DEGLACIATION OF THE MIDDLE MOHAWK AND SACANDAGA VALLEYS, OR A TALE OF TWO TONGUES*

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PURPOSE

The middle Mohawk Valley contains a record of the interaction between the Mohawk and Sacandaga glacial lobes, including evidence for several readvances. We will examine exposures in deposits that document these interactions and features.

INTRODUCTION

Interest in the glacial geology of New York State has experienced a renaissance during the past twenty-five years. Researchers have examined old interpretations of the glacial history of the State in the light of new geologic mapping, using techniques, hypotheses, topographic maps and airphotos that were not available to the earlier workers. The previous surge of glacial mapping lasted from the turn of the cnetury to the thirties.

New York State was covered by glacial ice during the Wisconsinan Glaciation. This glaciation commenced about 120,000 years ago, reached its maximum 22,000 years ago, and ended in New York State about 12,500 years ago (Mickelson and others, 1983). New York was almost completely covered by ice, except for the Salamanca Re-entrant in western New York and the southern edges of Staten Island and Long Island (Fig. 1). This ice came from the Laurentian

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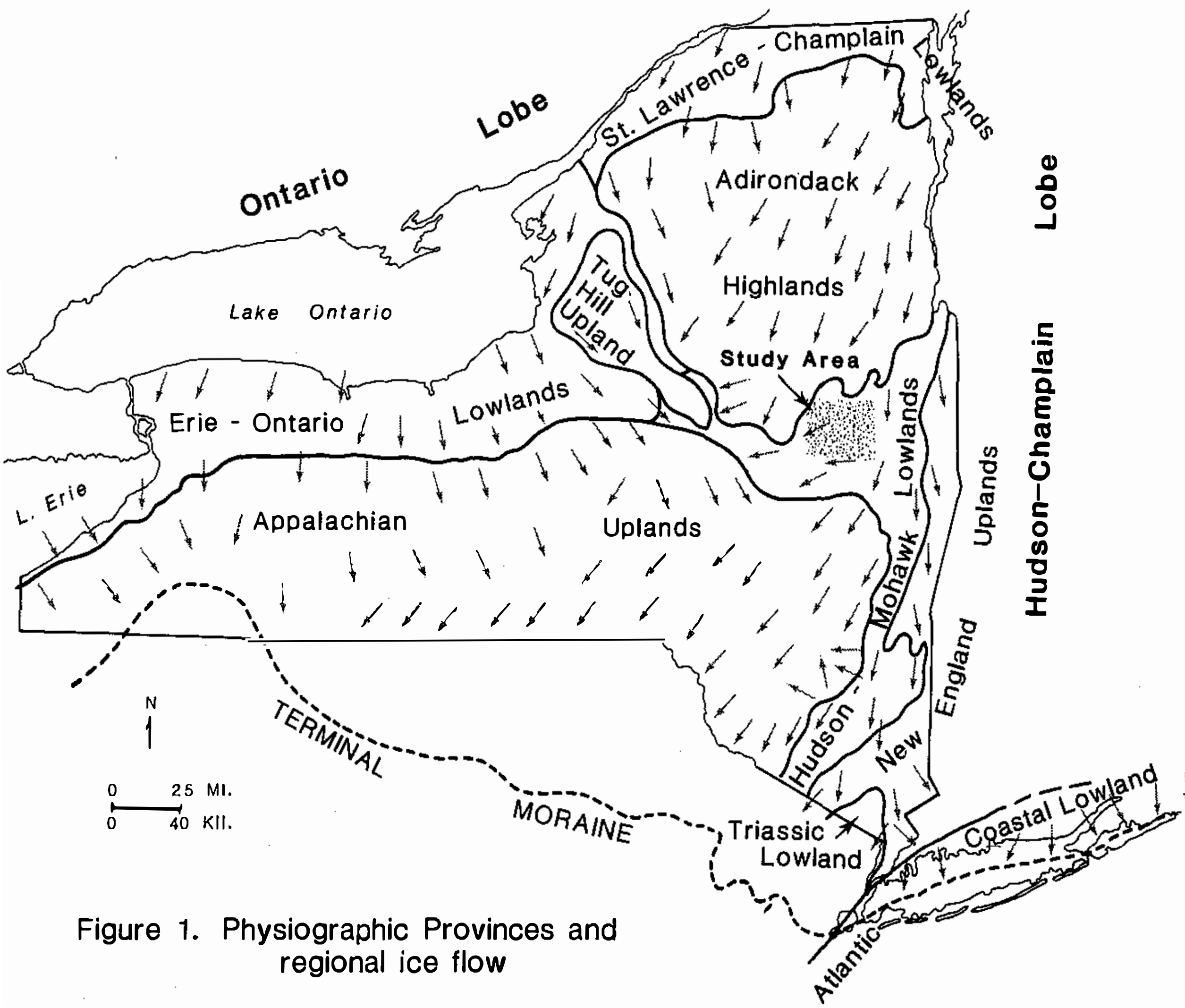

Figure 1: Physiographic Provinces and Ice Movement in New York State. The Physiographic Provinces are from Broughton and others (1966), the Terminal Moraine is from Flint (1971), and Ice Movement Directions are from Fairchild (1907), MacClintock and Apfel (1944), Fullerton (1980), and Dineen (1983).

Mountain region of Quebec in two major lobes - the St. Lawrence-Ontario Lobe and the Hudson-Champlain Lobe. The physiography of the State controlled the movement of these great ice streams, which tended to flow around highlands and along the axes of major preglacial lowlands (Fig. 1). Ice flow directions (Fig. 1) are summarized from Fairchild (1907), MacClintock and Apfel (1944), Fullerton (1980), Dineen (1983; in press), Sirkin (1982; in press) and Ridge and others (1984). The Ontario and Hudson lobes flowed around the Adirondack Mountains and were split into sublobes by uplands (Fig. 1). The Hudson-Champlain Lobe was divided into the southward-flowing Hudson lobe, the Mohawk lobe which flowed westward up the Mohawk Valley, and the Adirondack lobe that followed the northeast-to-southwest structural and topographic grain of the Adirondack Mountains. The Sacandaga and Kayaderosseras sublobes of the Adirondack lobe interacted with the Mohawk lobe near Gloversville (Figs. 1 and 2).

The Mohawk Valley connects the Erie-Ontario and Hudson Lowlands across the south edge of the Adirondack Mountains (Fig. 1). The topography of the eastern Mohawk and Kayaderosseras valleys are controlled by NE-SW trending faults that define a series of grabens and horsts (Roorbach, 1913; Fisher, 1965, 1980; McLelland, 1984). Most of the fault blocks are tilted so that their eastern edges tend to be higher than the western (Roorbach, 1913). The east fork of the Great Sacandaga Lake lies in a graben (McLelland, 1984); so do the upper Kayaderosseras and Hudson valleys (Isachsen, 1965).

