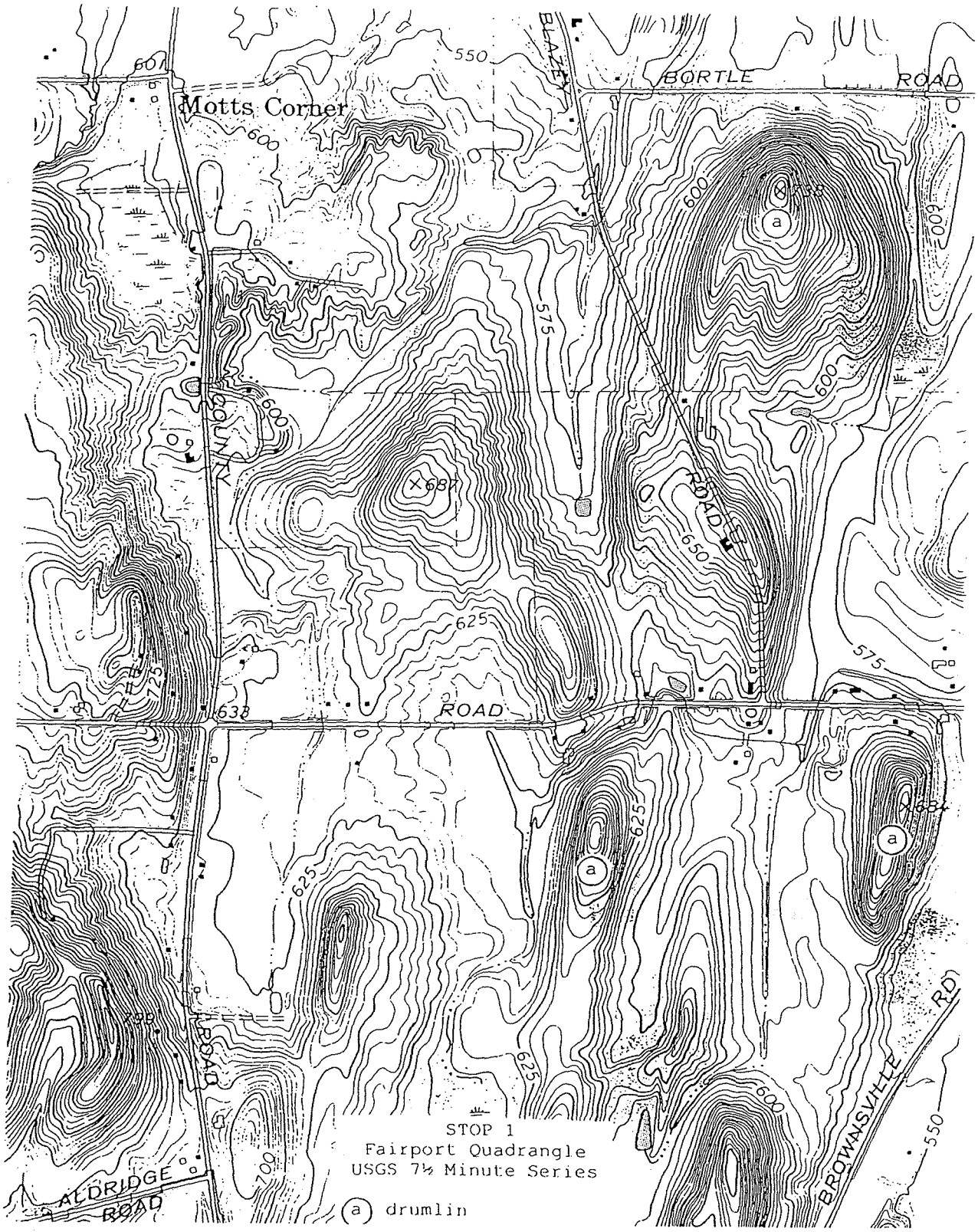
CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
161.7	0.7	Travel north on Phelps Road to intersection the Rte. 364, turn west on Rte. 364
162.4	0.7	Intersection of Rte. 364 and Rte. 247, turn north on Rte. 247
166.1	3.7	Intersection of Rte. 247 and Rte. 245 in village of Rushville (flashing light), stay on Rte. 245and Rte. 247 as they travel together to the east of Rushville, then stay on Rte. 245
177.6	11.5	Pass through villages of Gorham and Stanley to intersection of Rte. 245 and Rte. 14A, turn north on Rte. 14A
180.8	3.2	Intersection of Rte. 14A and Routes 5 and 20, turn east on Routes 5 and 20
182.4	1.6	Intersection of Routes 5 and 20 with Rte. 14 in city of Geneva

