FRIENDS OF THE PLEISTOCENE

36th Annual Renunion

Binghamton, New York

May 18-20, 1973

FIELD GUIDEBOOK

Donald R. Coates, Friendly Host

Department of Geological Sciences

State University of New York at Binghamton

Binghamton, New York 13901

SCHEDULE OF THE REUNION

The central gathering place will be Roosevalt Hall, Hinman College, SUNY-Binghamton. Friends will meet here, will be housed here, and will obtain buses here.

Friday, May 18

Gathering of Friends at Roosevelt Hall. Entertainment for the day and evening is *ad hoc*.

Saturday, May 19

0730 (sharp)	-	Breakfast at ~~Hinman~~ C.W* dining hall
0800 (sharp)	-	Buses leave for field trip of the Great Bend Region.
1200	-	Box lunch
1700	-	End of trip
1800	-	Happy Hour and Friendly Relaxation in the Susquehanna Room of the University Union
1900	-	Annual Banquet in the Susquehanna Room

Sunday, May 20

0730 (sharp)	-	Breakfast in dining hall of College of the Woods*
0800 (sharp)	-	Buses leave for field trip of lower Chenango Valley area
1300	-	End of trip. This completes the scheduled affairs for this friendly reunion.

FRIENDS' REUNIONS

	Year	Place	Leader
1.	1934	Durham, N.H., Hanover, N.H.	J.W. Goldthwait, G.W. White, R.F. Flint, D.H. Chapman
2.	1935	New Haven-Hartford district	R.F. Flint
3.	1936	Rhode Island Shore-Cape Cod	K. Dryan
4.	1937	Hanover-Mt. Washington, N.H.	J.W. Goldthwait, R.P. Goldthwait, R.J. Lougee
5.	1938	Black Rock Forest, N. Y.	C.S. Denny, H.M. Raup
6.	1939	Northern, N.J. (3 drifts)	P. MacClintock
7.	1940	Cape Cod, west end	K.F. Mather, R.P. Goldthwait, L. Thiesmeyer
8.*	1941	Catskills	J.L. Rich
9.	1946	Lowell, Mass. area	L.W. Currier with K. Bryan
10.	1947	Eastern Finger Lakes	E.T. Apfel
11.	1948	Toronto-Barrie, Ontario	A.K. Watt, R.E. Deane, D.F. Putnam, M.W. Tovell
12.	1949	Pensauken formation, N.J.	P. MacClintock, M. Johnson, J. Graham, J.B. Lucke
13.	1950	Ithaca, N. Y.	O.D. Von Engeln
14.	1951	Waldorf, Md.	J.T. Hack, P. MacClintock, coordinator
15.	1952	Columbus-Xenia, Ohio	R.P. Goldthwait
16.	1953	Ayer-Cambridge, Mass.	L.W. Currier, J.H. Hartshorn
17.	1954	Wellsboro, Pa.	C.S. Denny, W.H. Lyford
18.	1955	Malone, N. Y.	P. MacClintock
19.	1956	Drummondville, Quebec	N.R. Gadd
20.	1957	Potsdam, N. Y.	J.N. Harris
21.	1958	Harrisonburg, Va.	J.T. Hack
22.	1959	London, Ontario	A. Dreimanis
23.	1960	Dunkirk, Olean, N. Y.	E.H. Muller
24.	1961	Coastal Maine	A.L. Bloom
25.	1962	Kingston, R.I.	C.A. Kaye, J.P. Schafer
26.	1963	Riviere-du-Loup, Quebec	H.A. Lee
27.	1964	Martha's Vineyard, Mass.	C.A. Kaye
28.	1965	Long Island, N. Y.	J.E. Upson
29.	1966	Chesapeake, Va.	N.K. Coch
30.	1967	Machias, Me.	H.E. Borns, Jr.
31.	1968	Cape Cod, Mass.	C.Koteff, R.N. Oldale, J.H. Hartshorn
32.	1969	Sherbrooke, Quebec	N.R. Gadd, B.C. McDonald
33.	1970	Mt. Washington, N.H.	R.P. Goldthwait
34.	1971	Glens Falls, N. Y.	G.G. Connally, L.A. Sirkin
35.	1972	Ithaca, N. Y.	A.L. Bloom, J.H. McAndrews
36.	1973	Binghamton, N. Y.	D.R. Coates