The preglacial Sacandaga River drained the south-central Adirondacks (Brigham, 1929), the ancient Luzerne River drained the southeastern Adirondacks (Miller, 1911), and the ancient Mohawk River flowed east from Little Falls to the Hudson Lowlands (Brigham, 1929). This preglacial rectangular drainage pattern was towards the southwest, along the bases of the fault blocks. Differential weathering and erosion sculpted a series of east-facing escarpments along the strike-slopes of resistant rock units (Roorbach, 1913). The southwest-flowing streams received only short streams from the fault-line scarps to the west, but long streams drained west across the dipslopes of the horsts (Miller, 1911). The preglacial Sacandaga followed the southwest grain of the rocks until it entered the Mohawk near Fonda (Fig. 2; Miller, 1911; Arnow, 1951; Jeffords, 1950). It divided into two forks north of Broadalbin; where one fork extended into the Adirondacks above Northville, and the other extended to Conklinville.

The preglacial Mohawk River cut across the rock structures, and entered the Hudson Lowlands at Schenectady. The Luzerne River included the upper Hudson Valley; it entered the Kayaderosseras Valley at Corinth where it followed the bedrock structure into the Hudson Lowlands at Saratoga Springs (Fig. 2; Miller, 1911; Heath and others, 1963; Mack and others, 1964). The thickest glacial deposits overlie the preglacial valleys, and blanket the lower portions of the fault blocks.

The glacial geology of the eastern Mohawk and upper Hudson region has been extensively studied ever since Chamberlin (1983) recognized the lobate nature of the ice front in New York State, and observed that the Mohawk Valley was the "key" to correlating glacial events between the Ontario and Hudson Lowlands. He noted evidence that suggested a westward-flowing glacial lobe in the Mohawk Valley, an observation that was confirmed by Brigham (1898). Fairchild (1912, 1917) interpreted terraces and sand plains as evidence for

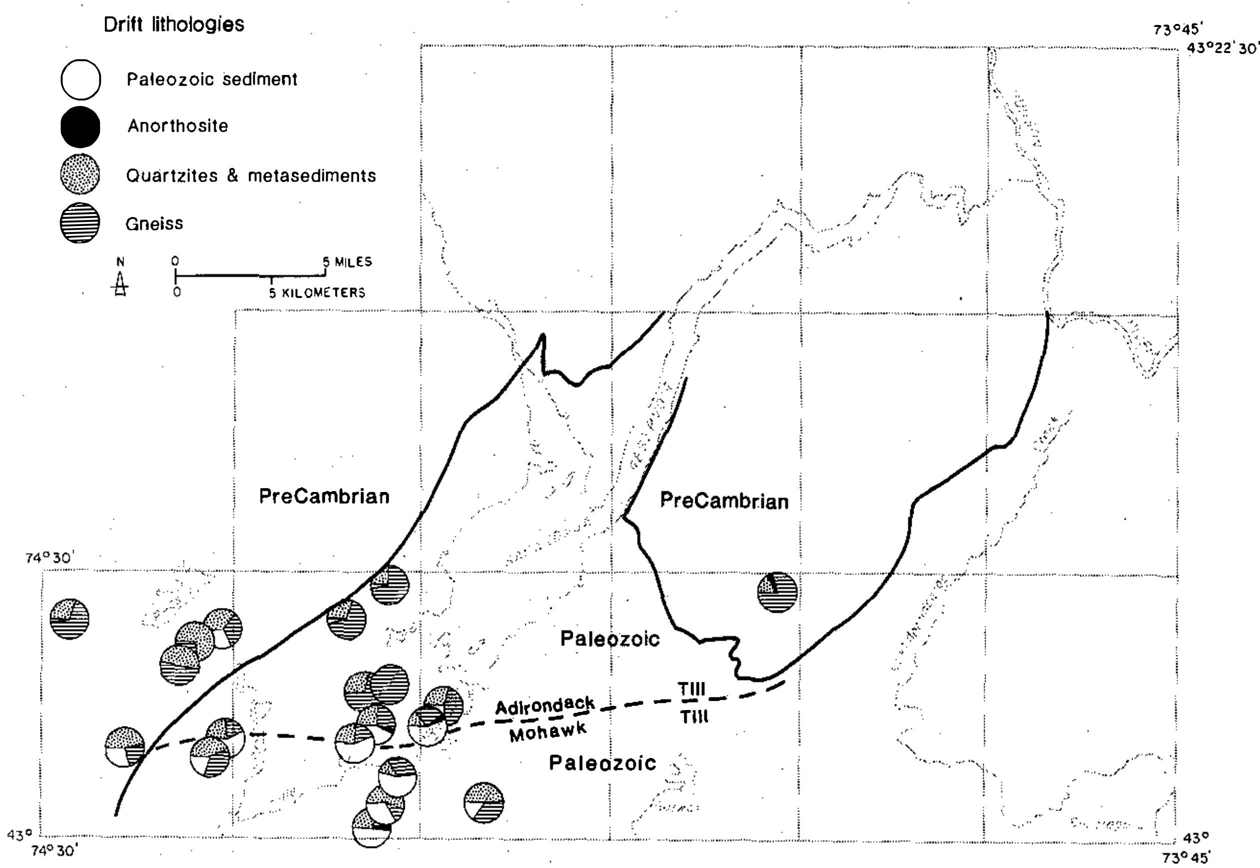

Figure 3. Drift Lithologies

Figure 3: Drift Lithologies. Data are from Yatsevitch (1968) and the authors. Q: metasediment clases, A: Anorthosite clasts, G: gneissic clasts, and S: Paleozoic sedimentary rock clasts. The Solid Line is the contact between Paleozoic and Precambrian rocks. The dotted line is the contact between the sandy, metamorphic clast-rich tills of the Sacandaga and Kayaderosseras sublobes, and the clayey, sedimentary clast-rich tills of the Mohawk Lobe.

a continuous glacial lake in the Mohawk Valley that "girded" the southern Adirondack Highlands, a notion that was demolished by Stoller (1916), Miller (1925), and Brigham (1929, 1931). Lakes in the Sacandaga and Upper Hudson Valley were documented by Stoller (1916), Miller (1923, 1925), and Chadwick (1928). Evaluation of the interpretations and correlations of the early workers was hampered by a dearth of surficial maps, except for Brigham (1929) and Stoller (1916). Thus, correlations between the Ontario and Hudson Lowlands depended on a series of publications that contained interpretations based on a minimum of surficial data.

Beginning twenty-five years ago, LaFleur (1961, 1965, 1969) rekindled interest in the eastern Mohawk Valley. Yatsevitch (1968) mapped the lower Sacandaga in detail. LaFleur (1975, 1979a, 1979b, 1983) has further refined the stratigraphy of the eastern Mohawk Valley, while Muller and others (1983) and Ridge and others (1984) have refined the stratigraphy of the western Mohawk Valley. Dineen (1983; in press), Dineen and others (1979, 1983) and Connally and Sirkin (1971) have documented the deglacial stratigraphy in the Hudson Valley.