ROAD LOG FOR GLACIAL FEATURES OF THE WESTERN FINGER LAKES LANDSCAPE HALF DAY EXCURSION

CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
0.0	0.0	Intersection of Routes 5 and 20 with Rte. 14 in the city of Geneva, turn west of Routes 5 and 20
15.2	15.2	Intersection of Routes 5 and 20 with Rte. 332 (Main Street) in the city of Canandaigua, turn north on Rte. 332
23.1	7.9	Intersection of Rte. 332 and Rte. 96, turn west on Rte. 96
24.4	1.3	Intersection of Rte. 96 and McMahon Road, turn north on McMahon Road
25.0	0.6	Intersection of McMahon Road and Plaster Mill Road, turn west on Plaster Mill Road
25.1	0.1	Intersection of Plaster Mill Road and Brownville Road, turn north on Brownville Road
27.2	2.1	Intersection of Brownville Road and Gillis Road, turn west on Gillis Road
27.3	0.1	Around curve in Gillis Road, bear left at intersection with Cline Road, STOP 1

STOP 1. NEW YORK'S WORLD FAMOUS DRUMLIN FIELD AS VIEWED FROM GILLIS ROAD NEAR THE HAMLET OF BROWNVILLE.

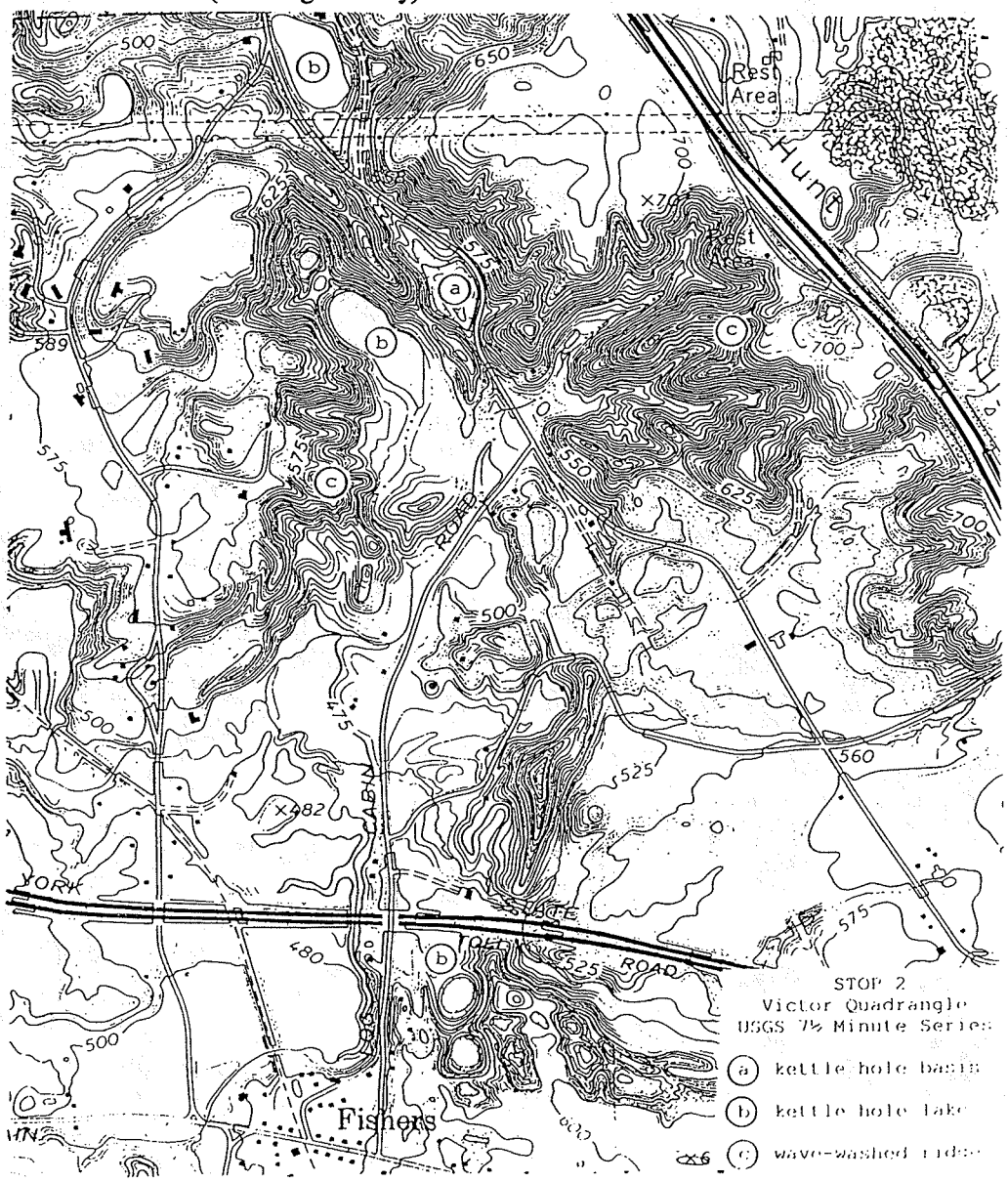
While the best known local drumlin is likely to be Hill Cumorah, this stop at an unnamed drumlin was selected because most of the hill is unforested, readily revealing its streamlined shape. For more information on drumlins, turn to STOP 2 in the full day excursion.