Information from E.H. Muller and R.F. Flint

*
1942-45 Inactive during the war

List of Participating Friends

Ager, Thomas A.	Ohio State University
Bannister, Everett	University of Pittsburgh
Barker, Rachel M.	U. S. Geological Survey
Bingham, James W. (Hartford, water resources)	U. S. Geological Survey
Black, Robert F.	University of Connecticut
Bloom, Arthur L.	Cornell University
Borns, Harold W., Jr.	University of Maine
Byers, Douglas S.	R. S. Peabody Foundation
Cadwell, Donald H.	Lafayette College
Caldwell, D. W.	Boston University
Chapman, Donald H.*	University of New Hampshire
Ciolkosz, Edward J.	Penn State University
Clark, G. Michael	University of Tennessee
Coates, Donald R.	SUNY-Binghamton
Connally, G. Gordon ✓	SUNY-Buffalo
Craft, Jesse L.	Penna. Topo & Geol. Survey
Crowl, George H. →	Ohio Wesleyan University
Deily, Charles R. E., Jr.	Lafayette College
Derksen, Stephen	Ohio State University
Dineen, Robert J.	N.Y.S. Geological Survey
Duckworth, Peter	University of Toronto
Eden, William J.*	NRC- Canada
Fahey, B. D.	University of Guelph
Fairbridge, Rhodes	Columbia University
Feldman, Lawrence	Boston University
Fletcher, Misty	Case Western Reserve University
Flint, Richard F.*	Yale University
Forsyth, Jane	Bowling Green University
Frimpter, Michael H.	U. S. Geological Survey
Frank, Barbara	Amherst College
Funk, James M.	University of Connecticut
Gehris, Clarence W.	Brockport State
Genes, Andrew (Nick!)	Boston State
Goldthwait, Richard P.	Ohio State University
Gray, Richard E.	General Analytics, Inc.
Hayes, Pamela	Ohio State University
Henderson, Eric P.	Canada Geological Survey
Heusser, Cal*	New York University
Hollin, John T.	University of Maine
Hutchinson, Charles	D.H.R. Inc.
Judson, Sheldon	Princeton University
Keegan, Frank*	New Hampshire University
Kelley, George →	Syracuse University
King, Cuchlaine A. M.	University of Nottingham
Kirkland, James T.	SUNY-Binghamton
Koteff, Carl	U. S. Geological Survey
LaFleur, Robert G.	R.P.I.
Langer, William	U. S. Geological Survey
LaSalle, Pierre not there	Quebec Dept. Nat. Res.
Lasca, Norman P.	University of Wisconsin-Milwaukee
Legget, Robert*	Ottawa, Canada
Mahaney, William C.	York University
McKeon, John B.	Ohio State University

Mc Saveney, Maurice J.*	Ohio State University
Minard, Jim	U. S. Geological Survey
Morisawa, Marie E.	SUNY-Binghamton
Newman, Walter S.	Queens College
Newman, William A.	Northeastern University
Ogden, Gordon J. III	Dalhousie University
Osborne, Robert V.	N.Y.S.D.O.T.
Paine, Fredenia	U. S. Geological Survey
Palkovics, William E.	Penn State University
Peltier, Louis C.	University of Pittsburgh
Pessl, Fred → not there	U. S. Geological Survey
Quinn, Michael J.	Ohio State University
Randall, Allan D. ✓ (U.S.G.S.)	U. S. Geological Survey
Rhodehamel, Edward C.	Centreville, Virginia
Rubin, Meyer	U. S. Geological Survey
Sanger, David	University of Maine
Sanger, J. E.	Ohio State University
Schmidt, Victor E.	Brockport State
Sinnott, Allen*	U. S. Geological Survey
Sirkin, Les ✓	Adelphi University
Snow, Dean R.	SUNY-Albany
Stalker, Archie M.	Canada Geological Survey
Stone, Byron	Johns Hopkins University
Stuckenrath, Robert	Smithsonian Institution
Terasmae, Jan	Brock University
Vlangas, Louis P.	Whitman, Requard Assoc.
Waitt, Richard B., Jr.	Franklin and Marshall College
White, Sidney E.	Ohio State University
Winn, Ron*	Brock University
Williams, John R.	U. S. Geological Survey
Wright, Gary H.	SUNY-Albany

Field trip graduate student assistants from SUNY-Binghamton are Don Ash, Steve Gilje, and Ken Tompkins

* includes spouse

FIELD GUIDE

GREAT BEND TRIP

Donald R. Coates and Cuchlaine A. M. King

Mileage	
0 3.0	Leave SUNY-Binghamton campus travel north across west-flowing Susquehanna R. and take Route 17 east toward Binghamton and Windsor. The bedrock hill is upper Devonian shale and siltstone.
4.6	Thickness of valley fill is 200 ft. in the south-flowing Chenango R. Along the west bank are former U.S. Geological Survey observation wells that indicate Holocene sands intercalated with wood at various depths (about 2650 yrs. at 24 ft. and 3800 yrs. at 45 ft.).
7.6	Notice the right angle bend in the Susquehanna, it flows north from Great Bend and is first viewed flowing west.
11.8	Till shadow hills are seen to the north. At West Windsor till is 248 ft. thick and the shadow effect has pushed the east-flowing Park Ck. to the south, causing it to incise bedrock.
	Take side road to Occanum and STOP 1.
15.3	<u>STOP 1</u>. Occanum Creek. This site about 2 mi. west of Windsor on the south side of Occanum Ck. provides one of the few good till exposures that is characteristic of uplands east of Binghamton. This 60 ft. outcrop was greatly enhanced by Hurricane Agnes. The till composition shows it to be Olean-type largely comprised by sandstone and siltstone clasts derived from local Devonian strata in the immediate vicinity. The short distance of transport is indicated by low roundness values and siltstone content of the clasts. Three samples of 50 stones produced values of 158, 130, and 142, with low standard deviations, suggesting sample homogeneity. The roundness of two till samples nearer Windsor were 168 and 218, the latter derived from till near Occanum's stream level. The higher roundness indices probably reflect longer transport by ice moving in the main Susquehanna valley, where flow would be more concentrated and vigorous. The Occanum Ck. fabrics (see Coates-King article for detailed description) suggest ice flow from the Susquehanna valley up Occanum Ck. The fabrics lie parallel to the supposed direction of ice flow, having preferred orientations to the south-southwest or southwest with one exception. Another till locality nearer to the mouth of Occanum Cr. has a transverse orientation, elongated to the northwest. This suggests a possible transverse fabric, which could be explained by the pressure on the basal ice in this position, as the ice squeezed into the Creek mouth from the wider main valley.