Glacial Movement

The directions of glacial movement are shown by the orientations of drumlins and striae. Several streams of ice can be deduced from Figure 2. The Hudson Lobe moved south, down the Hudson Lowlands. The strong north-south striae and drumlin orientations were made by the Kayaderosseras sub-lobe; southwest striae were carved by this lobe when it veered over the McGregor and Spruce Mountain Ranges. The southwest-trending Sacandaga sub-lobe flowed down the Conklinville fork of the ancestral Sacandaga River (Fig. 2). These sublobes were part of the Adirondack lobe. The Mohawk lobe formed the east-west and northwest drumlins and striae. Till fabric orientations at Luzerne corroborate the drumlin and striae data in that area (Hansen and others, 1961, Connally and Sirkin, 1971).

Ice movement also can be inferred from drift lithologies, based on pebble counts in tills and stratified drift, and on the texture of the till matrix. Drift lithologies tend to reflect the lighologies of the underlying bedrock. The glaciers deposited most of their sediment load within 5 to 10 km (3 to 6 miles) of the sediment source (Drake, 1983). Areas that are underlain by acidic igneous, coarse-grained metamorphic rocks, and sandstones tend to yield sand-size particles during glacial milling, while areas under-lain by mudstones, shales, and carbonates yield silt to clay size particles (Flint, 1971). Thus, areas with abundant igneous, gneissic, or sandstone outcrops are blanketed with sandy tills, while areas underlain by shales and carbonates have a compact, clayey till veneer. The Kayaderosseras and Sacandaga sublobes deposited sandy tills, with many gneissic and metasediment clasts, and the Mohawk and Hudson Lobes deposited clayey tills with Paleo-zoic sedimentary rock clasts and infrequent boulders of anorthosite (Fig. 3, based on Yatsevitch, 1968).

Several exposures and borings with till over stratified drift occur throughout the area (Fig. 2). Pits with buried soil zones were observed at Amsterdam (Hell Hollow) and West Milton by LaFleur (1983, oral communication).

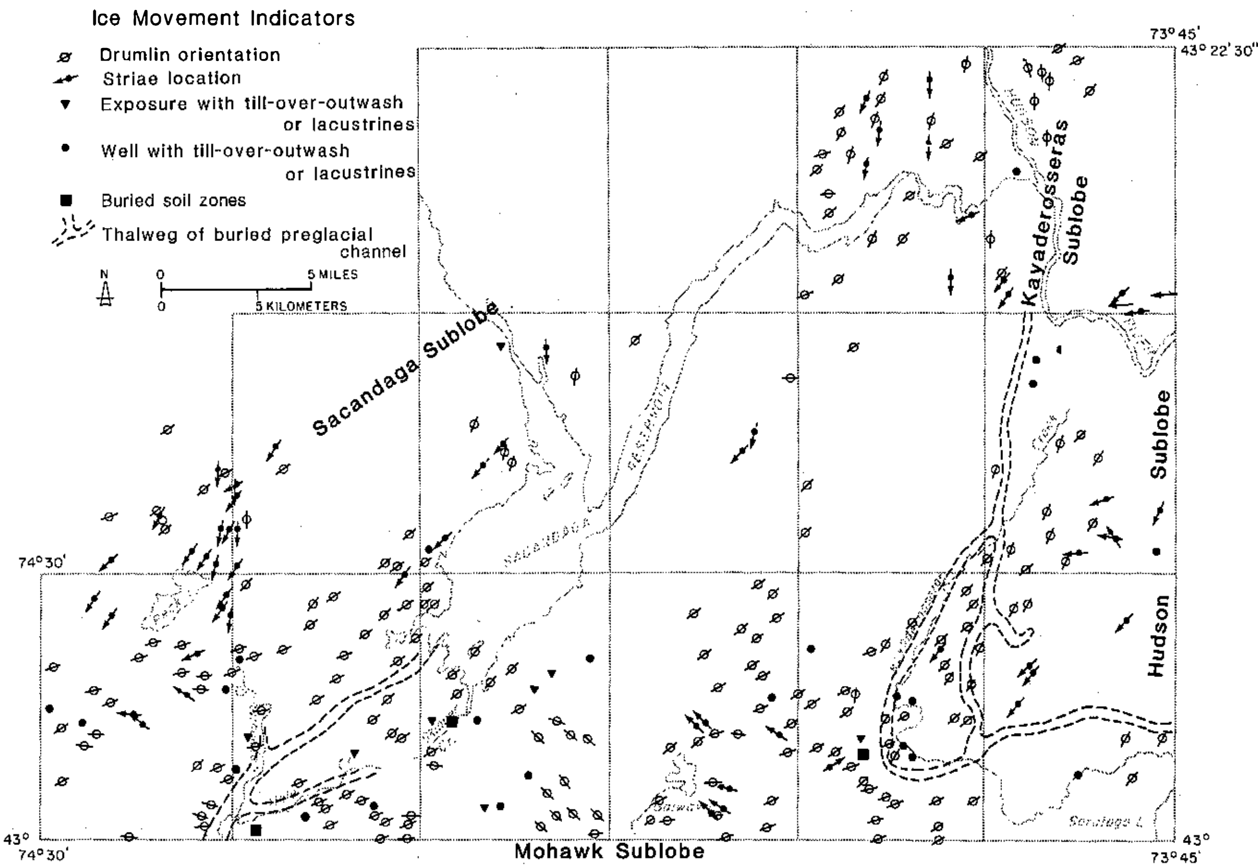

Figure 2. Regional Ice Movement

<u>Figure 2</u>: Ice Movement Indicators. Drumlin orientations are based on airphoto and topographic map interpretation. Striae orientations and localities are from Brigham, 1929, Stoller, 1916, Miller, 1923, and the authors. Wells are from Yatsevitch, 1968, Jeffords, 1950, Arnow, 1951, Heath and others, 1963, and the authors. The trends of the preglacial valleys are inferred from the well data. Exposure data are from Yatsevitch, 1968, the authors, and Connally and Sirkin, 1971.

and east of Gloversville by Yatsevitch (1968) and Dineen (Stop 3). These soil zones imply several thousands of years of weathering between glacial readvances.

Glacial Deposits

The surficial geology is summarized on Figure 4. This map is based on the 1:60,000 and 1:250,000 reconnaissance glacial maps that were prepared for the Surficial Map Project of the NYSGS. Several units are identified on Figure 4.

Meltwater channels are scoured channels and outwash trains, the arrowhead points in flow direction. Upper end of arrows mark heads-of-outwash and ice margin positions.

Several large, extensive moraines occur in the area:

The Jackson Summit Moraine Complex dominates the northwestern portion of the map. It borders Peck Lake, wraps around the heights of the Jackson Summit Mountain Range, and extends southwestward to the Noses. Several major valley trains originate at this recessional moraine. They grade downstream into proglacial lake sands south of Caroga Lake (Fig. 4).

The Woodward Lake Moraine Complex lies along the foot of the Jackson Summit Mountain Range. It is named for a lake west of Northville, where it is very well developed. It is predominantly a kame moraine with large quantities of stratified drift. Many gravel pits document water flow from the adjacent uplands into the glacier. This is a recessional moraine, built primarily against the Sacandaga sublobe, and is contemporaneous with the Broadalbin Moraine Complex (below).