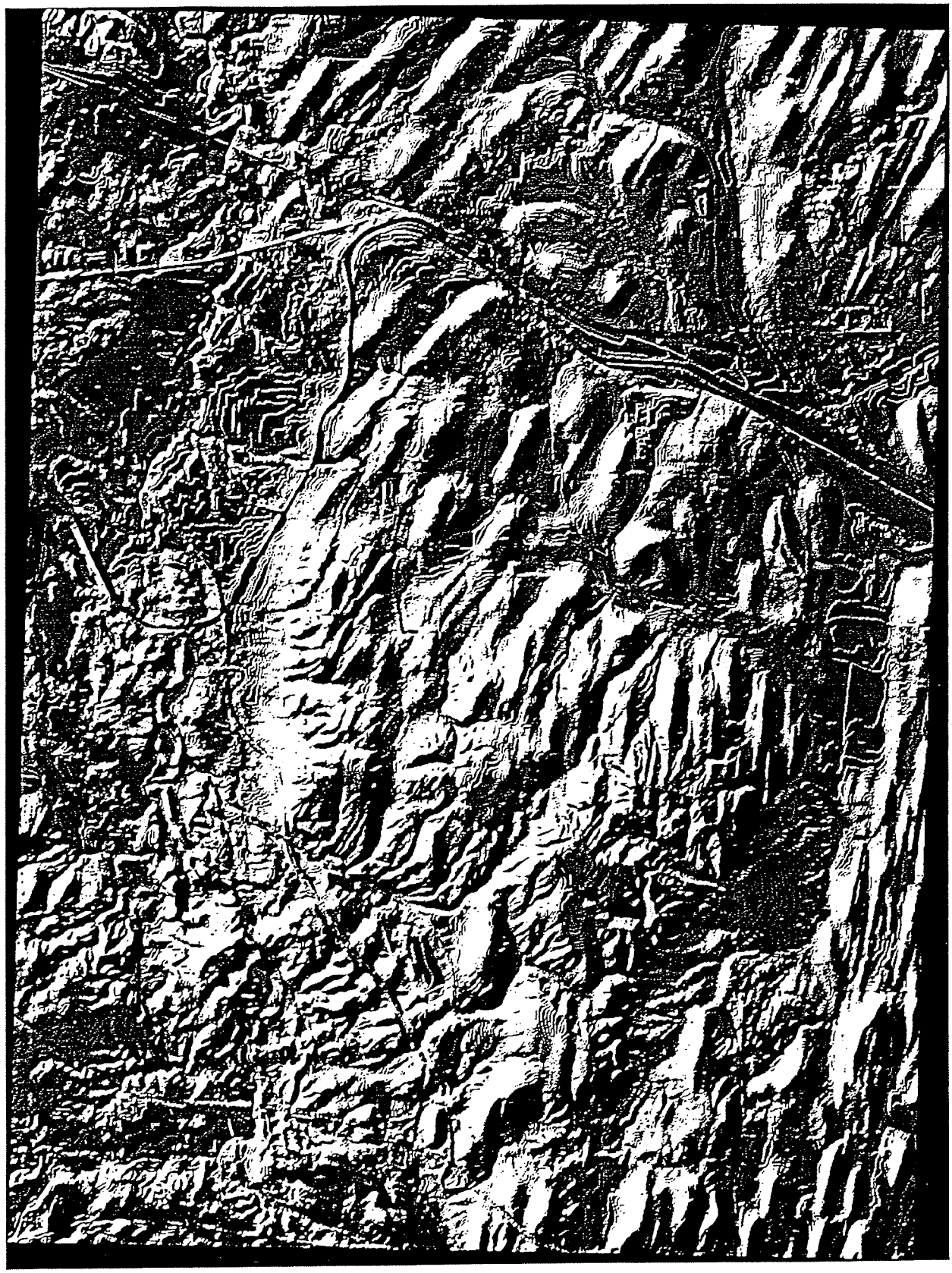

Motts Corner
BORTLE ROAD
BLAZEY ROAD
COUNTY ROAD
ROAD
ALDRIDGE ROAD
BROWNSVILLE RD
550
575
600
625
650
700
638
STOP 1
Fairport Quadrangle
USGS 7½ Minute Series
(a) drumlin

CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
30.2	3.0	Continue west on Gillis Road to end, intersection with High Street, turn north on High Street
31.4	1.2	Intersection of High Street and Rte. 96 (near East View mall), turn north on Rte. 96
33.3	1.9	Intersection of Rte. 96 and Fishers Road, turn south on Fishers Road
34.1	0.8	Intersection of Fishers Road and Benson Road, STOP 2

STOP 2. KETTLE HOLE LAKES NORTH OF FISHERS ALONG BENSON ROAD.

This disintegration landscape of stagnant ice features contains kettle hole basins, kettle hole lakes, wave washed ridges and hummocky kames. Large chunks of ice (actually crumb-like in size when compared to the massive continental ice sheet) were buried here. Subsequently they were covered by outwash and, as melting occurred, they formed nearly circular depressions. Today, several of them are spring- fed ponds. Other well known kettle hole lake complexes in the Finger Lakes region include Mendon Ponds (Monroe County), Junius Ponds (Seneca County) and Labrador Hollow (Onondaga County).





CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
36.0	1.9	Continue south on Fishers Road to Main Street, turn east on Main Street
36.1	0.1	Intersection of Main Street and CR 42
36.9	0.8	Intersection of CR 42 and Rte. 251, turn west on Rte. 251
37.2	0.3	Intersection of Rte. 251 and Strong Road, turn south on Strong Road
42.4	5.2	Intersection of Strong Road and Rte. 64, STOP 3

STOP 3. KAME MORAINE, LOCALLY KNOWN AS THE HOPPER HILLS, VIEWED FROM STRONG ROAD NEAR THE HAMLET OF IONIA.