The site introduces the problems of ice flow over an undulating area, where the grain of the country lies athwart the path of the ice. It brings out the contrast between the development of the east-west trending valleys, with their characteristic asymmetry, and the north-south valleys that will be examined during the last stop at Blatchley.

Travel along Occanum Ck. to Windsor, back on Route 17 eastward.

17.6 Pass over south-flowing Susquehanna River, where valley fill is greater than 111 ft. Windsor is built on an alluvial fan of Occanum Ck. Stratified glacial deposits and landforms occur along Susquehanna valley, including kames and askers. An umlaufberg is on the right side of the river 2 mi. north of Windsor.

East of Windsor most rocks are Catskill-type terrestrial sandstones with occasional interbedded siltstones and shales. Ascend Tuscarora Mountain; the steepest grade on Route 17 in this region.

24.2 Take Exit 81 east to PICTURE STOP at Deer Lake and Fly Pond.

2 pictures (lake + geologists)

The lake is impounded by a till barrier, one of five such barriers occurring in Fly Ck. The depth to rock is 160 ft. at the north end of lake.

25.3 Continue southeast to exit for Gulf Summit. Just east of exit is a high level kame delta at 1450 ft.

25.9 <u>STOP 2</u>. Kame north of village of Gulf Summit. This area affords a good example of the style of deglaciation in this part of the Catskills. Two separate types of events mark the morphology of the region. One concerns the nature of valley blockages that occur in Fly Ck. and the other the conditions that brought about overflow and development of the spillway that forms the head of Cascade Ck. A working model for each series of events will be set forth. As ice stagnated in the area a series of successively lower hill-hummocks were formed by a combined process of till deposition and earth-flow movement from the hill side out into a valley position. The entire valley of Fly Ck. is thickly covered with till, to depths of 160 ft. but many inequalities in till deposition occur. It is interesting to note that the five mounds (three contain associated lakes) are of about equal spacing and occur on either side of the valley. When the ice level dropped to a 1450 ft. elevation stagnation rather than active movement set in. Meltwaters discovered a low col (now the headwaters of Cascade Ck.) and flowed southwest into Susquehanna drainage. The 70 ft. incisement of this spillway was sharpened during the Wisconsin phase but (may have been) initiated at an earlier stage. Stratified units such as kame deltas occur just north of old Route 17 and along

1 picture of very high end kame at alternate Stop 2 (highest strat. drift in area)

parts of the surrounding hillsides at the same elevation. Kames and kettles occur in the topographic basin of Gulf Summit and show the features typical of ice stagnation deposits. Some of these units are more than 100 ft. thick and attest to the amount of debris and volume of water that was impounded in the area. Since ice-contact deposits are at lower elevation to the east this indicates that when a lower outlet channel was discovered this allowed drainage to become reversed and establish an eastern flow into the Delaware system. The kame contains some stratified red beds. A west-facing exposure near the railroad embankment contains a dark humic horizon of uncertain formation. How did this form?

26.1 Continue south and east, taking dirt road to right at church.

26.5 PICTURE STOP. This is a view of the outflow channel forming headwaters of Cascade Ck. The hillslope to the north, on which there are large sandstone blocks, shows evidence of periglacial movement of blocks that are largely stabilized under present climatic conditions.

Best of x-bedded SS Dev.

31.9 Continue southeast on Cascade Ck. road toward Lanesboro, Pa. and Susquehanna valley. The unusual stone masonry bridge was built in 1848 by a Scotsman, Kirkwood, after several earlier contractors had gone broke attempting to build a span across the Susquehanna valley. Take route to
33.9 Susquehanna, Pa. and cross river to Oakland and bear right at blinker to next stop.