The Broadalbin Moraine Complex is an extensive interlobate moraine that extends east 23 km (15 mi) from Gloversville to beyond Broadalbin. This moraine was deposited between the Sacandaga and Mohawk lobes. It is 30 to 100 m (100 to 300 ft) high on 0.5 to 6 km (0.25 to 4 mi) wide. It is comprised of ice-contact trough-crossbedded gravelly sand, with interbeds of till. It is coarser-grained to the east, where it also contains numerous flow tills. Brigham (1929) called it "the Interlobate Moraine" and noted that it was primarily waterlaid. Yatsevitch (1968) reamed it the Gloversville Kame Complex, and also noted its water- washed character. He considered it to have been deposited in a "fluvial- lacustrine" environment over and around older sandy till drumlins. Crossbeds show that it was deposited by water flowing from southwest to northeast (Stops 3 and 4).

Brigham (1929) inferred that a Mohawk lobe readvance deposited the till veneer on the southern edge of the complex, and created the subdued topography south of "the Interlobate Moraine". Yatsevitch (1968) also noted the subdued topography and till veneer. He correlated them with a till moraine at an elevation of 213 m (700 ft) along the base of the Noses Escarpment. According to Yatsevitch (1968) these features were emplaced by the Yost Readvance, a "weak readvance" of the Mohawk Lobe. Additional evidence for the Yost Readvance can be observed at Stops 2 and 3.

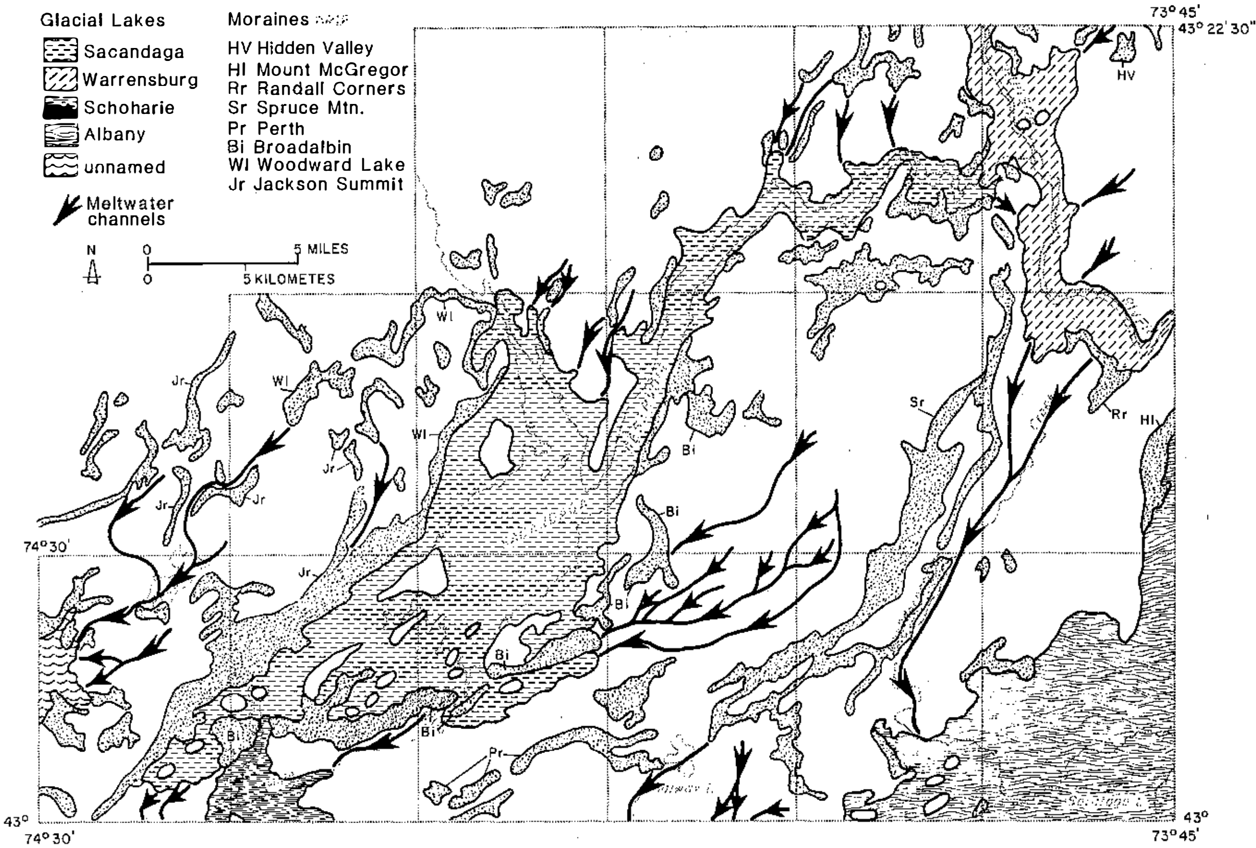

Figure 4. Surficial Geology of the Sacandaga Area

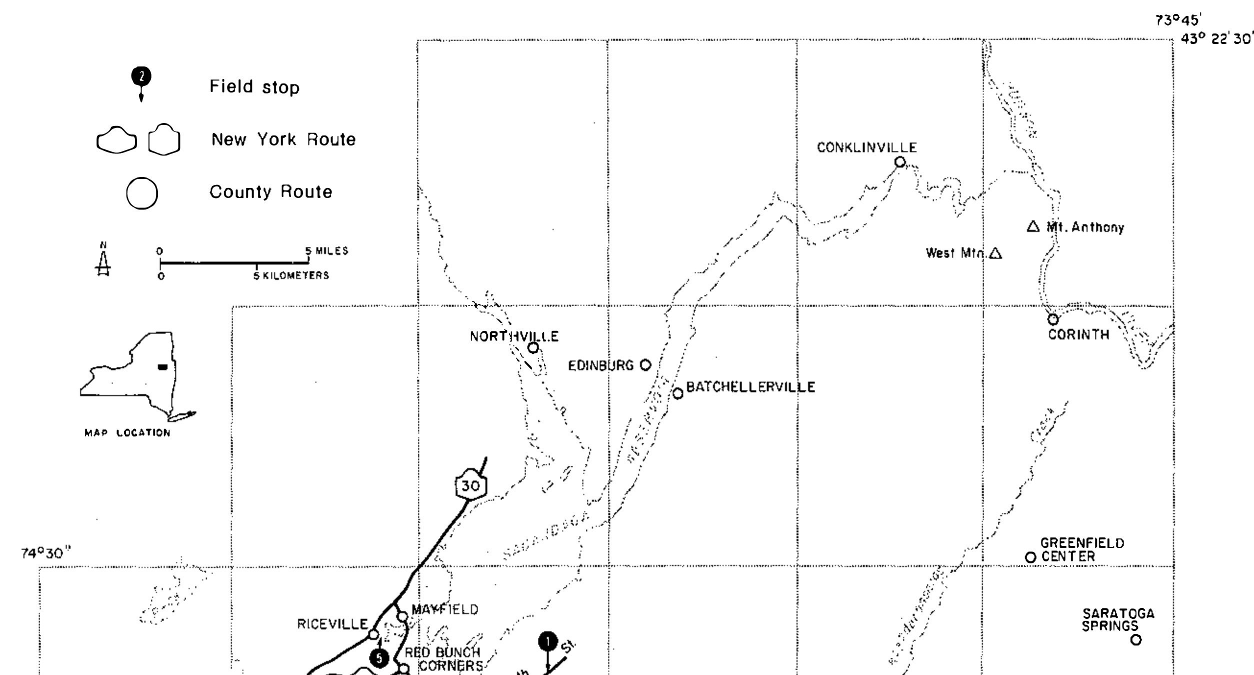

Figure 5. Field Trip Stops

The moraine was deposited during several episodes of sedimentation - a soil zone is developed on the sediments below the Yosts till (Stop 3). The moraine was originally deposited by meltwater flowing between the Sacandaga and Mohawk lobes, and was modified by the Yosts Readvance after a relatively long period of subareal exposure.