(For stops 3 through 6, the half day excursion now overlaps with the description and maps provided for the full day field excursion)

STOP 7. GLACIAL LAKE MIDDLESEX SPILLWAY ALONG ROUTE 364 EAST OF MIDDLESEX.

(After viewing the barbed trough junction, continue traveling south on Rte. 21 to intersection with Rte. 245 just north of the village of Naples. Turn east on Rte. 245. The description for stop 7 on the half day excursion is the same as the description for stop 10 in the full day excursion)

REFERENCES CITED

Besse, S.A. 1984. Chemical and physical factors associated with stratified phytoplankton populations in Junius Ponds, New York. Master's thesis, American University. Washington, D.C.

Burkholder, P. 1931. Studies in the phytoplankton of the Cayuga Lake basin, New York. Bulletin of the Buffalo Society of Natural Sciences 15:21-181.

Dreimanis, A. and R.P. Goldthwait. 1973. Wisconsin glaciation in the Huron, Erie, and Ontario Lobes. pp 71-106 in: Black, R.F., R.P. Goldthwait and H.B. Willman. The Wisconsinan Stage. The Geological Society of America, Memoir 136. 334 p.

Fairchild, H.L. 1909. Glacial waters in central New York. New York State Museum and Science Service Bulletin 127, 66 p.

Pendl, M.P. 1982. A comparative study of meromixis and dimixis with reference to TIC, POC, and DOC. Master's thesis, SUNY Buffalo. Buffalo, New York.

Principle, M.A. 1981. A preliminary limnological investigation of the physical and chemical characteristics of a meromictic pond. Master's thesis, SUNY-ESF. Syracuse, New York.

Schloss, J.A. 1985. The characterization of optical anomalies in dimictic and meromictic basins of Junius Ponds, New York. Master's thesis, American University. Washington, D.C.

Van Diver, B.B. 1985. Roadside geology of New York. Mountain Press Publishing Company. Missoula, Montana. 397 p.