34.4 STOP 3. Oakland esker. This esker along the north side of the Susquehanna River is the largest in the region. It not only can be followed a distance of >2 mi. in this locality but a continuation of it occurs on the east side of the river where it extends northwards for another 1-2 mi. The esker is not a simple ridge, but is double in several parts, such as the outlet on the west side of the village. Side slopes of the esker are steep and it exceeds heights of 100 ft., on the north side there are the typical depressions and undulating topography. The crest of the esker is also uneven and rolling. Composition of the esker indicates a lithology that is largely local, but with exotics including crystallines, red sandstone, and chert that total up to 5 percent. The deposit shows a wide range of fragment size, with appreciable rounding of gravel and cobbles...the roundness index of stones 2-4cm in diameter is 419. Exposures on the flanks of the esker on the west show incorporation of much till. On the east side of the village bedding relations show a range from horizontal to steeply dipping. One 45 degree dipping gravel unit (beyond the angle of repose) was probably frozen as a unit and then moved into place by the meltwaters. At least two different horizons are suggestive of flowtill origin. Harrison (1966) has described the esker and his study indicated it formed at least in part, in a channel open to the sky during sedimentation.

2 pictures here; close-up shows Doc P. + steep gravels (frozen when emplaced?)

Go west on Route 171. Note narrowness of valley in several places and occurrences of bedrock.

42.9 STOP 4. Great Bend. The purpose of this stop is to examine an unusual till and discuss a possible series of events that could have created the unusual deposits, terrain, and drainage development of the puzzling Great Bend Region. This 75 ft. till exposure contains blocks of extraordinary size, more than 6 ft., which is not duplicated elsewhere in the region. The lithology of the till indicates a local source in uplands to the north of Windsor. The topographic setting of the till, as a distinct ridge immediately south of a rock defended shoulder extending west from Penny Hill is noteworthy. Bedrock spur levels and till 100 ft. thick on the west side of the Susquehanna aid in filling in this picture. When these features are considered with a knickpoint in the Susquehanna, and the system of cols, troughs, sluiceways, and the unique southern reentrant of the Susquehanna a possible explanation starts to emerge. For example the most spectacular meltwater feature in the region is the channel that has been carved southwest of New Milford and called the "New Milford Sluiceway" (Harrison, 1966) labelled Martin Ck. on maps. Actually this feature is an extension of the abnormally straight valley of Salt Lick Creek that extends between Hallstead and New Milford. The bedrock walls, the flat floor, the 400 ft. of relief, and the lack of high order tributaries indicates a spectacular short-lived formation of the sluiceway. An equally unusual glacial event probably occurred to develop such a topographic anomaly. The straightness of Salt Lick Ck., continuing the line of the Susquehanna, the strongly truncated spurs, and the flat floor suggest erosion by an intrusive glacier, moving up stream, as in the Susquehanna north of Great Bend. The valley leading west and then south through the New Milford gap, on the other hand, was cut by meltwater from ice that occupied valleys to the north. We propose for the Great Bend a long history of drainage modifications and diversions throughout the Pleistocene, and believe some of these changes were induced by such unusual events as glacier surges. Thus, the configuration of the Great Bend of the Susquehanna is conceived to have resulted from incisement as a marginal river following the surge of the ice sheet during the early Pleistocene. This peculiar arc of the river contains so many drainage abberations that their formation must have occurred by a somewhat abnormal series of events...normal drainage evolution cannot explain the configurations. There are probably several different generations of features, some the inheritance of earlier ice sheets and others more recent developments. It is also possible that earlier events were repeated by later glaciations and the valleys reoccupied by more than a single episode. Harrison (1966) had indicated development by the rather normal process of spillover and erosion by meltwaters from a proglacial lake when the ice margin had withdrawn to a position on the New York side of the Susquehanna.

picture of striated boulder in till

49.9 Take Route 81 south to New Milford and then return on 81 going north. This is Salt Lick Ck., an anomalously straight and narrow valley, with bedrock depths of 62 ft. The valley form continues into the New Milford sluiceway to the southwest. North from New Milford the next stop is at an iron gate and gravel deposit currently being worked by the State of Pennsylvania.

54.4 STOP 5. "DELTA?" IN SALT LICK CREEK. This delta owes its development to events that occurred in Little Egpyt Ck. the north-flowing stream on the east side of Maunatome Mtn. Along the north-south ridge of the mountain are a series of high level cols that were occupied by ice and meltwaters during different glacial and proglacial meltwater events. Two spillways in cols to the south were developed at 1500 ft. whereas the stream forming this delta crossed a col at a lower 1400 ft. level, when meltwaters used the Little Egypt drainage as an avenue to spill over into Salt Lick drainage. The material must have been deposited into a lake, the surface of which was at about 1140 ft., held up in the tributary embayment by the glacier that eroded the trough of Salt Lick Cr. This is the most spectacular hanging delta in the area, but is only one of a family of many stratified meltwater landforms throughout the area, but is only one of a family of many stratified meltwater landforms throughout the area that bear witness to the style of deglaciation of this region. This delta contains more than 150 ft. of deposits that are of Olean-type lithology. Typical deltaic sedimentation structures occur, topsets, foresets etc. with a general lobate pattern of dips away from the central core. A unit with very large boulders may represent some type of catastrophic phenomenon, such as a mud flow or glacier pulse over the col.