The Perth Moraine is a high (40 to 50 m, 120 to 150 ft) platform of till-and-stratified drift that is south of the Broadalbin Moraine. The platform has a low (3 to 6 m, 10 to 30 ft high) recessional moraine near its southern edge, shown as the Perth Recessional Moraine. The platform is capped with massive (unbedded) sand north of the recessional moraine, and till south of it. An exposure at Perth (Stop 2) shows silty till that is interbedded with fluvially-crossbedded sand and gravel. Some outwash channels extend northwest from the moraine. The Perth Moraine appears to grade eastward into the Galway and Spruce Mountain moraine systems.

The Randall Corners Recessional Moraine lies at the head of the Kayaderosseras Valley. It is mostly bouldery kame gravels and was originally described by Stoller (1916) as being lobate and forming a head of outwash.

The McGregor Moraine was mapped by Stoller (1916) at the base of Mt. McGregor as the Kings Station kame terrace. Connally and Sirkin (1971) renamed this feature and correlated it with the Luzerne Readvance.

The Hidden Valley Moraine, in the Lake Luzerne quadrangle is a till moraine that Connally and Sirkin (1971) also correlated with the Luzerne Readvance.

Glacial Lakes: We have correlated lake levels using the elevations of delta tops and sand or clay plains. The existence and extent of glacial lakes is indicated by extensive, low-relief areas underlain by laminated sand, rhythmic silt and clays, and by beach terraces. Most of the lake-bottom deposits north of the Broadalbin Moraine are very sandy, whereas silt and clay characterize lake-bottom sediment south of the moraine.

Glacial Lake Gloversville occupied a re-entrant between the Broadalbin and Woodward Lake moraines of the Mohawk and Sacandaga Lobes. It is recorded by an 265 m (870 ft) kame delta-and-sandplain that lies along the foot of the Jackson Summit Mountain Range between Gloversville and Mayfield. It drained southwest, along the base of the Noses Escarpment, and formed as the Sacandaga sublobe retreated from the Broadalbin Moraine.

Glacial Lake Sacandaga was a large, relatively long-lived proglacial lake that was dammed between the retreating Sacandaga Sublobe and the Broadalbin Moraine)Brigham, 1929; Yatsevitch, 1968; LaFleur, 1961, 1965, 1969). Several lake levels are recorded by deltas, beaches, and sandplains at 262 m (860 ft), 250 m (820 ft), 244 m (800 ft), and 238 m (780 ft). Locally, eskers grade southward into wedges of gravelly sand (Stop 5), while other ice-marginal deposits include a kame delta and moraine at Northville (Brigham, 1929), and kame deltas and moraines at Edinburg and Batchellerville.

Borings into tills that underlie fine sands in the Broadalbin area suggest that the Sacandaga ice tongue readvanced into Glacial Lake Sacandaga (or its predecessor). The southern shore of the lake consists of fans projecting from the Broadalbin Interlobate Moraine, built into the lake by outwash from the Yosts Readvance.

Some controversy surrounds the outlet of the lake. Brigham (1929) placed the outlet along Cayadutta Creek, an underfit stream that occupies a boggy channel with well-developed boulder pavements, with a spillway at 238 m (780 ft). LaFleur (1965) disagreed, and drained the lake north through the Conklinville area. We place the spillway for the early phases of the lake across the swampy, 244 m (800 ft) divide between Skinner and Hale Creeks (Fig. 4); Hale Creek was the lake outlet. It occupies a well-scoured valley (Stop 3) and is a tributary to Cayadutta Creek. Additional, temporary spillways lie west of Johnstown. These outlets controlled the 262 m through 244 m lakes, while the 238 m lake was controlled by 229 m (750 ft), rock-floored spillways between West Mountain and Mount Anthony near Conklinville, 24 km (15 mi) north of Broadalbin. This outlet could not have controlled the higher level lakes. It was at least 10.5 m too low during glacial times, based on a rebound rate of 2.5 ft/mi (LaFleur, 1965), and was blocked by the Sacandaga Lobe.

Lake Sacandaga existed while a series of kame deltas, ice-free deltas, and outwash terraces were formed along Hale Creek by the falling levels of Lakes Schoharie and Amsterdam in the Mohawk Valley. Lake Sacandaga briefly drained into early Lake Warrensburg in the Corinth area via the Mt. Anthony Channel (Fig. 5).

Lake Schoharie originally was defined as a circum-Adirondack 335 m (1100 ft) lake level (Fairchild, 1912). Brigham (1929) demonstrated that the water plane was by no means continuous, and redefined it as a 262 to 253 m (860 to 830 ft) proglacial lake in the Schoharie Valley, controlled by the Delanson outlet. LaFleur (1965, 1969) redefined Lake Schoharie as a 262 m (860 ft) lake that was confined to the Schoharie Valley by the Yosts Readvance. We define Lake Schoharie by a series of sandplains, clay plains, and deltas in the Mohawk and Schoharie Valleys that range from 256 to 213 m (840 to 700 ft). It received large quantities of sand from Lake Sacandaga via Hale Creek, and outwash from an ice margin at Galway Lake via Chuctanunda Creek (Fig. 4). Lake Sacandaga was dammed by retreating ice in the Mohawk Valley.

Lake Amsterdam is represented in the Mohawk Valley by sandplains at 183 to 122 m (600 to 400 ft). They extend from Fonda to Schenectady. Brigham (1929) and LaFleur (1961, 1965, 1969) believed that the lake was dammed by stagnant ice at Schenectady. Yatsevitch (1968) thought that the Fonda sandplain represented outwash. The Fonda sandplain coarsens and grades up towards the north, along Cayadutta Creek. It received the overflow of Lake Sacandaga through a dry valley between Jonnstown and Fonda that contains Sammons Cemetary and Rt. 30A (see the Randall 7-1/2 minute quadrangle). The Fonda sand plain was redeposited Glacial Lake Sacandaga sand and was subsequently scoured by catastrophic floods from the upper Mohawk Valley.