(picture of steep beds at base of exposure (ice contact, not part of "delta" upper unit))

58.0 Exit from Route 81 at Great Bend. Continue north through the village and turn right up Trowbridge Cr. road going northeast. Turn right at Blatchley to Trowbridge Cr. Walk along creek 1/4 mi. south to mound. Note till at creek junction.

Windsor, N.Y., quad. (lower left corner)

61.7 STOP 6. Blatchley. Distinctive concavo-convex landforms occur in the Great Bend - Windsor area that are well developed in the Blatchley area and in the north-south valley near Flowers. The features consist of an upper concave part and lower convex part that extends into the valley floor and pushes the stream to the far side of the valley. These landforms occur between very steep truncated spurs, on which the mean gradient is 19°, in north-south valleys to which ice had access from the north. The ice eroded the valleys, steepened and truncated the spurs and filled the reentrants with drift. Later solifluction created the concavo-convex forms in readjusting the slope, cut across till, to an equilibrium gradient under periglacial conditions.

picture of hill that may be a large slumped mass of till

The mound, which is 200 ft. high, has a closure of 740 ft. and is formed of reactivated till at least >40 feet thick at a point half way up the feature. The volume of the mound closely approximates the volume of the concave hollow in the hill behind it. One possible solution is that the whole mound formed by a major rotational shear slump, operating in the period following deglaciation, when the water content of the till would have been high. The soil horizon shows that more recent subsequent movement has affected the lower slopes of the mound where river undercutting is now active. Renewed movement could also have been facilitated by forest fires, to which the charcoal may bear witness, and which would have rendered the slope unstable by destruction of the vegatation. Trees on the hillslope indicate the gravity movement by their curved trunks.

Continue north along Hoadley Road to Bell Road, turn right along Bell Road and left along Bennett Road to Flowers. Turn left along Williams Road, passing through an ice-scoured col, with views of concavo-convex features along the road, to Trim Street. Turn left to Lester and continue, turning right down Place Road to rejoin Route 17 at
71.7 West Windsor. Another ice eroded col is crossed before descending to West Windsor. Follow Route 17 west back to
83.5 SUNY-Binghamton.

Although the above described trip provides a wide range of glacial landforms and deposits, it does not include everything of interest in the region. The following locales are also recommended for viewing when time permits.

Locality 7. North Windsor. Excellent kames and other meltwater features occur throughout this area. A thick lacustrine series of clay, silt, and sand contains a great variety of internal structures of special interest to the sedimentologist. A well-developed umlaufberg contains a 90 ft. incised channel representing an earlier diversion of the Susquehanna R.

Locality 8. Periglacial features. The best-developed tor in the region occurs here(at least 7 others have been mapped in the Great Bend area). Patterned ground is also present slightly south on this road between Susquehanna and Lakeside, Pennsylvania.

Locality 9. New Milford Sluiceway. This is the most spectacular glacial outflow channel in the region. Bedrock walls are nearly 400 ft. high, the gorge is 7 mi. long, exceptionally narrow, and flat-floored. This feature was developed by proglacial meltwaters when the ice margin was north of Great Bend.

Locality 10. Kame terrace at Hillcrest. The village is built on the best kame terrace in the area. Several good exposures reveal the glaciofluvial character of the deposits which consist of very coarse, at times poorly bedded and sorted, materials of Binghamton-type stratified drift. Cementation zones are especially prominent throughout this section.

Localities 11-14. See Chenango Valley field guide.

Locality 15. SUNY-Binghamton. The campus is located in a reentrant hollow of the Susquehanna valley with 120 ft. thick Binghamton-type till. The deposits have been fashioned into a series of gentle ridges. From this area south is the Lake District of northern Pennsylvania. The Montrose-New Milford-Starrucca region of Pennsylvania is honeycombed with 10's of lakes whose topography shows a vast change from the contiguous area in New York; whereas the drainages and hills in New York seem more ordered and continuous, those in Pennsylvania are exceptionally disordered, random, and haphazard. This lack of continuity represents a morainic belt that has not yet been described in the literature...an area of massive ice stagnation where ice was dismembered from nourishment by glaciers farther north. Here the range of surface deposits show particularly well the many problems associated with trying to differentiate: (1) till deposited by active ice (2) till resulting from ice stagnation (3) till no longer in situ but maintaining most of its original character (4) colluvium.

FIELD GUIDE

CHENANGO VALLEY AREA

Donald H. Cadwell

STOP 11. ROSE CEMENT COMPANY. The pits exposed in this complex of stagnant ice deposits, terraces and outwash illustrate a wide range of stratified features. The deposition of the beds in the northwest section were in an ice contact position, adjacent to a large ice mass (ice tongue) occupying the valley. The total relief of the kame terrace is 50 ft. The ice tongue which extended several miles beyond the upland margin position is a salient from the main retreating ice sheet. The general topography is illustrated in the low angle air photograph. The view is generally to the north.

note cemented gravel (upper outwash unit) — large blocks are cemented by $CaCO_3$

The kame terrace has the following stratigraphy:

- zone (1) 2' soil
- zone (2) 8' coarse muddy, poorly sorted, mostly local drab glaciofluvial gravels (in percent): limestone 2, red ss 10, crystallines 8, local rocks 80.
- zone (3) 15' coarse, well stratified, cross bedded gravels with cemented units in section (in percent): limestone 13, red ss 14, crystallines 12, local rocks 61.

Typical problems concerning this site include:

1. Why is coarse gravel over fine sand? Is there a greater transport distance of fines through an outflow channel? Was there an ice readvance? Was there disintegration of an upstream dam?

2. What is the origin of the drab upper unit? Is this the "Olean-type" drift? If so, why is it on top of, and younger than Binghamton-type? Could this represent an ice readvance, a dam failure, or is it colluviam?

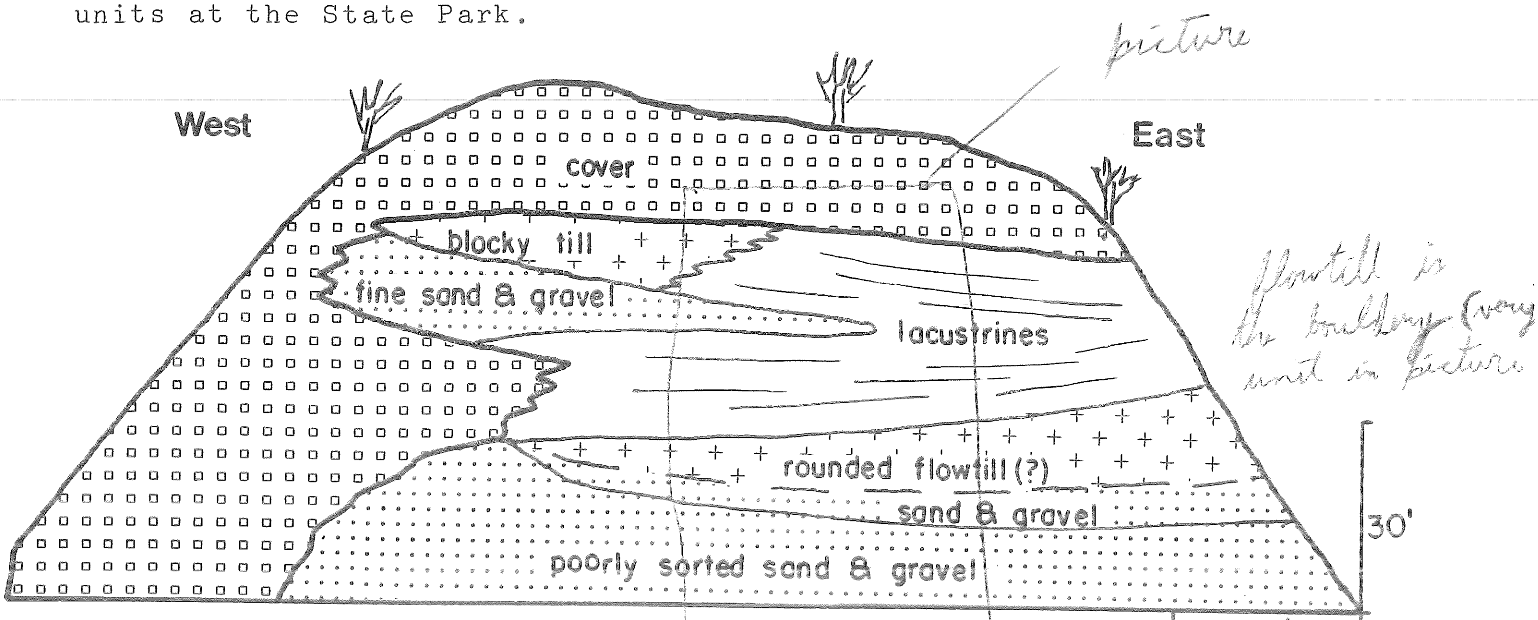
3. What is the origin of the large foreset units? Delta foresets? Migrating bar of a braided stream?

4. What is the origin of the umlaufberg to the east? Is it a preglacial erosion feature? Is it glacially scoured? If so, during which glaciation(s)?

5. When and how did the wind gaps form? Glacially? Fluvially? During a glacial, interglacial, or preglacial?

6. Why are there cemented zones? When and how did they form?

CHENANGO FORKS PICTURE STOP. This pit is just north of the junction of the Tioughnioga and Chenango Rivers. The suite of deposits include blocky till, well stratified sands and gravels, lacustrines, flowtill (?) and colluvium. These units are either younger or the same ages as units at the State Park.