Glacial Lake Warrensburg was a glacial lake at 213 m (700 ft) in the Hudson Valley north of Corinth (Miller, 1923, 1925). It was dammed by the Randall Corners Recessional Moraine (Stoller, 1916). The lake drained south through the Kayaderosseras Valley and was responsible for the high outwash terraces along that valley (Stoller, 1916). Connally and Sirkin (1971) were able to show that this lake was contemporaneous with the Luzerne Readvance and noted that many ice blocks occupied the lake. Our mapping indicates that Lake Sacandaga briefly drained into ice-marginal Lake Warrensburg via the Mt. Anthony spillways. Lake Warrensburg expanded as the Kayaderosseras sublobe retreated north. Till-over-lacustrine deposits along the Glens Falls to Luzerne road (Hansen and others, 1961; Connally and Sirkin, 1971), and in borings near Hadley suggest a readvance into this area. Unfortunately, subsurface data is lacking to determine whether the Hidden Valley Moraine and Sheaffers Brook outwash are recessional or readvance features.

The lower Kayaderosseras Valley outwash trains are graded downstream to the Milton sandplain at 152 to 158 m (500 to 520 ft). The Milton sandplain drops southward to 122 m (400 ft) at Ballston Spa (Stoller, 1911, 1916) suggesting that ice-marginal Lakes Alplaus and Milton were contemporaneous with Lake Warrensburg.

The water levels fell to Lake Corinth in the Upper Hudson Valley as the spillway at South Corinth was scoured to 201 m (660 ft) (Miller, 1923; Stoller, 1916). Lake Corinth deposits were later scoured by meltwater from upland glaciers.

The lower Hudson Valley lakes fell to the 110 m (360 ft) level of Lake Albany, as recorded by a large delta at Saratoga Springs. Lake Albany levels fell farther, to the 101 m (330 ft) level of Lake Quaker Springs. The large Quaker Springs delta at Saratoga Springs suggests that an immense quantity of sand was still coming from the Kayaderosseras Valley (from Lake Glacial Corinth drainage?). Late fluvial terraces were carved by catastrophic floods from the Mohawk Valley (Stoller, 1922, Hanson, 1977).

CONCLUSIONS

The exposures in the Sacandaga and Mohawk valleys record two glacial readvances. An early readvance is suggested by the lower, sandy till at Hadley, the weathered ice-contact stratified drift at Gloversville (Stop 3), the lower till at West Milton (Mack and others, 1964), and at Hell Hollow (LaFleur, 1983). We correlate the soil surfaces and eroded contacts in the study area with the "Free Drainage" episode of Ridge and others (1984), and correlate the tills to their West Canada Creek Till (Table I).

The lacustrine sands and outwash that overlie the weathered till were deposited in proglacial lakes in front of an advancing glacier that emplaced another till sheet. This second readvance was widespread; except for the deposits of the interlobate moraine, ice marginal deposits related to the readvance were not found within the study area. We suggest that these tills are equivalent to the basal part of the Mohawk I Till at Hell Hollow (LaFleur, 1983) and the Hawthorne Till in the western Mohawk (Ridge and others, 1984). The tills were deposited by the Middleburg Readvance (Table I).

As the glacier retreated again, proglacial lakes formed in the Mohawk, Sacandaga, Kayaderosseras, and Hudson Valleys (Table I). Lake Sacandaga drained south, through Hales Creek, into the Mohawk Valley. Glacial retreat was short-lived, however, and the Mohawk ice again readvanced into the area.

The Yosts Readvance went only as far west as the Noses, and built the 213 m (700 ft) moraine at Yosts (Yatsevitch, 1968), emplaced the upper till at Hadley, West Milton, and along the southern margin of the Broadalbin Moraine (Stop 3), and smoothed the topography between the Broadalbin and the Mohawk River (Stop 1 and Brigham, 1929). This is probably the same readvance that streamlined lake clays at South Amsterdam (LaFleur, 1979, p. 329) and deposited the New Salem Moraine in the Hudson Valley (Dineen and Rogers, 1979).

As the ice retreated from the Mohawk Valley for the last time, Lake Sacandaga expanded and spilled once more through the Hale and Cayadutta Creeks into Lake Schoharie, whose falling lake levels in the Mohawk Valley later stabilized at Lake Amsterdam, while recessional moralines were successively built at Perth, Galway, and Randall Corners (Table I).

Eventually, the retreating Sacandaga lobe uncovered a lake outlet at West Mountain, allowing rapidly falling Lake Sacandaga to drain into proglacial Lake Warrnesburg (Table I). This process might have been briefly interrupted by the Luzerne Readvance (Connally and Sirkin, 1971). Lake Sacandaga soon became extinct as the Kayaderosseras lobe retreated up the Hudson Valley, away from Mount Anthony, and Lakes Warrensburg and Corinth came into existence. Connally and Sirkin (1971) suggest that this happened 12,800 years ago. The ice then retreated from the Hudson Lowlands and postglacial time began in eastern New York.

There is a distinct difference between the ice-marginal environments north and south of the interlobate moraine. To the north are short eskers that terminate in subaqueous fans and kame deltas. These proglacial lake deposits are surrounded by lake sand. Kame deltas along the valley side show that meltwater also came from the adjacent uplands. An ice margin is suggested along the present shoreline of the Great Sacandaga Lake. Brigham (1929) thought that an ice tongue persisted in the area north of Broadalbin, based on the "mega-" kettle hole that formed the now-drowned Vly. All these features indicate that the Sacandaga lobe retreated from the interlobate moraine to Conklinville with few, if any, readvances.

The story south of the moraine is different. Here, multiple lake sand-outwash-till sequences, sometimes separated by soil zones, tell us that the Mohawk lobe was more active than the Sacandaga. At least two readvances can be documented in several pits along the southern flank of the moraine.

BIBLIOGRAPHY

Arnow, T. 1951. The ground water resources of Fulton County, New York: New York State Department of Environmental Conservation, Bulletin GW-24, 41 pp.

Brigham, A.P. 1968. Topography and glacial deposits of the Mohawk Valley: Geological Society of America, Bulletin 9:183-210.

__________. 1929. Glacial geology and geographic conditions of the lower Mohawk Valley: New York State Museum Bulletin 280, 133 pp.

__________. 1931. Glacial problems in Central New York: Association of American Geographers, Annals, 21:179-206.

Broughton, J.G., Fisher, D.W., Isachsen, Y.W., and Richard, L.V. 1966. Geology of New York: a short account: N.Y.S. Museum Educational Leaflet 20, 45 p.

Chadwick, G.H. 1928. Ice evacuation stages at Glens Falls, New York: Geological Society of America, Bulletin 39:901-922.

Chamberlain, T.C. 1883. Preliminary paper on the terminal moraine of the second geological epoch: U. S. Geological Survey Annual Report, 3:291-401.

Connally, G.G. and Sirkin, L. 1971. Luzerne readvance near Glens Falls, New York: Geological Society of America, Bulletin 82:989-1008.

Dineen, R.J. 1983. Glacial retreat in the Hudson Valley between New Paltz and Schenectady, New York (Abstract): Geological Society of America, Northeastern Section Abstracts with Programs, v. 15, p. 134.

__________. In press. Deglaciation of the Hudson Valley between Hyde Park and Albany, New York: New York State Museum Bulletin 455.

__________. Hanson, E.L. and Waller, R.M. 1983. Bedrock topography and glacial deposits of the Colonie Channel between Saratoga Lake and Coeymans, New York: New York State Museum, Map and Chart Number 37, 55 pp.