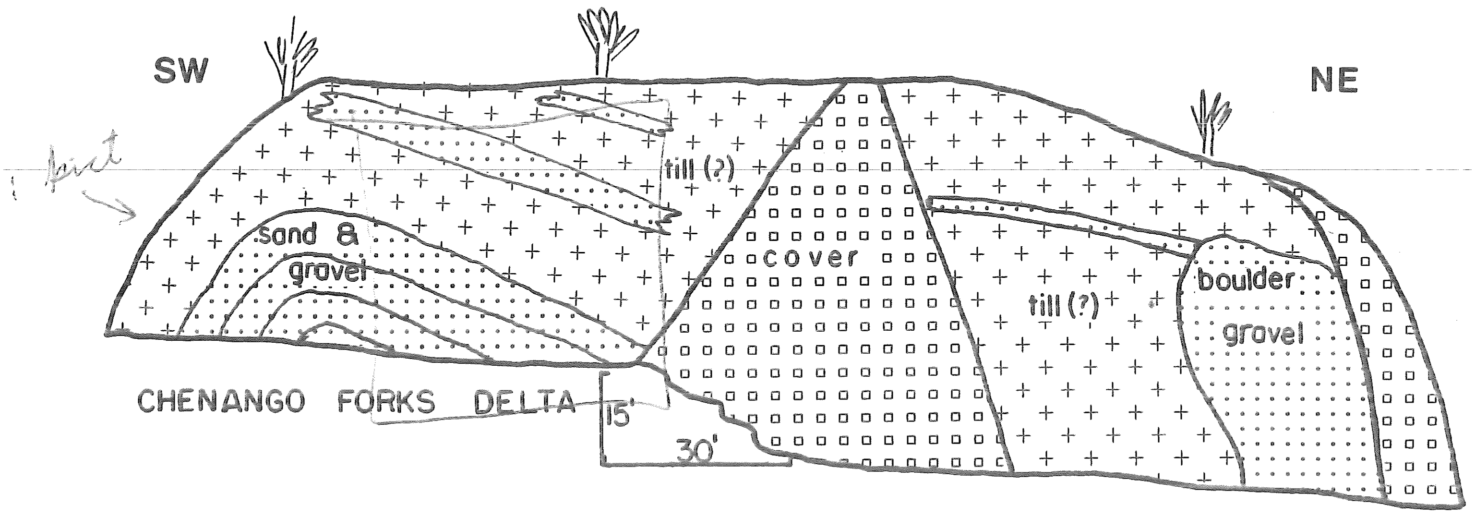


CHENANGO FORKS PICTURE STOP

The percentage composition will vary with sampling area: one count yielded(%) - limestone 32, red ss 16, crystallines 8, locals 44.

STOP 12. TIOGHNIOGA VALLEY. Because this valley is so anomalously steep, straight, and narrow, it cannot represent a usual drainage created by normal fluvial processes. A puzzling series of events is recorded in the wide range of deposits extending north of Chenango Forks. The drift includes Olean-type till, Binghamton-type stratified units, and 60 ft. thick lacustrine clays. These units are interspersed into the hillside between bedrock outcrops. A well-developed series of rotational slump blocks has developed by a process of piping in the silt and clay beds. From this site the trip will wind through the gap of Halfway Brook and into a wide valley with misfit streams. The size of the valley and bedrock depths in excess of 100 ft. indicate a former course of the Tioghnioga prior to its diversion into its current underfit valley.