__________, and Rogers, W.B. 1979. Sedimentary environments in Glacial Lake Albany in the Albany section of the Hudson-Champlain Lowlands: in Griedman, G.M. (editor), Guidebook for Field Trips: New York State Geological Association and New England Intercollegiate Geological Conference, Troy, pp. 87-119.

Drake, L.D., 1983. Ore plumes in till: Journal of Geology, v. 91, pp. 707-713.

Fairchild, H.L. 1907. Drumlins of central western New York: New York State Museum Bulletin 111, pp. 391-443.

Fairchild, H.L. 1912. Glacial waters in the Black and Mohawk Valleys: New York State Museum Bulletin 160, 47 pp.

__________. 1917. Post-glacial features of the upper Hudson Valley: New York State Museum Bulletin 195, 22 pp.

Fisher, D.W. 1965. Mohawk Valley Strata and structure: in Hewitt, Hall, P.C. and L.M., (editors) 1965, Guidebook to field trips: New York State Geological Association, 37th Annual Meeting, Union College, Schenectady, pp. Al-A58.

__________. 1980. Bedrock geology of the central Mohawk Valley, New York: New York State Museum, Map and Chart Number 33, 44 pp.

Flint, R.F., 1971. Glacial and Quaternary Geology: John Wiley and Sons, New York. 892 p.

Fullerton, D.S. 1980. Preliminary correlation of Post-Erie Interstadian events (16,000 to 12,000 radiocarbon years before present): U. S. Geological Survey Professional Paper 1089, 55 pp.

Hanson, E., Porter, S.C., Hall, B.A. and Hills, A. 1961. Decollement Structures in glacial lake sediments: Geological Society of America, Bulletin 72:1415-1418.

Hanson, E.L. 1977. Lake Woodfordian drainage history of the lower Mohawk Valley: unpublished Masters Thesis, Rensselaer Polytechnic Institute, 66 pp.

Heath, R.C., and Mack, F.K. and Tannebaum, J.A. 1963. Ground water studies in Saratoga County, New York: New York State Department of Environmental Conservation Bulletin GW-49, 128 pp.

Isachsen, Y.W. 1965. Geological excursions from Albany to the Glen via Lake George: in Hewitt, P.C. and Hallk, L.M. (editors), Guidebook to Field Trips: New York State Geological Association Meeting, Schenectady, New York, pp. Bl-B17.

Jeffrods, R.M. 1950. The ground water resources of Montgomery County, New York: New York State Department of Environmental Conservation Bulletin GW-23, 63 pp.

LaFleur, R.G. 1961. Glacial features in the vicinity of Troy, New York: in LaFleur, R.G. (editor), Guidebook for Field Trips: New York State Geological Association Meeting, Troy, New York, pp. Al-A20.

__________. 1965. Glacial lake sequence in the eastern Mohawk-northern Hudson Region: in Hewitt, P.C. and Hall, L.M. (editors), Guidebook to Field Trips: New York State Geological Association Meeting, Schenectady, New York, pp. Cl-C23.

LaFleur, R.G. 1969. Glacial geology of the Schoharie Valley: in Bird, J.M. (editor), Guidebook for Field Trips: New England Intercollegiate Geological Conference, Albany, pp. 5-1 - 5-20.

__________. 1975. Sequence of events in the eastern Mohawk Valley prior to the waning of Lake Albany (abstract): Geological Society of America, Northeastern Section, Abstracts with Programs, v. 7, p. 87.

__________. 1979a. Wisconsinan stratigraphy in east-central New York (abstract): Geological Society of America, Northeastern Section, Abstracts with Programs, v. 11, p. 21.

__________. 1979b. Deglacial events in the eastern Mohawk-northern Hudson lowlands: in Friedman, G.M. (editor), Guidebook for Field Trips: New York State Geological Association and New England Intercollegiate Geological Conference, Troy, New York, pp. 326-350.

__________. 1983. Middle (?) Wisconsinan and Woodfordian stratigraphy of the eastern Mohawk Lowland (abstract): Northeastern Section, Geological Society of America, Abstracts with Programs, v. 15, p. 134.

MacClintock, P. and Apfel, E.T. 1944. Correlation of drifts of the Salamanca Re-entrant, New York: Geological Society of America, Bulletin 55:1143-1164.

Mack, F.K., Pavszek, F.H. and Crippen, J.R. 1964. Geology and hydrology of the West Milton area, Saratoga County, New York: U. S. Geological Survey, Water Supply Paper 1747, 110 pp.

McLelland, J. 1984. Structure and rock fabric within the central and southern Adirondacks: in Potter, D.B. (editor), Field Trip Guidebook: N. Y. S. Geological Association, 56th Annual Meeting, Hamilton College, Clinton, pp. 278-303.

Mickelson, D.M., Clayton, L., Fullerton, D.S. and Borns, H.W., Jr. 1983. The Late Wisconsinan glacial record of the Laurentide ice sheet in the United States: in Porter, S.C. (editor), the Late Pleistocene, v. I of Late Quaternary Environments of the United States: University of Minnesota Press, Minneapolis, pp. 3-37.

Miller, W.J. 1911. Preglacial course of the upper Hudson River Geological Society of America Bulletin 22:177-186.

__________. 1923. Geology of the Luzerne quadrangle: New York State Museum Bulletin pp. 245-246.

__________. 1925. Remarkable Adirondack glacial lake: Geological Society of America Bulletin 36:513-520.

Muller, E.H., Franzi, D.A. and Ridge, J.C. 1983. Pleistocene stratigraphy of the western Mohawk Valley, New York (abstract): Geological Society of America, Northeastern Section Abstracts with Programs, v. 15, p. 134.

Ridge, J.C. Franzi, D.A. and Muller, E.H. 1984. The Late Wisconsin glaciation of the West Canada Creek Valley: in Potter, D.B. (editor), Field Trip Guidebook: N. Y. S. Geological Association, 56th Annual Meeting, Hamilton College, Clinton pp. 237-277.

Roorbach, G.B. 1913. The fault-block topography of the Mohawk Valley:

Geographical Society of Philadelphia Bulletin 11:183-198.

Sirkin, L. 1982. Wisconsinan glaciation of Long Island, New York, to Block Island, Rhode Island: in Larson, G.J. and Stone, B.D. (editors), Late Wisconsinan glaciation of New England: Kendall/Hunt Publishing, Dubuque, Iowa, pp. 35-60.

Sirkin, L. in press. Pleistocene stratigraphy of Long Island, New York: New York State Museum Bulletin 455.

Stoller, J.H. 1911. Glacial geology of the Schenectady quadrangle: New York State Museum Bulletin 154, 44 pp.

__________. 1916. Glacial geology of the Saratoga quadrangle: New York State Museum Bulletin 183, 50 p.

__________. 1922. Late Pleistocene history of the lower Mohawk and middle Hudson region: Geological Society of America Bulletin 25:515-526.

Yatsevitch, Y. 1968. The surficial geology of the Gloversville area: unpublished Masters Thesis, Rensselaer Polytechnic Institute, September 1968, 73 pp.