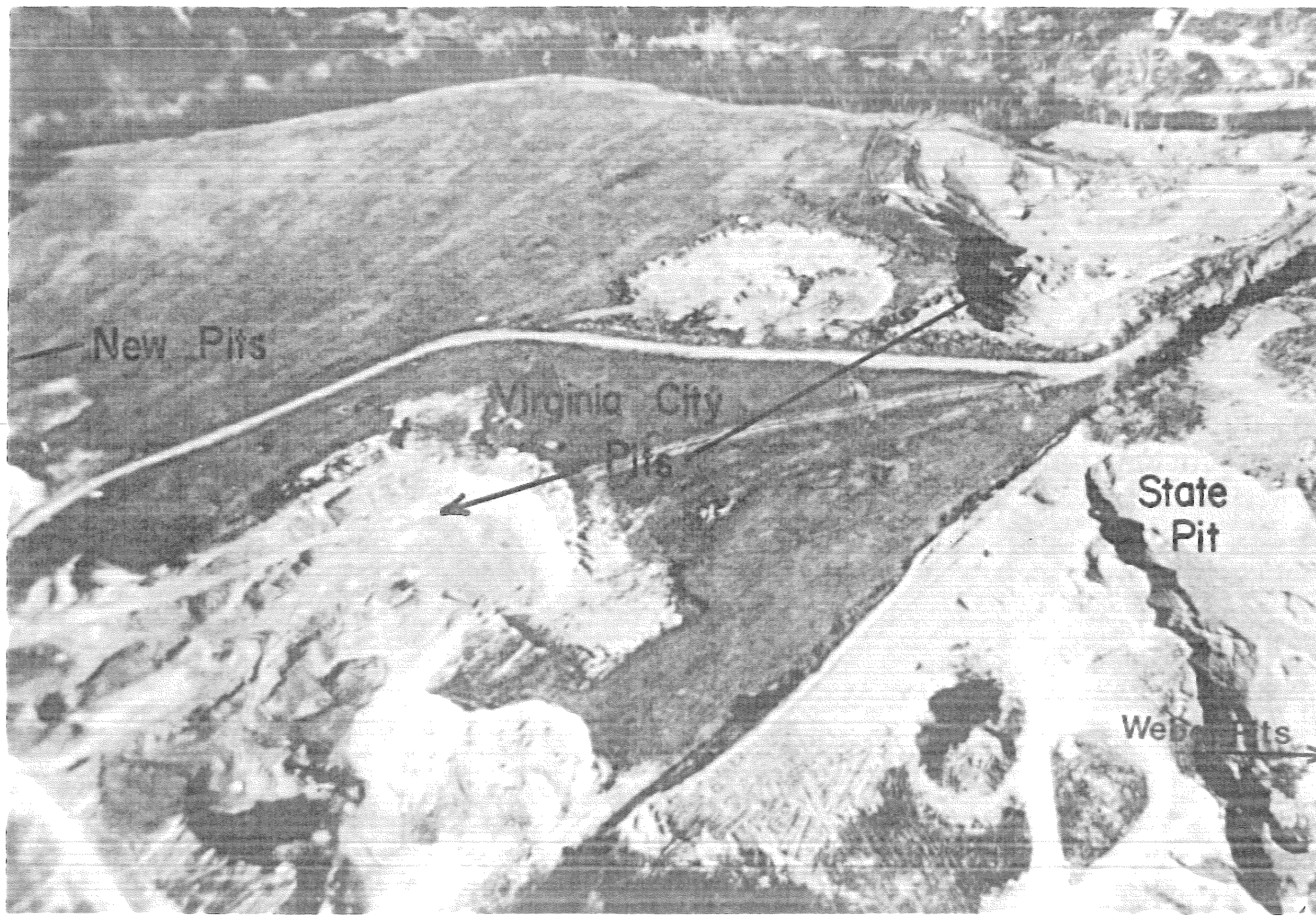
STOP 13. CHENANGO FORKS DELTA. This is a small delta that formed in a lake created by the valley plug at the Chenango Valley State Park, and the ice tongue to the east. The delta was deposited by a tributary stream flowing generally south-east from the uplands while additional meltwater was flowing along the main Chenango River valley adjacent to the ice tongue. The Chenango River meltwater flow is indicated by a northeast increase in the percentage of limestone toward the main valley. Bouldery till was deposited above the delta. Within this till (flowtill?) there are lenses of well stratified sands and gravels.



Percentage composition of delta unit: limestone 2, red ss 8, crystallines 6, local rocks 84. There is a general increase in the percentages of limestone, exotics and red sandstone toward the north-east in the bouldery region. The limestone increases to about 8%.

Problems: 1-What process caused the anticlinal structure? 2-What is the depositional relationship between the delta and the bouldery gravel to the NE? 3-What is the origin of the till over the delta if not a flow till? Is it a lodgment till from a readvance? Is it ablation till? Is it a colluvial deposit? Other possibilities? 4-Why are there stratified sands and gravels within the till above the delta and apparently undeformed? 5-When and how did the valley plug at the Chenango Valley State Park form? What is the relationship between the plug and those features seen at this exposure? Why did the plug form in that location.

STOP 14. VIRGINIA CITY AND VICINITY. These sand and gravel operations are south of the Chenango Valley State Park and the valley plug. In all exposures there are coarse (and sometimes poorly stratified) sediments above the finer well stratified sands below. This sedimentary relationship is similar to the Rose Cement Company. The general topography and extent of exposures can be seen in the low air photograph of the region. All the pits are labelled, except for the New Pit, which is to the left (south) of the photograph. View is generally to the west.



The following is a generalized stratigraphic section, from south to north.

South → North

New Pit	Virginia City	NYSDOT	Weber
4' dirty fluvial	6' dirty fluvial	8' dirty fluvial	8' dirty fluvial
15' dirty sand and gravel crossbedding	12' clean sand and coarse gravel crossbedded	26' horizontally stratified sand and gravel	15' horizontally stratified sand and gravel
20' well stratified sands with some gravel	28' well stratified crossbedded sands, some silts and gravels	>7' crossbedded sands	>6' fine sands

New Pit	Virginia City	NYSDOT	Weber
9% limestone	4% limestone	10% limestone	11% limestone
67% locals	73% locals	71% locals	67% locals
14% crystallines	17% crystallines	14% crystallines	13% crystallines
10% red ss	10% red ss	10% red ss	10% red ss

Problems:

1. Why is there coarse over fines, AGAIN? Does this indicate a readvance of the ice? Is this a glacial dam failure?
2. What is the relationship among these units, the Chenango Valley State Park area (valley plug), and the Page Brook region?

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