Ridge et al 1983 (in press)	LaFleur 1983	Mohawk	Sacandaga	Luzerne-Kayaderosseras	Hudson (Dineen, Hanson, Waller, 1983)
Holland Patent till	catastrophic floods Fonda gravel Lake Amsterdam Yosts readvance & Lake Schoharie	Scotia gravels Fonda sand plain Lake Amsterdam Sammons Cemetery Lake Schoharie * Yosts readvance Hales Creek upper Yosts till sand & gravel	760 Lake Sacandaga 800 Perth recessional moraine 860 Lake Gloversville	distal outwash Spier Falls Lake Corinth Kayaderosseras Lake Warrensburg Hidden Valley moraine Mt. Anthony Kayaderosseras Randalls Corners moraine upper sandy till at Hadley & W. Milton lakes at Hadley & W. Milton	Lake Quaker Springs Lake Albany Lake Milton Luzerne readvance Niskayuna ice margin (Hanson, 1976) Lake Alphaus Guilderland moraine (Dineen, Rogers, 1979) Meadowdale moraine (Dineen, Rogers, 1979) Lake Albany Delmar readvance New Salem moraine McKownville moraine
Hawthorne till	Mohawk till	Middleburg readvance middle Yosts till sand & gravel	Broadalbin moraine till over lake sand	upper clayey till at Hadley middle lake sand at Hadley	Middleburg readvance till over gravels at Duanesburg
free drainage	soil zone weathered till	soil zone weathered till	soil zone (weathered i. c. s. d.)	soil zone (weathered till at Hadley)	? gravels at Duanesburg retreat of Hudson Valley ice ?
West Canada till	Hell Hollow till	lower Yosts till	early Broadalbin moraine	lower till at Hadley	weathered clay at Niskayuna (Hanson, 1978)

* from the East i. c. s. d. ice-contact stratified drift drainage direction erosional interval readvance interbedding

Table 1. Stratigraphic Correlation in the Mohawk Valley

FIELD LOG - FIGURE 5

Miles from Start	Miles from Last Stop	
0.0	0.0	Mileage starts at the intersection of N.Y. Routes 50 and 29 in Saratoga Springs. You are on the Quaker Springs delta. Proceed west on NY 29.
6.5	6.5	Kame moraine.
17.1	10.6	East Broad St. Turn right (north) and go into the Village of Broadalbin.
18.0	0.9	North Street, veer right, follow North St. through village.
18.3	0.3	Follow North Street to the right (northeast), along south edge of Interlobate Moraine.
19.3	1.0	Town of Broadalbin Landfill (left side of road).
		<u>Stop 1: Broadalbin Town Landfill</u> This pit reveals the products of the ice-marginal environment. Here, the Yosts Readvance reached its maximum extent. The massive basal sands contain dewatering features (flame, dish, ball-and-pillow structures). These basal sands are sharply truncated, and overlain by fluvial sand with gravel that contains many reverse graded diamictons (flowtills).
		Another pit, 0.4 m (0.7 km) west of Stop 1 shows evidence of more active ice. At this pit, a sequence of trough corssbedded sand is shared and overlain by a thick (1 to 3 m) diamicton.
21.5	2.2	Retrace path to NY Rte. 29.
22.9	1.4	Turn right (west). Proceed along Lake Sacandaga sands to the intersection of NY Routes 29 and 30. Turn left (south) on NY Rte. 30.
25.1	2.2	Proceed on 30 to Perth, and Fulton County Route 107 (at Stoplight). The upland that we drove over is the broad platform of the Perth Moraine. The low rise that we cross just before the stoplight is the Perth Recessional Moraine. Turn right (west) onto County Route 107.
26.0	0.9	Go 0.9 mile to a small access road on the right (north) side of the road.

Stop 2: Perth Pit

We are on the Perth moraine, in a pit that cuts into the Perth Recessional Moraine. The base of the pit is trough-crossbedded outwash, overlain by 3 m of sand-matrix-supported diamicton. This till is overlain by trough-cross-laminated outwash sand and gravel. Wells nearby indicate that the pit is underlain by 30 to 40 m of interbedded till and sand. The till in this pit probably was deposited by the Yosts Readvance.

Leave pit, retrace path north to the intersection of NY Routes 29 and 30.

29.1	3.1	Turn left (west) on NY 29. Follow the outlet of Lake Sacandaga to the long access road at the next Stop. The Interlobate Moraine is on the right.
32.9	3.8	Turn right on access road, cut across the Hale Creek spillway of Lake Sacandaga.

Stop 3: Rex Excavating

This exceptional pit has many instructive exposures. The base of the pit is bluish-gray clayey Mohawk till, overlain by 5 m of laminated fine sand, cut by trough-cross bedded sand and gravel. The sand and gravel is capped by 2 m of weathered till that is overlain by another sequence of lacustrine sand and prograding outwash. Till overlies this outwash, and is interbedded with lacustrine sand.

The multiple tills are the products of at least two readvances. The soil zone between the major sequences suggest several thousand years separated the two advances. Both sequences involved glacial ice overriding proglacial lacustrine and outwash deposits. The several tills above the soil zone probably were mudflows and lodgement tills of the Yosts Readvance. A similar exposure lies 1.1 miles to the east.

We leave, with regret, the Rex Pits, and continue west along Hale Creek outlet on NY 29, to stoplight in Johnstown.

37.0	4.1	Intersection of Routes 30A and 29, turn right (north).
38.0	1.0	Intersection with Townsend Road at Stoplight. Turn left (west) onto Townsend Road, cross the Cayadutta Spillway.
38.1	0.1	Turn right (north) onto Main Street.
38.2	0.1	Turn left (west) on Maple Avenue.
39.0	0.8	Large exposure on right.

Stop 4: Twin Cities Sand and Gravel

This immense pit is over 300 m long and 7 m high. It is the distal portion of the Interlobate Moraine, and contains distinct deltaic features. Both thrust and gravity faults are common, especially on the eastern end of the pit. A sandy diamicton caps the sandy deltaic sequence. Aeolian sand unconformably overlies the sandy till on the eastern end of the pit.

Leave pit, retrace road to NY Rte. 30A.

40.0	1.0	Turn left (north) onto NY 30A. Drive up ice-contact slope of the Interlobate Moraine and onto the Lake Gloversville delta.
45.8	5.8	Nice drumlins to the west, the Interlobate Moraine dominates the skyline to the southeast.
47.7	1.9	Intersection of NY Routes 30 and 30A. Turn right (east) on 30.
47.9	0.2	Turn onto access road on left side of Rte. 30.

Stop 5: Mayfield Pits

This complex of pits is developed in an esker that drained the Sacandaga ice tongue. A subaqueous sand and gravel fan lies at the mouth of this esker. It was built by meltwater flowing in an ice tunnel into Lake Sacandaga. The esker is interbedded with lake sand.

To get home from this stop, you can retrace your drive to Rte. 30A, turn left, and follow 30A to the NYS Thruway at Fonda. Or, you can turn left and proceed down Rte. 30 to the NYS Thruway at Amsterdam. This route will also take you back to the intersection of 30 and 29. Turn left on 29 to get back to Saratoga Springs. Have a good trip home!